COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

APPLICATION OF NORTHERN KENTUCKY WATER DISTRICT FOR APPROVAL OF CONSTRUCTION OF UV DISINFECTION FACILITIES AND ISSUANCE OF A CERTIFICATE OF CONVENIENCE AND NECESSITY	))))))	CASE NO. 2007- 00052

APPLICATION FOR APPROVAL OF CONSTRUCTION

Northern Kentucky Water District (NKWD), by counsel, petitions for an order approving the construction of UV disinfection facilities at its Taylor Mill Treatment Plant. pursuant to KRS 278.020.

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

1. NKWD's office address is 2835 Crescent Springs Rd., Erlanger, KY 41018-0640. Its principal officers are listed in its current Annual Report on page 6, which is filed with the Commission as are its prior years Reports;

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 attached as Exhibit E.

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.

5. It proposes to construct UV disinfection facilities at its Taylor Mill Treatment Plant as described in Exhibit A (Two copies of the Maps, Plans, Specifications and Bid Documents are provided as a separate bound document). The District is financing the project with $1,500,000 of Bond Anticipation Notes (BAN) to be issued in 2007 and $500,000 of bonds issued in 2006.

6. The construction is in the public interest and is required to allow NKWD to continue to provide adequate service to its customers. The project will provide additional protection against potential contaminants. The project, its cost, need and other details are contained in Exhibit A.

7. The total project cost is approximately $1,650,000, see Exhibits B and D.

8. Easements and rights of way are not required, see Exhibit B.

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

10. The proposed project, identified in Exhibit A, is scheduled to begin construction in April, 2007 and be completed by May, 2008. Board approval of the project was given on January 24, 2007, attached as Exhibit C. Bid information is included with Exhibit B. Bids expire on April 10, 2007.

11. No new franchises are required. The DOW permit is attached as Exhibit B.

12. Construction descriptions are in Exhibit A and Bid Documents. Facts relied on to justify the public need are included in the project descriptions in Exhibit A.

13. Maps of the area showing location of the proposed facilities are in Exhibit A.

14. The construction costs will be funded by the issuance of BANS and previously issued bonds.

15. Estimated operating costs for operation and maintenance, depreciation and debt service after construction to the extent that there are any are shown in Exhibit D.

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

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

18. The start date for construction; proposed in-service date; and total estimated cost of construction at completion are included in Exhibits A and B.

19. CWIP at end of test year is listed in Exhibit E.

20. Plant retirements are listed in Exhibit B and E. No salvage values are included as booked.

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

22. No rate adjustment is being proposed.

23. The following information is provided in response to 807 KAR 5:001 (8):

a. Articles of Incorporation – None. NKWD is a statutorily created water district under KRS Chapter 74;

24. The following information is supplied pursuant to 807 KAR 5:001(9):

a. Facts relied upon to show that the application is in the public interest: See Exhibit A.

25. The following information is provided as required by 807 KAR 5:001 (11):

a. A general description of the property is contained in the Annual Report, Exhibit E.

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 financing are to construct 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.

26. The following exhibits are provided pursuant to 807 KAR 5:001 (11)(2):

a. There are no trust deeds. All notes, indebtedness and mortgages are included in Exhibits E and F.

b. Property is to be constructed is described in Exhibit A.

27. The following information is provided pursuant to 807 KAR 5:001(6):

a. No stock is authorized.

b. No stock is issued.

c. There are no stock preferences.

d. Mortgages are listed in Exhibit F.

e. Bonds are listed in Exhibit F.

f. Notes are listed in Exhibit F.

g. Other indebtedness is listed in Exhibit F.

h. No dividends have been paid.

i. Current balance sheet; income statement and debt schedule are attached as Exhibits F and G.

k. The facilities being constructed will be reflected in USoA Accounts as shown in Exhibit D.

For these reasons, the District requests authorization to construct the facilities and any other order or authorization that may be necessary to obtain Commission approval for

construction.

SUBMITTED BY:

John N. Hughes
124 W. Todd St.
Frankfort, KY 40601

Attorney for Northern
Kentucky Water District

NORTHERN KENTUCKY WATER DISTRICT
CASE 2007 - 00052
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

NORTHERN KENTUCKY WATER DISTRICT
Taylor Mill Treatment Plant UV Disinfection
184-0439

TABLE OF CONTENTS

EXHIBIT	TITLE
A	ENGINEERING REPORTS AND INFORMATION Copy of project map, Preliminary engineering report; Engineer's opinion of probable total construction cost; Black & Veatch plans titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006, sealed by a P.E.; Black & Veatch specifications titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006, and sealed by a P.E.
B	Certified statement from an authorized utility Official confirming: (1) Affidavit (2) Franchises (3) Plan review and permit status (4) Easements and Right-Of-Way status (5) Construction dates and proposed date in service (6) Plant retirements
C	BID INFORMATION AND BOARD RESOLUTION Bid tabulation, Engineer's recommendation of award, Board resolution.
D	PROJECT FINANCE INFORMATION Customers added and revenue effect, Debt issuance and source of debt, Additional costs and operating and maintenance, Depreciation cost and debt service after construction.
E	PSC ANNUAL REPORT - 2005
F	SCHEDULE OF MORTGAGES, BONDS, NOTES, AND OTHER INDEBTEDNESS
G	CURRENT BALANCE SHEET AND INCOME STATEMENT

NORTHERN KENTUCKY
WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Case No. 2007-00052
Exhibit A

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

ENGINEERING REPORTS AND INFORMATION

Project Map

Preliminary Design Memorandum

Engineer's Opinion of Probable Total Construction Cost

Plans prepared by Black & Veatch titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006

Specifications prepared by Black & Veatch titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006

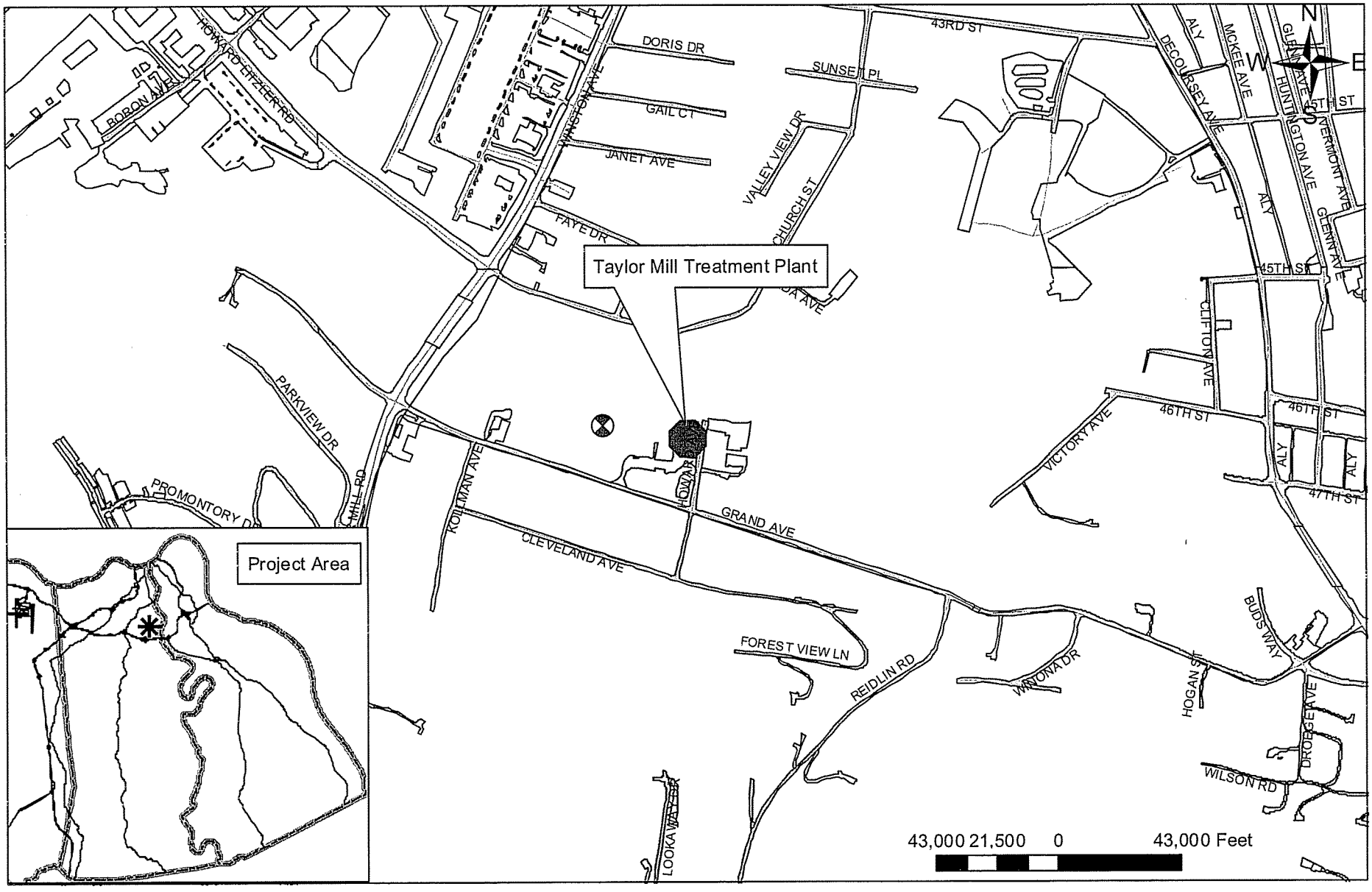
Case No. 2007-____
Exhibit ____A____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Project Map



Taylor Mill Treatment Plant

Case No. 2007-____
Exhibit ____A____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Preliminary Design Memorandum

Northern Kentucky Water District

Taylor Mill Treatment Plant
UV Disinfection

Final Design Memorandum

August 1, 2006

August 1, 2006

Prepared by
Black & Veatch Corporation
Cincinnati, Ohio

P.N. 143757

BLACK & VEATCH

FINAL DESIGN MEMORANDUM

Northern Kentucky Water District
Taylor Mill Treatment Plant UV Disinfection

B&V Project No. 143757
B&V File D-1.2
August 1, 2006

To: Distribution

From: Marissa Albright, Donnie Ginn

A. GENERAL

This memorandum provides design criteria and layout information for the addition of ultraviolet (UV) disinfection at the Taylor Mill Treatment Plant (TMTP) for the Northern Kentucky Water District (NKWD).

NKWD's 12 mgd Taylor Mill Treatment Plant is a conventional coagulation/settling/filtration treatment plant with the Licking River as its source water. The raw water is pumped to a rapid mix chamber and flows by gravity to the two parallel flocculation/sedimentation basin trains. Following sedimentation, water is filtered by eight dual media filters consisting of anthracite and sand. After filtration, the water enters a below-grade, baffled, concrete clearwell. The water is pumped into the distribution system via the high service pumps located at the TMTP. Treated water from the Fort Thomas Treatment Plant (FTTP) flows by gravity to the TMTP clearwell and is also pumped by the TMTP high service pumps into the distribution system. Chemicals fed at the TMTP include ferric sulfate, sodium hypochlorite, coagulant-aid polymer, corrosion inhibitor, fluoride, sodium bisulfite, caustic soda, filter-aid polymer, copper sulfate and powered activated carbon. Currently, the caustic soda system is not in operation.

During low demand conditions, the TMTP is operated 24 hours per day, 5 days per week; therefore, the plant is not in operation on Saturdays and Sundays. Typically, the plant operates 24 hours per day, 7 days per week under high demand conditions between Memorial Day and Labor Day. Plant operation is adjusted depending on emergency conditions, such as a water main break.

The objectives for the design and installation of UV disinfection at the TMTP are to:

- Provide an additional disinfection barrier,
- Increase the degree of inactivation of *Cryptosporidium, giardia*, and viruses,
- Minimize the formation of potential disinfection byproducts (DBPs), and
- Achieve enhanced treatment goals in the future.

This project consists of the Design, Bid and Construction Phase Services for the installation of Ultraviolet (UV) disinfection at the Taylor Mill Treatment Plant, including:

- UV disinfection equipment consisting of 2 reactors (one duty, one standby), local control panels for each reactor and instrumentation as required for monitoring lamp intensity, power failure, operating time, etc.
- Chemical feed piping modifications to provide a new application point for sodium hypochlorite, caustic soda, corrosion inhibitor, and fluoride at the new entrance to the clearwell.
- Combined Filter Effluent piping modifications for isolation of UV reactors and flow control.
- New electric utility service including a pad mount transformer, service entrance switchboard, and distribution power panels to support new UV disinfection system.
- New Uninterruptible Power Supply (UPS)
- New instrumentation and controls to connect new equipment devices to the plant SCADA system.

The Appendix of this design memorandum includes preliminary drawings and control descriptions. The drawings are included in Appendix A and include the following:

- G4 – Site Plan
- C3 – Basement and Filter Pipe Gallery Plan and Sections
- E2 – Power Distribution Functional Diagram
- P4 – UV Disinfection System P&ID

The control descriptions for the UV Disinfection System are included in Appendix B.

The Guaranteed Present Worth Form to be included with the Bid Form is included in Appendix C.

B. ENGINEERING SERVICES

All design, quality control and contract document preparation services for the project will be the responsibility of Black & Veatch, administered through the Cincinnati office. The Project Manager is Donnie Ginn; Larry Gaddis is the Design Technical Advisor; Bruce Long is the Process Technical Advisor; Marissa Albright is the Engineering Manager; Heather Landis is the Process Engineer; Adam Westermann is the Project Engineer; and Debbie Duncan is the Engineering Technician. Mark Magella and Steve Yakimow are the Electrical Project Engineer and Instrumentation Project Engineer, respectively.

C. PROJECT SCHEDULE

The following schedule in Table 1 has been established for the project:

Table 1

Project Schedule

Contract Execution (Notice to Proceed)	January 25, 2006
Kick-off Meeting and Workshop	January 12, 2006
KDOW Meeting	January 13, 2006
Evaluation Memorandum	April 5, 2006
Evaluation Memorandum Review Meeting	April 24, 2006
Draft Preliminary Design Memorandum (PDM) Submission	June 22, 2006
PDM Comments Received from NKWD	July 5, 2006
Review Meeting with NKWD	July 25, 2006
Final Design Memorandum Submission	August 1, 2006
Level I (50%) Design Complete	August 30, 2006
Level I Review Meeting with NKWD	September 13, 2006
Level 2 (90%) Design Complete	October 11, 2006
Submit Contract Documents to KDOW for Approval	October 11, 2006
Level 2 Review Meeting with NKWD	October 25, 2006
QA/QC Complete	November 1, 2006

Table 1 Project Schedule	
Final Contract Documents Submission	November 29, 2006
Advertise for Bids	November 30, 2006
Receive Bids	January 9, 2006
Award Contract	April 9, 2007
Start Construction	May 2007
Substantial Completion	April 2008
Final Completion	May 2008

The schedule in Table 1 allows 90 days for the Public Service Commission to review and approve the project. Depending on the actual length of the review period, the construction start date may be changed.

D. DRAFTING STANDARDS AND PROCEDURES

All project plans will be plotted on 22 inch by 34 inch mylar with the Cincinnati Office standard title block. Drafting will be conducted in accordance with standard B&V policy. Debbie Duncan will be responsible for coordinating all drafting. All drawings will be prepared in AutoCAD Version 2004 format. All drawings will be signed and sealed by each respective discipline's responsible engineer/architect licensed in the Commonwealth of Kentucky.

Correspondence, files, drawings, specifications, and other related information will be available on CYGNET. All members of the Black & Veatch project team will have access to the project on CYGNET and are responsible for updating the information as necessary.

E. CODES AND REGULATORY AGENCIES

The following codes and regulatory agencies will be applicable for this project:

- Great Lakes – Upper Mississippi River Board of State Public Health & Environmental Managers "Recommended Standards for Water Works" (Ten States Standards), 2003 edition

- Kentucky Division of Water
- Kentucky Building Code, latest edition
- NEC – National Electrical Code

F. DATUM

Site elevations will be USGS datum. Elevations within the plant will be based on existing drawings and field verifications by Black & Veatch. The field verification included measuring the distance between the water levels of the clarifiers and filters and the top of the concrete walkways and platforms. The field measurements were reasonably accurate as compared to the existing drawings.

G. UTILITIES

Electric and gas service at the Taylor Mill Treatment Plant is provided by Duke Energy. Water service is provided by the Northern Kentucky Water District. Sewer service is provided by Northern Kentucky Sanitation District No. 1. The project site falls under the telephone service area of Cincinnati Bell.

H. BACKGROUND MATERIAL

Reference material for this project includes the following:

- 1953, Water Treatment Plant -- Construction Contract Drawings, Alfred LeFeber and Associates, 48 sheets.
- 1960, Water Treatment Plant Extensions – Construction Contract Drawings, O.G. Loomis & Son, 29 sheets.
- 1987, Taylor Mill WTP Improvements, Contract 87-4 – Construction Contract Drawings, Burgess & Niple, 27 sheets.
- 1991, Taylor Mill WTP Filter Rehabilitation, Contract 91-2 – Construction Contract Drawings, Burgess & Niple, 11 sheets.
- 1997, Taylor Mill WTP Chemical Building, Clarifier, and Clearwell Improvements, Contract 184-410 – Construction Contract Drawings, CH2MHill, 92 sheets.
- 2000, Taylor Mill WTP Filter Rehabilitation, Contract 184-423 – Construction Contract Drawings, Burgess & Niple, 10 sheets.
- 2001, Taylor Mill Water Treatment Plant Ultraviolet Disinfection Evaluation, Black & Veatch, Cincinnati, Ohio.
- 2001, Taylor Mill Water Treatment Plant Filter to Waste System – Construction Contract Drawings, Black & Veatch, 31 sheets.

- 2002, Taylor Mill Treatment Plant Ultraviolet Disinfection Evaluation Demonstration Study Summary, Black & Veatch, Cincinnati, Ohio.
- 2003, Taylor Mill Water Treatment Plant Ultraviolet Disinfection Evaluation Phase 2 Demonstration Study Summary, Black & Veatch, Cincinnati, Ohio.
- 2004, Asset Management Program, Black & Veatch, Cincinnati, Ohio.
- 2005, Taylor Mill Filter Media Replacement and Pump No. 3 Retrofit Project – Bid Drawings, Malcolm Pirnie, 5 sheets.
- 2006, Proposed 36" and 42" Water Main – Phase II Howard Avenue to Latonia Youth Club – Construction Drawings, Voix & Voix, 7 sheets.

Copies can be obtained from Debbie Duncan.

I. NEW FACILITIES DESCRIPTION

I.1. General

This project consists of the Design, Bid and Construction Phase Services for the installation of Ultraviolet (UV) disinfection at the Taylor Mill Treatment Plant, including:

- UV disinfection equipment including two UV reactors, a local control panel for each reactor, associated piping and valves, and electrical and instrumentation equipment.
- Chemical feed piping modifications to provide a new application point for sodium hypochlorite, caustic soda, corrosion inhibitor, and fluoride at the new entrance to the clearwell.
- Combined Filter Effluent piping modifications for isolation of UV reactors and flow control.
- New electric utility service including pad mount transformer, service entrance switchboard, and distribution power panel to support new UV disinfection system.
- New Uninterruptible Power Supply (UPS)
- New instrumentation and control to connect new equipment devices to the plant SCADA system.

I.2. Project Construction

During the construction of this project, the Taylor Mill Treatment Plant will be in continuous operation as discussed in Section A – General with short, partial and full plant outages to facilitate construction. Although it is possible to send the flow into the clearwell at the north end of the Filter Pipe Gallery, this operation is not expected to provide sufficient disinfectant contact time within the clearwell prior to the High Service Pumps. Therefore, plant outages during construction are anticipated for the following:

- Installation of the new entrance to the clearwell, including the wall fitting and piping within the clearwell.
- Installation of new piping for the Combined Filter Effluent modifications within the Filter Pipe Gallery.

Additionally, filters 1 and 3 may need to be taken off-line for an extended period of time while the instrumentation associated with each filter is relocated.

The installation of the UV reactors and associated piping, valving and instrumentation that does not directly connect to the existing 24-inch Combined Filter Effluent will not require a plant shutdown. It is anticipated that this work will be performed during normal plant operations. The Contractor will be required to provide space for TMTP staff to access existing piping, valves and instrumentation during construction.

The Contractor will be required to inform NKWD of planned outages during construction in advance for NKWD's approval. The scheduling and length of any outage will be based on the distribution system demand conditions and determined by NKWD.

I.3. Civil/Process

The following paragraphs summarize the basis of civil/process design for the UV disinfection equipment, modifications to the chemical feed system, piping modifications in the filter pipe gallery and site work.

UV Disinfection Equipment and Piping

The UV disinfection equipment will consist of two reactors and two control panels. Both reactors will be installed to operate in a parallel configuration without requiring additional by-pass piping. One reactor will be located in the Filter Pipe Gallery along the west wall beneath the effluent piping from Filters 1 and 3. The second reactor will be located in the Basement Pipe Gallery along the north wall beneath the existing 20-inch raw water main. The control panel for each reactor will be located in the Basement Pipe Gallery. The control panels for each reactor will be situated near the stairwell, south of the Filter Pipe Gallery entrance as indicated on Drawing C3 in Appendix A. The existing electrical conduit, thermostat and switches, currently located on the column, will be relocated to adjacent walls. Drawing C3 also illustrates the installation of the reactors and associated piping and valves.

Installation of reactors will include equipment drain piping and appurtenances as recommended by the manufacturer. The equipment drain for the Filter Pipe Gallery reactor will be routed to the existing trench drain in the Filter Pipe Gallery. The equipment drain for the reactor in the Basement Pipe Gallery will be routed to the existing sump in the southwest corner of the Basement Pipe Gallery. This equipment drain will connect with the drain piping from the existing analyzers installed on the instrumentation panel.

The design criteria for the UV disinfection equipment is listed in Table 2.

Table 2
TMTP Design Criteria

Plant design flow, mgd	12
Annual average flow, mgd	6
Plant minimum flow rate, mgd	4
Number of duty reactors	1
Number of standby reactors	1
Reactor capacity, mgd	12
Design UV transmittance, %	89
Design Dose, mJ/cm^2	40
Maximum headloss through reactor, inches water column	8

The UV reactors and control panels will be as manufactured by Trojan Technologies Inc., Calgon Carbon Corporation, or equal. Trojan Technologies Inc. and Calgon Carbon Corporation currently manufacture UV reactors that meet the design criteria as listed in Table 2. The UV disinfection equipment will be controlled as described in the Instrumentation and Control section. The UV reactors will be provided with the following:

- Sensors within the reactor to monitor lamp intensity. One sensor for each lamp will be required.
- A separate maintenance agreement with the UV equipment manufacturer for one year which is renewable at the same cost for up to 5 years. The maintenance agreement will include, but not be limited to, costs for materials and labor required to maintain UV reactor and replace lamps, sleeves, ballasts and sensors.

The installation of the reactor and associated piping in the Filter Pipe Gallery will require relocation of existing instrumentation equipment and hose reel. The turbidimeters, filter loss of head meters and filter effluent flow meters for Filters 1 and 3 will be relocated to instrument panels closer to the center of the gallery, similar to the installation of the instrumentation for Filters 2 and 4 during the Filter to Waste project.

The installation of the reactor and associated piping in the Basement Pipe Gallery is not expected to affect the existing instrumentation panel located at the west end of the gallery. Therefore, modifications or relocation of this instrumentation panel are not required.

Chemical Feed Modifications

Currently the Taylor Mill Treatment Plant has the capability to feed sodium hypochlorite, caustic soda (sodium hydroxide), corrosion inhibitor and fluoride to the filtered water prior to entering the clearwell. Modifications of the existing post-filtration application point in the Filter Pipe Gallery will be required with the installation of new combined filter effluent piping. The modifications to the existing chemical feed system include the installation of new chemical feed piping routed to the new entrance to the clearwell in the Basement Pipe Gallery. The chemical feed application points will be installed in the piping prior to the clearwell entrances as indicated on Drawing C3 in Appendix A. The construction materials for the chemical feed piping and appurtenances will match the existing system.

The chemical feed modifications will consist of 1-inch PVC Schedule 80 piping for each chemical (sodium hypochlorite, sodium hydroxide, corrosion inhibitor and fluoride), automatic valves for controlling application points, flexible hosing, corporation stops and diffusers appropriate for each chemical. The automatic valves will be controlled in conjunction with the operation of the UV disinfection system in order to inject chemicals downstream of the reactor which is in operation. The plant SCADA will be programmed to open and close the chemical feed valves as the associated UV reactor is turned on and off, respectively.

The existing post-filtration chemical feed in Filter Pipe Gallery will be modified to include new corporation stops and diffusers appropriate for each chemical. The chemicals will be inserted into the new 24-inch ductile iron pipe tee located at centerline elevation 511.25± before the combined filter effluent enters the clearwell.

The chemical feed improvements are limited to the installation of new piping and appurtenances to route the chemicals to the additional application point. Under normal

operation, the post-filtration chemical application will occur at one clearwell entrance location at a time. Therefore, additional evaluation and modifications to the chemical feed systems, including pumping and storage, were not performed under this project.

Combined Filter Effluent Piping Modifications

The combined filter effluent piping will be modified for the installation of the UV reactors. The existing combined filter effluent piping consists of flanged 24-inch ductile iron pipe installed at centerline elevation 519.08± throughout the length of the Filter Pipe Gallery. At the south end of the gallery, the combined filter effluent piping enters the clearwell at centerline elevation 511.25±. Drawing C3, located in Appendix A, is a preliminary drawing identifying the location of the new piping in the Filter and Basement Pipe Galleries.

The piping modifications will include installation of associated piping, fittings and AWWA butterfly valves for connecting the UV reactors with the existing 24-inch combined filter effluent piping and clearwell. The AWWA butterfly valves will be electrically operated and installed to control the flow to each reactor and provide the ability to isolate the reactors. The valves will be manufactured by Pratt or Milliken. The Valve Actuators will be Auma Compact standard electric actuators (no exceptions to match Owner's Existing equipment) with open/close controls and open/close limit switches. Modulating service will be handled by external control logic such as from provided by a PLC. The existing configuration of the 24-inch combined filter effluent, permitting flow directly to the clearwell, will remain in order to provide a bypass of the entire UV disinfection system. The existing influent piping within the clearwell will not be modified.

The existing platform and grating structures adjacent to Filters 1 and 3 will be modified based on the installation of the new 24-inch ductile iron pipe. The platforms will be modified similar to the platform adjacent to Filter 2 during the Filter to Waste project.

Site Work

A new concrete pad will be installed for the new electrical transformer, switchboard and distribution panel. The concrete pad will be located east of the existing Filter to Waste Basin as indicated on drawing G4 included in Appendix A.

For the new electrical service connection, a new utility pole will be located on the plant site along Grand Avenue as indicated on drawing G4 included in Appendix A. This pole will be furnished by the Utility (Duke Energy) and located outside of TMTP's fence. From the pole, the electrical service will be routed below grade in a new ductbank to the new

electrical transformer. A new ductbank will also be provided for routing the electrical service from the transformer to the existing electrical manhole. The new electrical service is described further in the Electrical section.

I.4. Electrical

The electrical design will conform to Black & Veatch standards and will be designed generally as follows:

- All motors, ½ horsepower and larger, will be rated 460 volts, three phase.
- All motors, less than ½ horsepower will be rated 120 volts, single phase.
- Rigid galvanized steel conduit will be used for exposed indoor applications.
- Rigid Schedule 40 PVC conduit will be installed in floor slabs and walls and in underground duct banks.
- PVC Coated rigid steel conduit will be used for exposed outdoor areas.
- Concrete encasement for electrical duct banks will have reinforcing at roadway crossings and near future construction areas.
- All low voltage power and control cables will be rated for 600 volts. Power and control cables will have type XHHW insulation.
- All free-standing electrical equipment will be installed on housekeeping pads.
- Spare conduits will be provided per NKWD requirements, and will include pull strings.

Power Supply and Distribution

A new outdoor pad-mounted utility-owned transformer to serve the UV disinfection system will be located north of the Filter to Waste Basin and east of the Filter to Waste access drive. The service entrance equipment will be located adjacent to an existing electrical manhole. The arrangement will be similar to the transformer/switchboard located on the west side of the Filter to Waste access drive. The new transformer will be furnished by the Utility (Duke Energy), metered on the secondary of the transformer, and will feed an outdoor rated switchboard. The switchboard will be service entrance rated.

The new electric supply will receive power from Duke Energy at the distribution voltage level of 12.47 kV, 3 phase, 60 hertz via the utility's pole-mounted distribution system routed along Grand Avenue. The electrical service will feed the new oil-filled pad mount transformer rated at 500 kVA, 12.47 kV – 480 volt, three-phase, 60 Hz. The transformer size will account for possible future loads. The secondary of the transformer will feed

the outdoor switchboard. Provisions to connect a future standby power generator will be provided.

Three distribution buses will be included for the new electrical service to the UV Disinfection System. Drawing E2, included in Appendix A, lists the new buses which are 480 volt and indicated as follows:

- Outside Switchboard (Service Entrance),
- Corridor Power Panel (sub feed to UPS and future plant loads), and
- UPS Power Panel for feeding the UV system and additional future loads.

From the Outside Switchboard, the 480 volt power will be installed in an underground ductbank to the line side of the Corridor Power Panel located in the corridor between the Filter and Chemical Buildings. The design anticipates that an existing underground spare ductbank conduit installed between the existing manhole and the basement of the Filter Building will be used. Therefore, trenching across the plant entrance road should not be required.

To enhance the reliability of the UV disinfection system a three-phase, 480-volt, 100 kVa rated UPS will be installed inside the treatment plant. The UPS will be a battery type, continuous duty, on-line, double conversion solid-state unit and will regulate voltage to eliminate momentary voltage dips and power interruptions. The UPS battery capacity will provide approximately 8 to 10 minutes of backup power and the UPS will be equipped with a static bypass switch to allow the UPS to be taken out of service for maintenance or repairs. The output of the UPS will feed a 480-volt, three phase, power panel for distribution to the UV disinfection equipment control panels. The power panel will be equipped with transient voltage surge suppression (TVSS) and a total of five breakers for each UV reactor and three spares.

Communication Requirements

No telephone communication equipment will be provided at the Taylor Mill Treatment Plant with this project.

Lighting Requirements

Additional lighting at the TMTP is not required for this project. The existing lighting in the Basement and Filter Pipe Galleries is considered sufficient.

Environmental Requirements

Lightning protection systems will not be included. All electrical distribution equipment will be equipped with TVSS devices to mitigate voltage surges at all plant distribution voltage levels.

Environment requirements for the UPS system are:

- Ambient Temperature Range: 0-40 C (32-104 F)
- Recommended Operating Range: 20-25 C (68-77 F)
- Maximum Relative Humidity: 95%, noncondensing

I.5. Instrumentation and Control

This section discusses the SCADA requirements for the UV disinfection system. Each UV reactor will be provided with a local control panel known as the UV System Control Center. The local control panel includes a programmable logic controller (PLC) for control and monitoring of the UV reactor lamps and a panel screen type local operator interface (LOI). The LOI will provide local monitoring and alarming, and will allow operator entry of control and alarm setpoints and control mode selection. The PLC manufacturer and model will be specified to be Allen Bradley ControlLogix to match the Owner's existing PLCs. The LOI manufacturer will be specified as Allen Bradley PanelView Enhanced full color with Ethernet communication capability. Each PLC panel will also have an industrial DIN rail mount Ethernet switch to allow the PLC to be connected to PanelView inside the local panel while also providing connection to the plant SCADA system. Programming software will not be provided for the PLC, but will be provided for the PanelView. This software will be licensed to the Owner with one year of support.

The PLCs will be factory-programmed for automatic control of the reactor lamps. When the automatic (AUTO) mode is selected at the UV System Control Center LOI, the PLC will control lamp power and cycling based on flow of water through the UV reactor, the common reactor inlet UV transmittance and lamp intensity. The flow of water through the UV reactor will be the totalized flow from the existing flow meters installed on each filter's effluent piping.

Each UV System Control Center PLC will be factory-programmed to monitor UV lamp intensity, operating time and power failure. The PLC will generate alarms when values deviate from the limits recommended by the reactor manufacturer. UV reactor alarms

will be displayed on the LOI, and will identify the affected lamps by an address system. Alarms will be classified as "minor" or "major".

Minor alarms will indicate that maintenance is required and include the following:

- Low UV intensity warning will be preset at the factory at 80 percent of the intensity after 100 hours burn-in of the lamps. The set point will be field adjustable.
- Individual lamp failure (if a single lamp constitutes less than 5 percent of the total number of lamps in a reactor).
- Low UV dose alarm will occur when the operating UV dose drops below the field adjustable set point.
- Low UV transmittance alarm will occur when the influent UV transmittance drops below the field adjustable set point.

Major alarms will indicate a condition that may jeopardize the UV system performance and will include the following:

- Low-low UV intensity alarm will be preset at the factory at 70 percent of the intensity after 100 hours burn-in of the lamps. The set point is field adjustable.
- Low-low UV transmittance alarm will occur when the transmittance drops below the field adjustable set point.
- Low-low operational UV dose alarm will occur when the operational UV dose drops below the field adjustable set point.
- Failure of more than one lamp in a reactor will instigate a default routine in the PLC control to turn on all available UV lamps to ensure that disinfection will be achieved.
- Failure of an instrument or a communications link resulting in loss of a control signal will instigate a default routine in the PLC control to turn on all available UV lamps to ensure that disinfection is achieved.
- High temperature alarms for individual reactors.
- Low water level alarm when the water level in the UV reactor falls below a predetermined level.
- Failure of main power supply from transformer.
- Failure of power supply to the UV system from the UPS
- Ground fault interruption alarm.

Each UV System Control Center PLC will be connected by Ethernet to the Plant SCADA system to provide complete monitoring of each UV reactor system including detailed remote monitoring such as lamp data. Also, each UV System Control Center PLC will

receive the flow value from the Plant PLC. The Plant PLC will be programmed to sum the eight filter effluent flows to provide the plant flow value. The UV equipment supplier will be required to coordinate PLC programming to allow for efficient and accurate data transfer between the UV system PLCs and the plant PLCs/SCADA workstations. Integration of the UV system PLCs and the Plant SCADA system and programming of plant SCADA equipment will be provided by the OWNER/ENGINEER. The Plant PLC, located, on the second floor in the control room adjacent to the lab, will be expanded to include additional I/O for the five butterfly valves and the eight chemical feed valves to control the flow through the UV reactors. Programming of the valve control logic will be provided by the OWNER/ENGINEER.

I.6. Ventilation

Improvements to the existing ventilation are not anticipated for the UV Disinfection project. The existing ventilation in the corridor between the Filter and Chemical Buildings consists of a manually operated power roof ventilator (PRV) located approximately in the center of the room. The heat load from the UPS will be approximately 30,000 BTU/hr (8790 watts) under full load conditions and the existing PRV will be used for exhaust.

J. OPINION OF PROBABLE CONSTRUCTION COST

This section presents the Preliminary Opinion of Probable Construction Costs for the installation of UV Disinfection at the Taylor Mill Treatment Plant. The costs are presented as a lump sum bid for the entire project with an alternative deduction for the Uninterruptible Power Supply. Table 3 presents the summary of the Preliminary Opinion of Probable Construction Cost for this project.

Table 3

Preliminary Opinion of Probable Construction Cost[1]

Description	Add/Deduct $	Total $
UV Disinfection Project (Lump Sum)		$2,420,000
Alternative		
Uninterruptible Power Supply (deduct)	($155,000)	$2,265,000

[1] Costs are presented as June 2006 costs.

This Preliminary Opinion of Probable Construction Cost includes a contingency of 10% and assumes that the manufacturer's standard control panels for the UV disinfection

equipment will be utilized. If custom control panels are required, the unit cost for the UV equipment may increase. The Preliminary Opinion of Probable Construction Cost does not include additional costs associated with the maintenance agreement as discussed in Section I.3 – Civil/Process.

K. BID FORM STRUCTURE

The Bid Form will be structured as a Lump Sum Bid for the entire project including the following components:

- General requirements (mobilization, temporary facilities and equipment rental).
- UV disinfection equipment (reactors, control panels and instrumentation).
- Combined Filter Effluent piping modifications (piping and butterfly valves).
- Chemical feed piping and valves.
- Electrical improvements (transformer, switchgear, distribution power panels and associated wiring and conduit).
- Uninterruptible Power Supply.
- Instrumentation and controls for connecting new equipment to existing Plant SCADA.
- Maintenance Agreement with the UV equipment manufacturer for one year which is renewable at the same cost for up to 5 years.

The Bid Form will also include a Guaranteed Present Worth form which will be required to be filled out by the UV equipment manufacturer and included with the Bid. A preliminary copy of the Guaranteed Present Worth Form is included in Appendix C. The Guaranteed Present Worth form will be utilized during the Bid Evaluation for comparing the UV manufacturers. The form will also be verified during performance testing of the UV disinfection equipment as the selected manufacturer will be required to meet their guaranteed total power and maximum headloss values under the conditions listed in the form. The UV Disinfection Equipment specification will include penalties if the installed UV reactor does not perform in accordance with the values provided in the Guaranteed Present Worth form.

In addition to the Lump Sum Bid, an alternative deduct for the Uninterruptible Power Supply (UPS) will be provided by the Contractor. This will provide NKWD with a cost if NKWD decides to install the UPS at a later time.

L. OPERATION AND MAINTENANCE COSTS

This section presents the estimated operations and maintenance (O&M) costs associated with the operation of the UV Disinfection system. O&M costs will be included

as a table in the Contract Documents as guaranteed present worth costs. These costs will be further developed during the detailed design phase with input from the equipment manufacturers.

Table 4 presents an estimate of the O&M costs on an annual basis for a single UV reactor operating at an average of 6 mgd, 5 days per week. Additionally, the following factors were assumed:

- Lamp replacement is calculated according to manufacturer's estimates of lamp life.
- Quartz sleeve inspection performed annually.
- Quartz sleeves replaced every 6 years.
- Mechanical wiper maintenance every 2 years.
- Sensor calibration done weekly to monthly.
- Ballast/transformer inspection performed every 3 to 6 months.
- Ballast/transformer replacement is performed every 10 years.
- Labor is estimated at 200 hours per year for O&M and repairs.
- $25 per hour for labor with no benefits.
- $0.069 per kW-hr.
- 1,560 million gallons of water treatment per year.

Table 4

Estimated Operation and Maintenance Costs
UV Disinfection Operating at 6 mgd, 5 days per week

Description	Annual Cost, $/year
Power	$17,000
Materials	$10,000
Staff (record data and lamp replacement)	$5,000
Licensing Cost ($0.015 per 1,000 gallons)[1]	$24,000
Total Operation and Maintenance	$56,000
Cost per MG treated	$36

[1] There is approximately 16 years left on the patent.

M. PRELIMINARY SHEET LIST

The preliminary sheet list is provided in Table 5.

Table 5

Preliminary Sheet List

Sheet	Discipline	Title
		Cover Sheet
G1	General	List of Drawings and Location Map
G2	General	Abbreviations and Legends
G3	General	General Notes and Description of Facilities
G4	General	Site Plan
C1	Civil	Basement and Filter Pipe Gallery Demolition Plans
C2	Civil	Basement and Filter Pipe Gallery Demolition Sections and Details
C3	Civil	Basement and Filter Pipe Gallery Plan and Sections
C4	Civil	Basement and Filter Pipe Gallery Sections and Details
C5	Civil	Miscellaneous Details
C6	Civil	Standard Concrete Details
C7	Civil	Standard Concrete Details
E1	Electrical	Abbreviations, Legend and General Notes
E2	Electrical	Power Distribution Functional Diagram
E3	Electrical	Transformer and Utility Connection Site Plan
E4	Electrical	Demolition Plan and One-Line Diagrams
E5	Electrical	One-Line Diagrams
E6	Electrical	Basement and Filter Pipe Gallery Power Plan
E7	Electrical	Schedule and Details
P1	Process	P&ID Abbreviations and Legends, Sheet 1 of 3
P2	Process	P&ID Abbreviations and Legends, Sheet 2 of 3
P3	Process	P&ID Abbreviations and Legends, Sheet 3 of 3
P4	Process	Ultraviolet Disinfection System P&ID
I1	Instrumentation	Control System Block Diagram
I2	Instrumentation	Instrument Installation Details
I3	Instrumentation	Enclosure Details

N. PRELIMINARY SPECIFICATION LIST

The preliminary specification list is provided in Table 6.

Table 6

Preliminary Specification List

Section	Title
00020	Invitation to Bid
00100	Instructions to Bidders
00400	Bid Form
00410	Bid Bond
00430	List of Subcontractors
00450	Equipment Questionnaire
00452	Instrumentation and Control System Supplier Questionnaire
00480	Noncollusion Affidavit
00500	Agreement
00510	Performance Bond
00520	Payment Bond
00550	Certificate of Insurance
00552	Certificate of Property Insurance
00700	Standard General Conditions of the Construction Contract
00800	Supplementary Conditions
	Duties, Responsibilities and Limitations of Authority of the Resident Project Representative as Set Forth in the Owner/Engineer Agreement
01015	Project Requirements
01070	Abbreviations
01300	Submittals
01310	Construction Scheduling
01320	Construction Progress Documentation
01380	Construction Photographs
01400	Quality Control
01500	Temporary Facilities
01605	General Equipment Requirements
01610	General Equipment Stipulation
01612	Shipping
01614	Handling and Storage
01620	Equipment Schedule
01630	Pipeline Schedule
01650	Startup Requirements
02050	Demolition and Salvage

Table 6

Preliminary Specification List

Section	Title
02200	Earthwork
02202	Trenching and Backfilling
02704	Pipeline Pressure and Leakage Testing
02832	Chain Link Fencing
02930	Seeding and Sodding
03100	Concrete Formwork
03200	Concrete Reinforcement
03250	Concrete Joints Accessories
03301	Cast-In-Place Concrete
03350	Concrete Placing, Finishing and Curing
03600	Grout
05520	Handrailing, Guardrailing and Ladders
05530	Grating
05550	Anchorage in Concrete and Masonry
05990	Structural and Miscellaneous Metals
07900	Caulking
09940	Protective Coatings
11060	Equipment Installation
13500	Computer Control System
13510	Computer System Hardware
13520	Computer System Software
13530	Programmable Logic Controllers
	Appendix 13530 – PLC Input/Output List
13550	Software Control Block Diagrams
13560	Instrumentation General Requirements
	Appendix 13560 – Instrument Device Schedule
13561	Panel Mounted Instruments
13562	Flow Instruments
13563	Pressure and Level Instruments
13564	Analytical Instruments
13565	Miscellaneous Instruments
13570	Panels, Consoles and Appurtenances
13580	Uninterruptible Power Supplies
13700	UV Disinfection
15010	Valve Installation
15020	Miscellaneous Piping and Accessories Installation
15060	Miscellaneous Piping and Pipe Assembly

Table 6

Preliminary Specification List

Section	Title
15061	Ductile Iron Pipe
15067	Miscellaneous Plastic Pipe, Tubing and Accessories
15070	Copper Tubing and Accessories
15091	Miscellaneous Ball Valves
15093	Check Valves
15100	Miscellaneous Valves
15101	AWWA Butterfly Valves
15140	Pipe Supports
15180	Valve and Gate Actuators
15990	Testing, Adjusting and Balancing
16050	Electrical
16100	Electrical Equipment Installation
16220	General Purpose Induction Motors
16425	Switchboards
16610	Uninterruptible Power Supply System

O. CONTACT LIST

Northern Kentucky Water District
2835 Crescent Springs Road
P.O. Box 18640 Phone (859) 578-9898
Erlanger, KY 41017-0640 Fax (859) 578-7893

Amy Kramer	Design Engineering Manager	x 2048

Black & Veatch
11500 Northlake Drive Suite 205 Phone (513) 984-6630
Cincinnati, OH 45249 Fax (513) 984-6686

Donnie Ginn	Project Manager	(513) 936-5117
Larry Gaddis	Design Technical Advisor	(513) 936-5107
Marissa Albright	Engineering Manager	(513) 936-5148
Adam Westermann	Project Engineer	(513) 936-5122
Debbie Duncan	Engineering Technician	(513) 936-5145
Mark Magella	Electrical Project Engineer	(513) 936-5105
Steve Yakimow	Instrumentation Project Engineer	(513) 936-5111

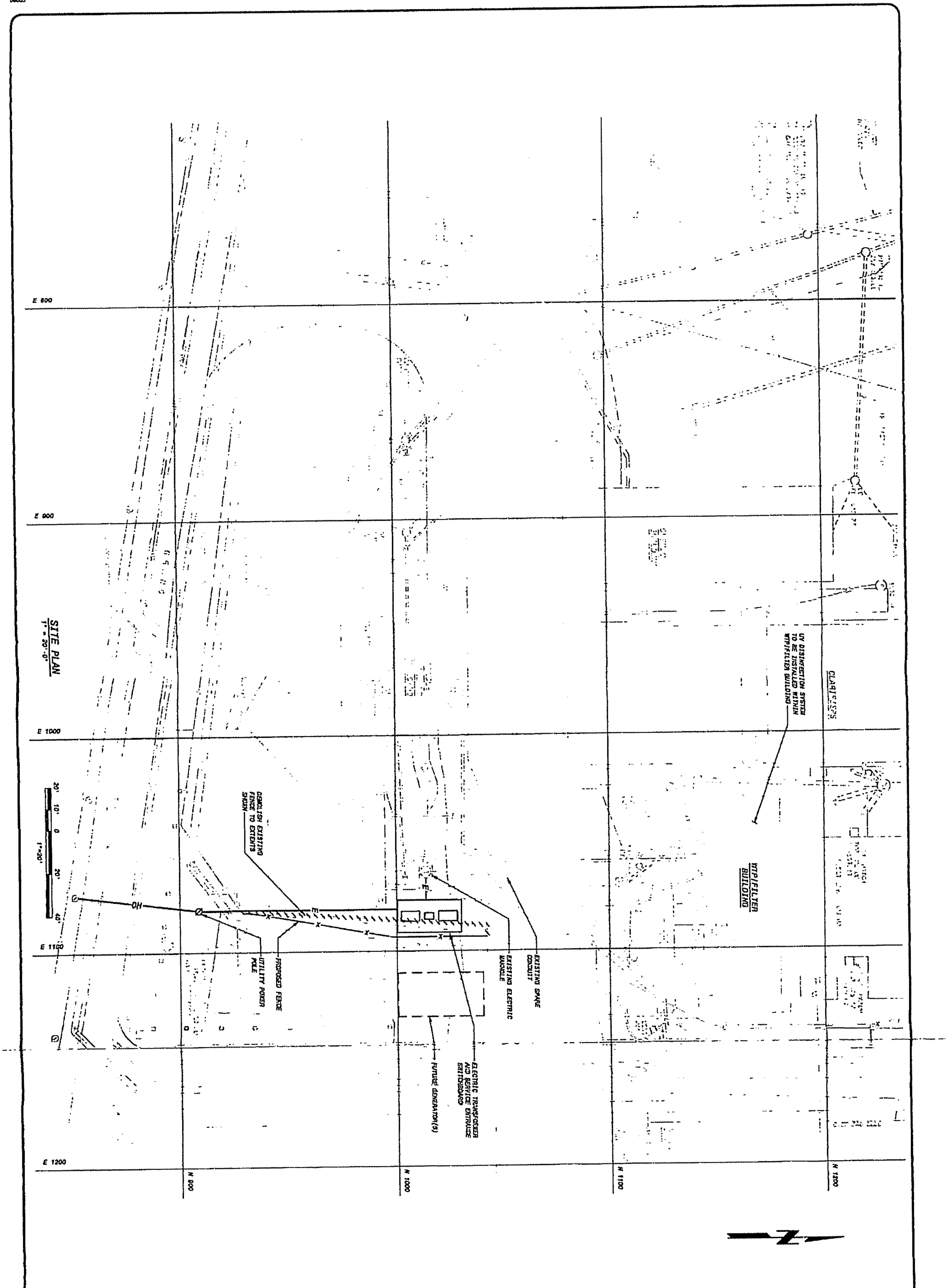
Distribution:

Amy Kramer, NKWD
Bari Joslyn, NKWD
Bill Wulfeck, NKWD
Jim Dierig, NKWD
Mary Carol Wagner, NKWD
Amy Matracia, NKWD

Larry Gaddis, B&V
Adam Westermann, B&V
Heather Landis, B&V
Mark Magella, B&V
Joe Forbes, B&V
Steve Yakimow, B&V
Debbie Duncan, B&V
Amber McDonough, B&V

APPENDIX A

Drawings


SITE PLAN
1" = 20'-0"
E 800
E 900
E 1000
E 1100
E 1200
N 900
N 1000
N 1100
N 1200
CLARIFIERS
UV DISINFECTION SYSTEM TO BE INSTALLED WITHIN WTP/FILTER BUILDING
WTP/FILTER BUILDING
DEMOLISH EXISTING FENCE TO EXTENTS SHOWN
UTILITY POWER POLE
PROPOSED FENCE
EXISTING ELECTRIC MANHOLE
EXISTING SPARE CONDUIT
ELECTRIC TRANSFORMER AND SERVICE ENTRANCE SWITCHBOARD
FUTURE GENERATOR(S)
OH

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

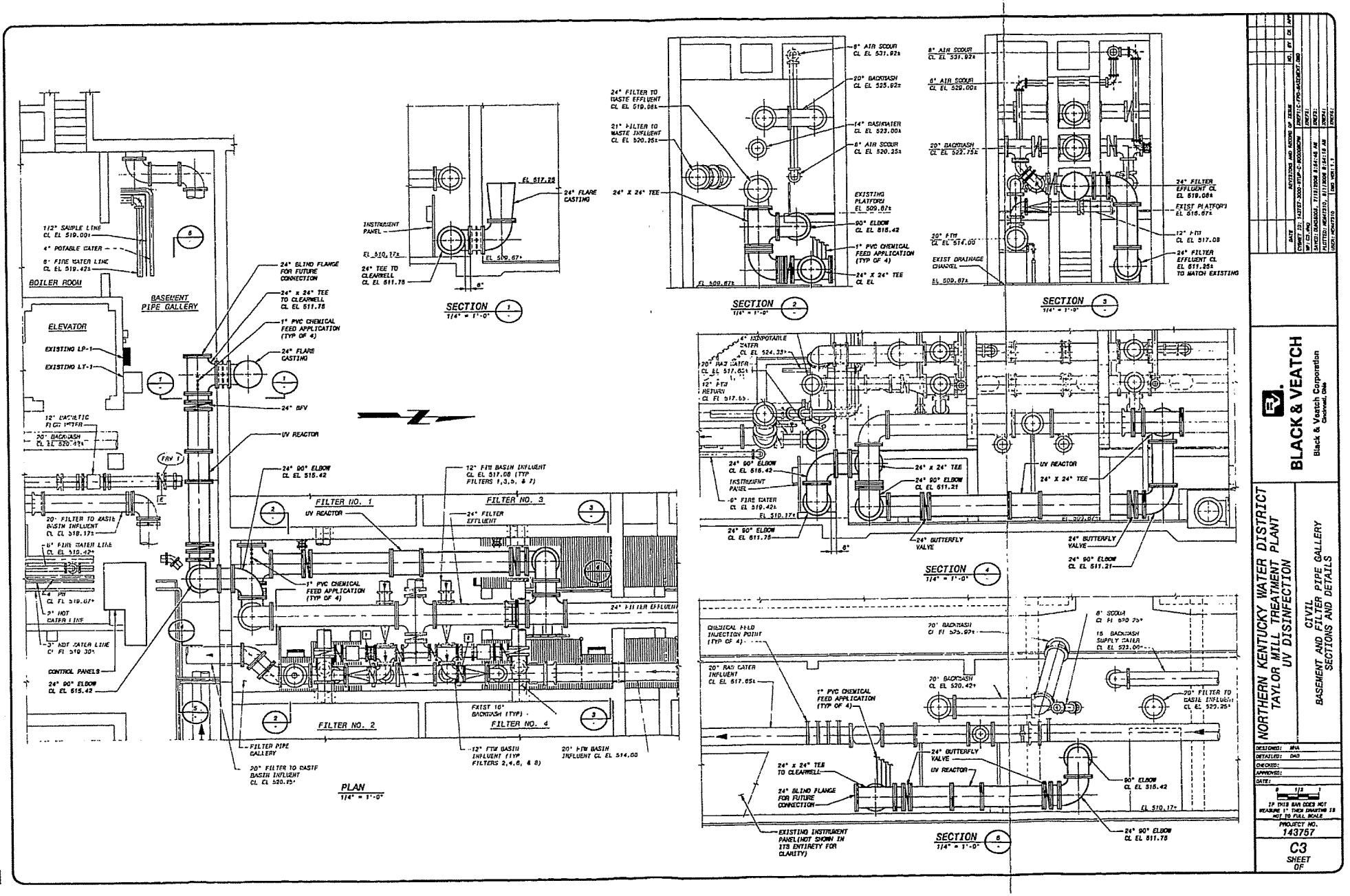
GENERAL
SITE PLAN

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

PROJECT NO. 143757

G4
SHEET
OF

DATE | REVISIONS AND RECORD OF ISSUE | NO. | BY | CK | APP



BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

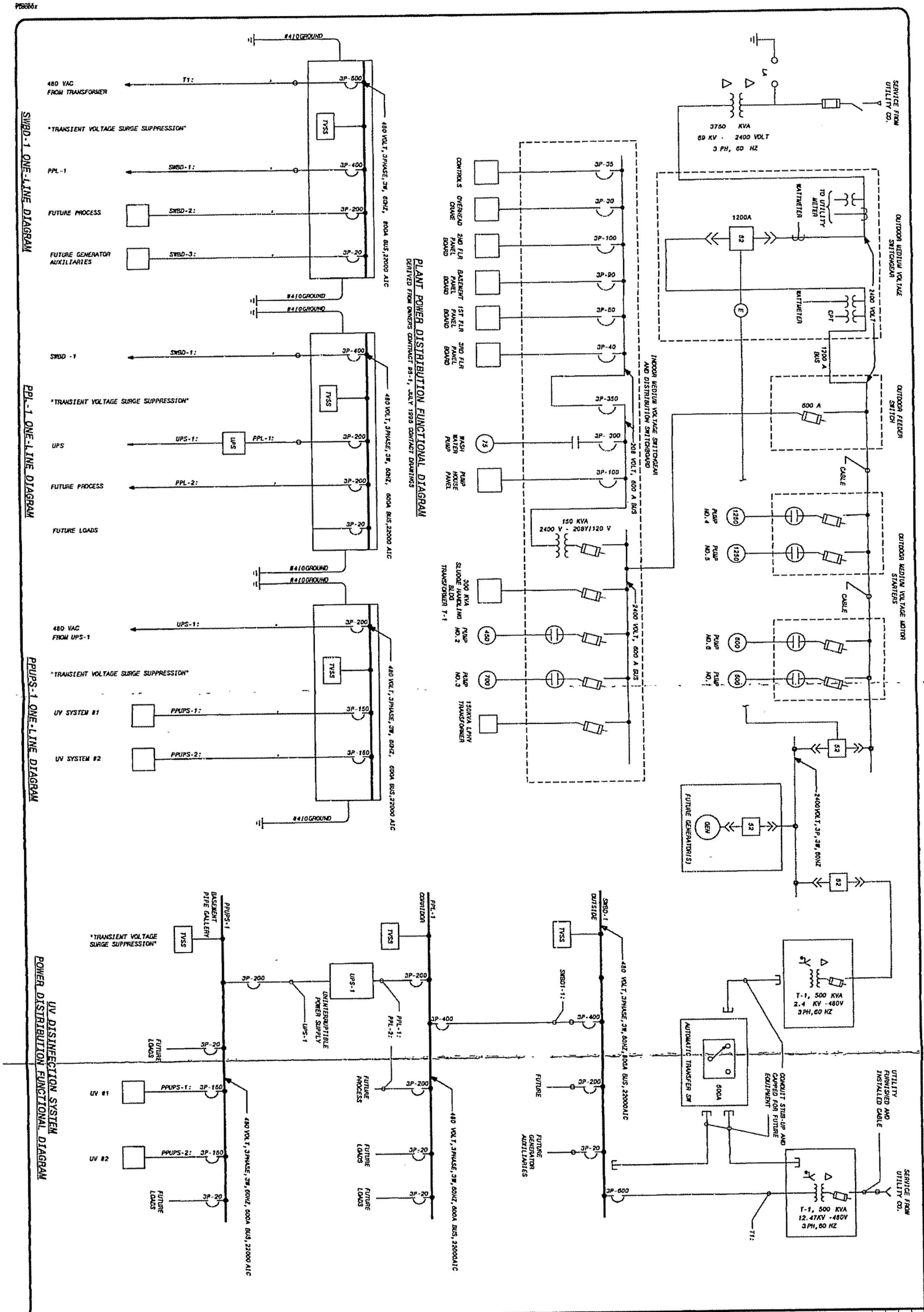
CIVIL
BASEMENT AND FILTER PIPE GALLERY SECTIONS AND DETAILS

DESIGNED: MHA
DETAILED: DAD
CHECKED:
APPROVED:
DATE:

0 1/4
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

C3
SHEET OF



NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

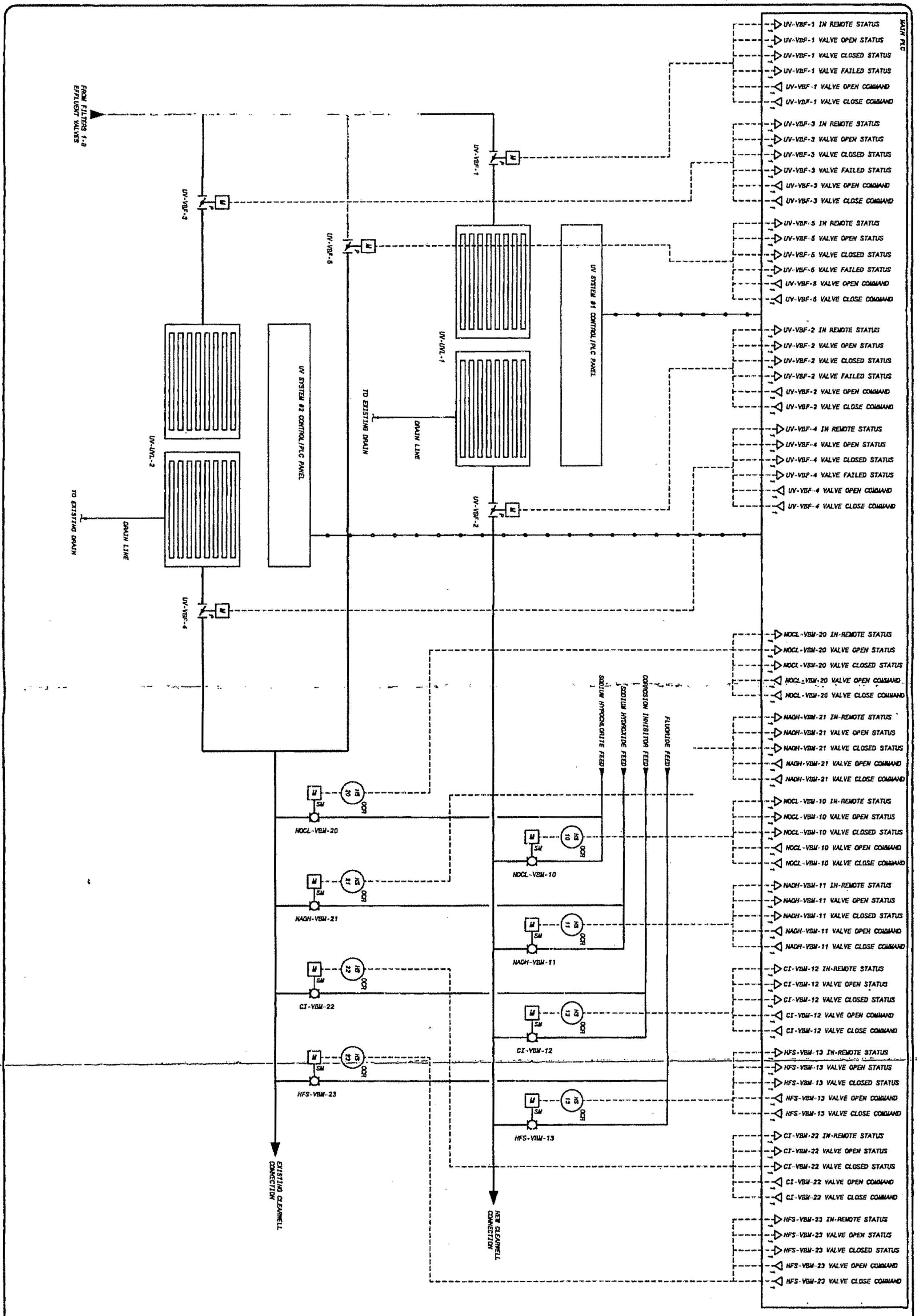
ELECTRICAL
POWER DISTRIBUTION FUNCTIONAL DIAGRAM
PRELIMINARY

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

PROJECT NO. 143757

E2

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP



P4
PROJECT NO. 143757

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

DESIGNED: SAY
DETAILED: SAY
CHECKED:
APPROVED:
DATE: JUNE 2008

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

P&ID
UV SYSTEM P&ID
PRELIMINARY

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

CYGNET ID: 143757-3000-WPE-I-800008YRL | XREF1:
WF: UV SYSTEM P&ID.dwg | XREF2:
SAVED: DUN38005, 8/18/2008 11:03:23 AM | XREF3:
PLOTTED: DUN38005, 8/18/2008 11:02:51 AM | XREF4:
USER: DUN38005 | DWG VER: 1.4 | XREF5:

APPENDIX B

Control Descriptions

BLACK & VEATCH

BASIS OF DESIGN MEMORANDUM – APPENDIX B

Northern Kentucky Water District
Taylor Mill Treatment Plant UV Disinfection

B&V Project No. 143757
B&V File D-1.2
June 22, 2006

To: Distribution

From: Steve Yakimow

PROCESS CONTROL DESCRIPTIONS

The instrumentation and control system design will adhere to Black & Veatch engineering standards except when accommodating specific client requests or preferences. In general, equipment will be controlled as described below.

1. UV System

1.01. Loop Description Title
UV Reactor System

Associated Equipment
UV-UVL-1, UV-UVL-2

Associated PLC
UV Equipment PLCs

Associated P&ID(s)
P4

Local Manual Mode
Local manual control of the UV Reactor System will be from each system's Local Operator Interface (LOI) located on each system's PLC panel. Start/stop, local/remote selection, auto/manual selection, and intensity manual adjustment will be initiated from the LOI. When Local and manual are selected from the LOI and start is selected from the LOI, the system will start and operate at the lamp intensity manually set.

Local Auto Mode

Local automatic control of the UV Reactor System intensity will be from each system's LOI located on each system's PLC panel. The intensity setpoint will be entered at the LOI. The UV system will pace based on the sum of the filter effluent flows. Start/stop will remain manual in the Local Automatic mode.

Remote Manual Mode

None. Remote monitoring at a SCADA system Operator Workstation will be provided.

Remote Auto Mode

None. Remote monitoring at a SCADA system Operator Workstation will be provided.

Alarms

The PLC shall generate a UV Start Fail alarm when the UV system does not report a run status within an adjustable time delay (0-30 sec, initially set at 5 sec). The alarm shall be generated only when the UV system is in remote mode.

Operator Workstation Status Indications

The HMI shall indicate the following UV System status:
UV System in Local/Remote, Auto/Manual, Running, Not Running, Individual Lamp Intensities, UV Transmittance, UV Dose Applied, UV Dose Setpoint, and the following Fail Statuses:

- Low-low UV Intensity
- Low-low UV Transmittance
- Low-low Operational UV dose
- Lamp Failure
- Communication Failure
- High temperature for Individual Reactors
- Low Water Level
- Main Power Supply Failure
- Standby Power Supply Failure
- Ground Fault Low
- UV Intensity Warning
- Individual Lamp Failure
- Low Operational UV Dose
- Low UV Transmittance

PLC Power-up
On PLC power-up, control of the UV System shall be set to local manual mode.

Power Failure
Control of the UV System shall resume with the control mode established prior to the power failure.

Operator Workstation Requirements
The UV System shall be depicted on the Clearwell display. The display layout shall be similar to the P&ID. The UV System symbol shall be a selectable target which retrieves the respective control overlay display. The overlay display shall contain control targets which allow selection of UV System operational adjustments and shall duplicate status indications as shown on the main display.

Calculations
Dosage, Transmittance, UV Intensity

1.02. Loop Description Title
UV System Isolation Valves

Associated Equipment
UV-VBF-1, UV-VBF-2, UV-VBF-3, UV-VBF-4, UV-VBF-5

Associated PLC
PLC-1

Associated P&ID(s)
P4

Local Manual Mode
Local manual control of the UV System Isolation Valves shall be provided through the OPEN-CLOSE--REMOTE (O-C-R) selector switch located on the valve's local control panel. In the OPEN position, the valve shall open. In the CLOSE position, the valve shall close.

Local Auto Mode
None

Remote Manual Mode

Remote manual control of the UV System Isolation Valves shall be provided through a SCADA system Operator Workstation or as also referred as a Human Machine Interface (HMI). When the O-C-R selector switch located on the valve's local control panel is in the REMOTE position and MANUAL is selected at the HMI, the valve shall be opened and closed from the PLC using manual operator commands at the HMI.

Remote Auto Mode

Remote automatic control of the UV System Isolation Valves shall be provided through a SCADA system Operator Workstation or as also referred as a Human Machine Interface (HMI). When the O-C-R selector switch located on the valve's local control panel is in the REMOTE position and AUTO is selected at the Operator Workstation, the valve shall be opened and closed from the PLC when the UV System is called to operate or stop.

Alarms

The PLC shall generate a Valve Fail alarm when the valve position switch indicates that the valve did not reach the commanded position within an adjustable (0-90 sec, initially set at 30 sec) time delay. The alarm shall be generated only when the valve is in remote mode.

Operator Workstation Status Indications

The HMI shall indicate the following valve status:
Valve in Local/Remote, Valve in Auto/Manual, Valve Open, Valve Closed, and Valve Fail.

PLC Power-up

N/A

PLC Power Failure

N/A

Operator Workstation Requirements

The UV System Isolation Valves shall be depicted on the UV System display. The display layout shall be similar to the P&ID. The valve symbol shall be a selectable target which retrieves the respective control overlay display. The overlay display shall contain control targets which allow selection of valve open duration and frequency adjustments and shall duplicate status indications as shown on the main display.

Calculations
None

1.03. Loop Description Title
Clearwell Chemical Feed Isolation Valves

Associated Equipment
NOCL-VBM-10, NOCL-VBM-20, NAOH-VBM-11, NAOH-VBM-21, CI-VBM-12, CI-VBM-22, HFS-VBM-13, HFS-VBM-23

Associated PLC
PLC-1

Associated P&ID(s)
P4

Local Manual Mode
Local manual control of the Clearwell Chemical Feed Isolation Valves shall be provided through the OPEN-CLOSE--REMOTE (O-C-R) selector switch located on the valve's local control station. In the OPEN position, the valve shall open. In the CLOSE position, the valve shall close.

Local Auto Mode
None

Remote Manual Mode
Remote manual control of the Clearwell Chemical Feed Isolation Valves shall be provided through a SCADA system Operator Workstation or as also referred as a Human Machine Interface (HMI). When the O-C-R selector switch located on the valve's local control station is in the REMOTE position and MANUAL is selected at the HMI, the valve shall be opened and closed from the PLC using manual operator commands at the HMI.

Remote Auto Mode
Remote automatic control of the Clearwell Chemical Feed Isolation Valves shall be provided through a SCADA system Operator Workstation or as also referred as a Human Machine Interface (HMI). When the O-C-R selector switch located on the valve's

local control station is in the REMOTE position and AUTO is selected at the HMI, the valve shall be opened and closed from the PLC when the UV System is called to operate or stop.

Alarms

The PLC shall generate a Valve Fail alarm when the valve position switch indicates that the valve did not reach the commanded position within an adjustable (0-90 sec, initially set at 30 sec) time delay. The alarm shall be generated only when the valve is in remote mode.

Operator Workstation Status Indications

The HMI shall indicate the following valve status:
Valve in Local/Remote, Valve in Auto/Manual, Valve Open, Valve Closed, and Valve Fail.

PLC Power-up

N/A

PLC Power Failure

N/A

Operator Workstation Requirements

The Clearwell Chemical Feed Isolation Valves shall be depicted on the UV System display. The display layout shall be similar to the P&ID. The valve symbol shall be a selectable target which retrieves the respective control overlay display. The overlay display shall contain control targets which allow selection of valve open duration and frequency adjustments and shall duplicate status indications as shown on the main display.

Calculations

None

APPENDIX C

Guaranteed Present Worth Form

Table 1
Guaranteed Present Worth from Contract
Design UVT as stated in Specification 13700 - UV Disinfection System

		Units	Flow (mgd)		
			4	6	12
1	Reduction Equivalent Dose	mJ/cm^2	40	40	40
2	UV Transmittance, average	%	93.6	93.6	93.6
3	Time Weight		0.28	0.55	0.18
4	Number of Reactors	No.	1	1	1
5	Guaranteed Total Power	kW			
6	Guaranteed Maximum Headloss through Reactor	in. of w.c.	8	8	8
7	Total No. of Lamps in Service	No.			
8	Total No. of Sleeves in Service	No.			
9	Total No. of Ballasts in Service	No.			
10	Total No. of Sensors in Service	No.			
11	Expected Lamp Life (Evaluation limited to 10,000 h)	hours			
12	Sleeve Life (Evaluation limited to 20 years)	years			
13	Ballast Life (Evaluation limited to 10 years)	years			
14	Sensor Life (Evaluation limited to 10 years)	years			
15	Lamp Replacement Cost (G.1 of POQF)	$ / lamp			
16	Sleeve Replacement Cost (G.1 of POQF)	$ / sleeve			
17	Ballast Replacement Cost (G.1 of POQF)	$ / ballast			
18	Sensor Replacement Cost (G.1 of POQF)	$ / sensor			
	Calculations				
19	Adjusted Flow	mgd	1.1	3.3	2.2
20	Adjusted Total Power with LF	KW			
21	Adjusted Total Annual Energy Cost	$ / year			
22	Adjusted Annual Lamp Replacement Cost	$ / year			
23	Adjusted Annual Sleeve Replacement Cost	$ / year			
24	Adjusted Annual Ballast Replacement Cost	$ / year			
25	Adjusted Sensor Replacement Cost	$ / year			
26	Sum of Adjusted Total Annual Energy Cost	$ / year			
27	Sum of Adjusted Annual Lamp Replacement	$ / year			
28	Sum of Adjusted Annual Sleeve Replacement	$ / year			
29	Sum of Adjusted Annual Ballast Replacement	$ / year			
30	Sum of Adjusted Annual Sensor Replacement	$ / year			
31	Present Worth Energy Cost (26*PWF)	$			
32	Present Worth Lamp Cost (27*PWF)	$			
33	Present Worth Sleeve Cost (28*PWF)	$			
34	Present Worth Ballast Cost (29*PWF)	$			
35	Present Worth Sensor Cost (30* PWF)	$			
36	**Total Present Worth Cost**	**$**			

AO	Annual Operations (hours) = 6258	LF	Lamp Factor = 0.80
EC	Energy Costs ($ / kWh) = $0.069	PWF	Present Worth Factor = 11.47

Case No. 2007-____
Exhibit ____A____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Engineer's Opinion of Probable Total Construction Cost

BLACK & VEATCH

11500 Northlake Drive, Suite 205, Cincinnati, Ohio 45249, (513) 984-6630

B&V Project 143757

NORTHERN KENTUCY WATER DISTRICT
TAYLOR MILL, KENTUCKY

TAYLOR MILL TREATMENT PLANT UV DISINFECTION

OPINION OF
PROBABLE CONSTRUCTION COST
January 4, 2007
This opinion of probable construction cost reflects December 2006 price levels.

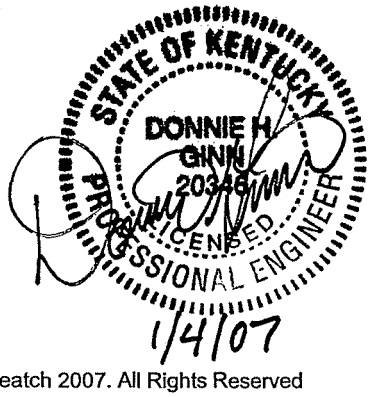
SUMMARY

General Requirements	$241,000
UV Disinfection	$1,496,000
Electrical Service	$414,000
Uninterruptible Power Supply	$99,000
TOTAL PROBABLE CONSTRUCTION COST	**2,250,000**

Alternatives

Uninterruptible Power Supply (deduct)	**$99,000**

Since Engineer has no control over the cost of labor, materials, or equipment furnished by others, or over the resources provided by others to meet project schedules, Engineer's opinion of probable costs and of project schedules shall be made on the basis of experience and qualifications as a professional engineer. Engineer does not guarantee that proposals, bids, or actual project costs will not vary from Engineer's opinion of probable costs or that actual schedules will not vary from Engineer's projected schedules. This seal represents that this Opinion of Probable Construction Cost was prepared under the supervision of a Professional Engineer licensed in the State of Kentucky.



Submitted by
BLACK & VEATCH
By
Donnie Ginn, P.E.
Project Manager

BLACK & VEATCH

Taylor Mill, Kentucy
Northern Kentucky Water District
Taylor Mill Treatment Plant UV Disinfection
Probable Construction Cost
January 4, 2007

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
GENERAL REQUIREMENTS				
Mobilization		Lump Sum		38,200
Supervision		Lump Sum		120,500
Temporary facilities		Lump Sum		28,100
Temporary utilities		Lump Sum		20,100
Equipment rental & misc.		Lump Sum		34,200
Total - General Requirements				$241,000
UV DISINFECTION				
Demolition and Structural Modifications		Lump Sum		20,000
Metal				
Handrail	40	lin ft	50.00	2,000
Grating	130	sq ft	45.00	5,900
Painting		Lump Sum		5,000
Equipment				
Janua UV Reactors (2 - includes transmittance monitors)		Lump Sum		670,000
Mechanical				
Process piping				
Ductile iron pipe				
24"	9,600	pound	5.50	52,800
Fittings				
90 bend - 24"	6	each	8,000.00	48,000
90 bend with flare - 24"	1	each	9,600.00	9,600
Tee - 24" x 24"	4	each	10,800.00	43,200
Flgd cplg adapters				
24" steel	3	each	2,900.00	8,700
Wall casting, flanged joint				
24"	1	each	4,200.00	4,200
Valves				
AWWA Butterfly				
Electric				
24"	4	each	20,100.00	80,400
Pipe Supports		Lump Sum		30,000
Chemical Feed Relocation				
PVC Sch 80 Piping and Fittings - Fluoride, Corrosion Inhibitor				
1" piping (solvent weld)	200	lin ft	9.00	1,800
1" fittings (solvent weld)	100	each	10.00	1,000
1" BV (motorized)	10	each	3,000.00	30,000
Corporation stops	8	each	300.00	2,400
Plumbing - Equipment drain piping		Lump Sum		5,000
Electrical & Instrumentation		Lump Sum		204,000
Miscellaneous		Lump Sum		272,000
Total - UV Disinfection				$1,496,000

BLACK & VEATCH

Taylor Mill, Kentucy
Northern Kentucky Water District
Taylor Mill Treatment Plant UV Disinfection
Probable Construction Cost
January 4, 2007

Item Description	Quantity	Unit	Unit Cost $	Total Cost $
ELECTRICAL SERVICE				
Demolition & removal		Lump Sum		10,000
Earthwork & Site excavation		Lump Sum		10,000
Fill	600	cu yd	40.00	24,000
Surfacings				
Asphalt pavement	60	sq yd	45.00	2,700
Fencing				
Chain link	205	lin ft	25.00	5,125
Electrical yard accessories				
Duct banks				
Trenching	200	lin ft	15.00	3,000
Concrete encasement	8	cu yd	500.00	4,000
Equipment pads		Lump Sum		5,000
Electrical Vault				
Concrete, cast in place				
Slab on grade	20	cu yd	800.00	16,000
Base slab/footings	12	cu yd	800.00	9,600
Walls	23	cu yd	1,100.00	25,300
Fill	2	cu yd	500.00	1,000
Access Hatch - Bilco	1	each	3,000.00	3,000
Intrusion Alarm on Hatch	1	each	150.00	150
Miscellaneous Electrical (lighting, outlet)		Lump Sun	1,500.00	1,500
Cast Iron Soil Pipe (vault drain)				
4" Piping (bell and spigot)	60	lf	200.00	12,000
Floor grate	1	each	275.00	275
Fittings				
90 bend	1	each	150.00	150
45 bend	1	each	200.00	200
Gaskets	10	each	50.00	500
4" Flap gate	1	each	300.00	300
Switchboard with enclosure		Lump Sum		135,000
Conduit and wiring		Lump Sum		70,000
Miscellaneous		Lump Sum		75,200
Total - Electrical Service				$414,000
UNINTERRUPTIBLE POWER SUPPLY				
Concrete Pad		Lump Sum		2,000
Equipment		Lump Sum		78,000
Conduit and wiring		Lump Sum		10,000
Miscellaneous		Lump Sum		9,000
Total - Uninterruptible Power Supply				$99,000

Case No. 2007-____
Exhibit ____A____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Plans and specifications prepared by Black & Veatch titled "Taylor Mill Treatment Plant UV Disinfection"

Submitted as separate attachments

Northern Kentucky
Water District

The following items are enclosed separately from this volume.

- Plans prepared by Black & Veatch titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006. (5 sets)

- Specifications prepared by Black & Veatch titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006. (5 sets)

2835 Crescent Springs Rd Erlanger, KY 41018 (859) 578-9898 Fax (859) 578-5456

Case No. 2007-00052
Exhibit B

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

CERTIFIED STATEMENTS

Affidavit

Franchises

Plan Review and Permit Status

Easements and Right-of-Way Status

Construction Dates and Proposed Date In Service

Plant Retirements

AFFIDAVIT
Taylor Mill Treatment Plant UV Disinfection

Affiant, Jack Bragg, Jr., being the first duly sworn, deposes and says that he is the Vice President of Finance of the Northern Kentucky Water District, which he is the Applicant in the proceeding styled above; that he has read the foregoing "Taylor Mill Treatment Plant UV Disinfection" Application and knows the contents thereof, and that the same is true of his own knowledge, except as to matters which are therein stated on information or belief, and that is to those matters he believes them to be true.

Jack Bragg, Jr.
Vice President - Finance
Northern Ky. Water District

Subscribed and sworn to before me in said County to be his act and deed by Jack Bragg, Jr., Vice President of Finance of the Northern Kentucky Water District, this 29th day of JANUARY 2007.

NOTARY PUBLIC
Campbell County, Kentucky
My commission expires 1-3-2010

Franchises required – None

Plan Review and Permit Status - The District has reviewed and approved the plans and specifications prepared by Black & Veatch titled "Taylor Mill Treatment Plant UV Disinfection" dated November, 2006.

The District received approval from the Division of Water on October 23, 2006. See attached letter.

Easements and Right-of-Way Status - Easement and Right-of-Way statements are not required.

Start date of construction – assumed April 2007

Proposed date in service – assumed May 2008

Plant retirements –There will be no plant retirements.

Case No. 2007-00052
Exhibit B

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

PLAN REVIEW AND PERMIT STATUS

Approval Letter from Kentucky Division of Water

184-439
permits

ERNIE FLETCHER
GOVERNOR

ENVIRONMENTAL AND PUBLIC PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
14 REILLY ROAD
FRANKFORT, KENTUCKY 40601
www.kentucky.gov

TERESA J. HILL
SECRETARY

October 23, 2006

Amy Kramer, P.E., Design Engineering Manager
Northern Kentucky Water District
2835 Crescent Springs Road
P. O. Box 18640
Erlanger, Kentucky 41018

RE: DW # 0590220-06-042
AI #: 2485
APE #: 20060042
Water Treatment Plant Improvements
Taylor Mill WTP UV Disinfection

Dear Ms. Kramer:

We have completed the review of the plans and specifications for the above referenced project. The plans proposed the Installation of two Ultraviolet (UV) light disinfection reactors (dosage of 40 mJ/cm^2 at plant's peak flow of 12 mgd) between the existing filters and clearwell with appropriate instrumentation. Also, it consists of modification to the existing chemical feed piping and installation of a new combine filter effluent entrance to the clearwell to accommodate the second UV reactor unit. This is to advise that plans and specifications for the above referenced project are APPROVED with respect to sanitary features of design, as of the date of this approval letter, with the following stipulations:

1. The rated capacity of the water treatment plant shall remain at 12.0 MGD. This facility is required to keep the chlorine as the primary disinfectant after filtration and UV system is to be used as a supplemental disinfection only.

2. No bypass line shall be installed for the UV reactor if this facility is approved for Cryptosporidium removal credit.

3. In the 2003 edition of Recommended Standards for Water Works, there is a policy statement on UV light for treatment of public water supplies. UV water treatment devices shall comply with criteria approved by class A criteria under ANSI/NSF Standard 55 – Ultraviolet Microbial Water Treatment Systems. Each UV water treatment device shall meet the following standards:

    a. Ultraviolet radiation at a wavelength of 253.7 nanometers shall be applied at a minimum dose of 40 milijoules per square centimeter (mJ/cm^2) at the failsafe set point at the end of lamp life.

    b. The UV device shall be fitted with a light sensor to safely verify that UV light is being delivered into the reactor.

c. The UV light assembly shall be insulated from direct contact with water by a quartz (or high silica glass with similar optical and strength characteristics) lamp jacket to maintain proper operating lamp temperature.

d. The design and installation of the UV reactor shall ensure that the manufacture's maximum rated flow and pressure cannot be exceeded.

e. The UV assemblies shall be accessible for visual observation, cleaning and replacement of the lamp, lamp jackets and sensor window/lens.

f. A narrow band UV monitoring device shall be provided that is sensitive to germicidal UV light. It shall be accurately calibrated so that it indicates the true irradiance (mJ/cm^2) at 253.7 nanometers and be installed at the location critical for that unit. The device shall trigger an audible alarm in the event the sensor or lamp fails or if insufficient dosage is detected.

g. An automated shutdown valve shall be installed in the water supply line ahead of the UV treatment system that will be activated whenever the water treatment system loses power or is tripped by a monitoring device when the dosage is below its alarm point of 40 mJ/cm^2. When power is not being supplied to the UV unit the valve shall be in a closed (fail safe) position.

h. The UV housing shall be stainless steel 304 or 316L.

3. Adequate supply of UV bulbs shall be kept at the facility site for maintenance purposes.

4. Adequate ventilation and humidity control shall be provided for the UV system control unit.

5. Prior to put into operation, UV system shall be disinfected according to the Kentucky Division of Water's regulations.

6. When this project is completed, the owner shall submit a written certification to the Division of Water that the above referenced water supply facilities have been constructed and tested in accordance with the approved plans and specifications and the above stipulations. Such certification shall be signed by a licensed professional engineer.

This approval has been issued under the provisions of KRS Chapter 224 and regulations promulgated pursuant thereto. Issuance of this approval does not relieve the applicant from the responsibility of obtaining any other permits or licenses required by this Cabinet and other state, federal and local agencies.

Unless construction on this project commences within one year from the date of this approval letter, Northern Kentucky Water District shall request an official extension from the Division of Water prior to the first anniversary of this approval letter, or re-submit the original plans and specifications for a new comprehensive review.

If you have any questions concerning this project, please contact Solitha W.Dharman, PE, at (502) 564-2225, extension 572.

Sincerely,

Donna S. Marlin

Donna S. Marlin, Manager
Drinking Water Branch
Division of Water

DSM: SWD
Enclosures

C: Donnie Ginn, P.E., Project Manager, Black & Veatch
Marissa Albright, P.E., Project Engineer, Black & Veatch
Bari Joslyn, NKWD
Kenton county Health Department
Julie Roney, Supervisor, Technical Assistance Section
Florence Field Office

Case No. 2007-00052
Exhibit C

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

BID INFORMATION AND BOARD RESOLUTION

Bid Tabulation

Engineer's Recommendation of Award

Board Resolution

Northern Kentucky
Water District

ITEMS CONCERNING BID INFORMATION AND BOARD RESOLUTION

- The Bid opening was January 11, 2007 and bid tabulation is attached. Bids will expire April 10, 2007. The project includes improvements to the Taylor Mill Treatment Plant. These improvements are related to the disinfection of filtered water using ultraviolet (UV) light. Additional disinfection is recommended to ensure that the plant continues to meet current and future regulations. A summary of the project costs is provided below:

o Design Engineering	$ 185,000
o Construction Engineering	$ 50,000
o Contractor's Bid	$1 ,200,00
o Misc. & Contingencies	$ 215,000
Total Project Cost	$1,650,000

Total Taylor Mill
Treatment Plant UV Disinfection
$500,000 financed through BOND 2006
$1,150,000 financed through BAN 2007

- The Engineer's Recommendation of Award is attached.

- The Board Resolution from the January 24, 2007 meeting is attached.

Case No. 2007-____
Exhibit ____C____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Bid Tabulation

BID TABULATION

Taylor Mill Treatment Plant Ultraviolet Disinfection Improvements

January 11, 2007

Contractor	Total Bid Amount	Alternate Deduct
Fryman-Kuck	$1,200,000.00	$68,200.00
Building Crafts, Inc.	$1,226,141.00	$60,000.00

Case No. 2007-____
Exhibit ____C____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Engineer's Recommendation of Award

BLACK & VEATCH

11500 Northlake Drive
Suite 205
Cincinnati, Ohio 45249
Tel: 513-984-6630
Fax: 513-984-6686

Black & Veatch Corporation

Northern Kentucky Water District
Taylor Mill Treatment Plant
UV Disinfection

B&V Project 143757
B&V File F
January 19, 2007

Mrs. Amy Kramer, P.E.
Design Engineering Manager
Northern Kentucky Water District
2835 Crescent Springs Road
P.O. Box 18640
Erlanger, KY 41018-0640

Subject: Evaluation of Fryman-Kuck General Contractors, Inc.

Dear Amy:

We have completed our evaluation of the information provided by Fryman-Kuck General Contractors, Inc. (Fryman-Kuck) in regards to the Taylor Mill Treatment Plant – UV Disinfection project. As you are aware, Fryman-Kuck is the apparent low bidder for this project. Subsequent to the bid opening, Black & Veatch (B&V) requested additional information from Fryman-Kuck to assist in the bid evaluation which included a list of ongoing projects with references, company financial summary and financial information, information on any legal affiliation with any other companies or firms, and information on any pending lawsuits or litigation.

We requested in our letter to Fryman-Kuck dated January 10, 2007 that all information be submitted by January 18, 2007. Fryman-Kuck complied with our request and submitted all the information with an original copy by January 16, 2007.

As part of our evaluation process, we contacted several references from the list provided by Fryman-Kuck to gather information on the Owner's and Engineer's experiences with regards to the quality of work, project schedule, change order claims, and overall experience. We found that all the references rated Fryman-Kuck as an above average contractor and were satisfied with Fryman-Kuck's performance. While talking to the references, we found that the quality of work ranged from very good to excellent. Work on past projects was either completed on time or ahead of schedule. Change orders and claims for extra work were reasonable and easily negotiated. Fryman-Kuck was considered easy to work with and responsive. None of the references that we contacted had any negative things to say about Fryman-Kuck.

Fryman-Kuck was the general contractor for the Village of Plain City on their $4.7 million wastewater treatment plant project. Patrick Hickman, the Superintendent, noted that Fryman-Kuck was very experienced and considered Fryman-Kuck as the best contractors he has worked with. He was very impressed at how safe and courteous they were and would recommend them. He also noted that the project was completed 9 months ahead of schedule.

The City of Middletown and the Village of Versailles have also had experience working with Fryman-Kuck on a clarifier rehabilitation project and a new water treatment plant project, respectively. Both commented on Fryman-Kuck being very responsive and cooperative and that they would consider using them again on future projects.

B&V's experience working with Fryman-Kuck has been good as well. B&V worked with Fryman-Kuck on the Centrifuge project for Butler County and the Advanced WWTP Phase 2 project for the City of Dayton. Fryman-Kuck was cooperative on both projects and our overall experience was good.

The information submitted by Fryman-Kuck includes a balance sheet for fiscal years 2005 and 2006, which indicates the company's assets and liabilities. We find the financial summary to be adequate. Additionally, Fryman-Kuck has indicated in their cover letter that it is not currently involved in any litigation or lawsuits and it does not have any legal affiliation with other companies or firms. None of the references that we contacted provided information contrary to Fryman-Kuck's statement regarding lawsuits and liens.

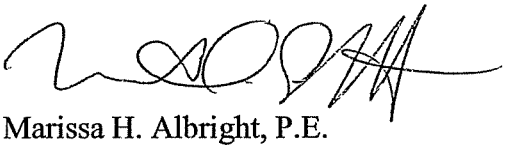
In conclusion, based on our evaluation presented in this letter and previous experience, we recommend that the Construction Contract for the Taylor Mill Treatment Plant – UV Disinfection project be awarded to Fryman-Kuck General Contractors, Inc.

All information submitted by Fryman-Kuck is attached with this letter for your review.

If you have any questions, please do not hesitate to call me at (513) 936-5148.

Very truly yours,

BLACK & VEATCH CORPORATION



Marissa H. Albright, P.E.
Engineering Manager

Enclosures

cc: Bari Joslyn, NKWD
Donnie Ginn, B&V

Case No. 2007-____
Exhibit ____C____

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

Board Resolution

Northern Kentucky Water District
Board of Commissioners Meeting
January 24, 2007

A regular meeting of the Board of Commissioners of the Northern Kentucky Water District was held on January 24, 2007 at the District's facility located at 2835 Crescent Springs Road in Erlanger, Kentucky. All Commissioners were present. Also present were Ron Lovan, Bari Joslyn, Richard Harrison, Mark Lofland, Jack Bragg, Bill Wulfeck, Don Gibson, Amy Kramer, Mary Carol Wagner, Jim Dierig, Frances Robinson, Bob Buhrlage, Todd Fuller, Pam Case, Steve Findley and Charles Pangburn.

Commissioner Koester called the meeting to order.

Mr. Pangburn led those in attendance in the Pledge of Allegiance.

Mr. Harrison and Mr. Fuller of the District staff delivered a presentation to the Board on water main rehabilitation, cleaning and epoxy lining.

The Board recognized and thanked Pam Case and Steve Findley on the occasion of their retirement for their many years of dedicated and faithful service to the District and the community.

The Board reviewed articles published and correspondence received since the last regular Board meeting on November 16, 2006.

On motion of Commissioner Wagner, seconded by Commissioner Collins, the Board unanimously approved the minutes for the regular Board meeting held on November 16, 2006.

On motion of Commissioner Macke, seconded by Commissioner Sommerkamp, and after discussion, the Board unanimously approved the expenditures of the District for the months of November and December, 2006.

On motion of Commissioner Sommerkamp, seconded by Commissioner Collins, and after discussion, the Board unanimously approved two resolutions approving the Contracts to Purchase the District's Kenton Lands Road property and Dixie Highway property and authorizing the Chairman of the Board of Commissioners and the President/CEO to execute any and all documents necessary to facilitate and carry out the transactions contemplated by the two Contracts to Purchase.

On motion of Commissioner Wagner, seconded by Commissioner Sommerkamp, and after discussion, the Board unanimously agreed to authorize the Chairman of the Board of Commissioners and the President/CEO to consent on behalf of the District, at their discretion, to any and all assignments of the Contracts to Purchase the Kenton Lands Road property and the Dixie Highway property.

On motion of Commissioner Collins, seconded by Commissioner Sommerkamp, and after discussion, the Board unanimously approved the attached list of commissioner training courses to satisfy the requirements of KRS 74.020 with respect to commissioner annual training.

On motion of Commissioner Wagner, seconded by Commissioner Jackson, and after discussion, the Board unanimously agreed to award the Narrows Road and Bristow Road water main extension project to Jack Gemmer and Sons and to authorize the District staff to execute appropriate contract documents.

On motion of Commissioner Wagner, seconded by Commissioner Collins, and after discussion, the Board unanimously agreed to reject all bids received for 30" Transition Couplings and to award contracts to the following vendors for the materials indicated for the 36" water main interconnect project along Licking Pike:

Florence Winwater	-36" x 36" x 36"-D.I.M.J. Tee (less normal ductile accessories)
Utility Service & Supply	-36" butterfly valve-250 PSI (less normal ductile accessories)
	-30" butterfly valve-250 psi (less normal ductile accessories)
	-36" mechanical joint wedge type restraint glands-250 psi working pressure (including gaskets & bolts)
	-30" mechanical joint wedge type restraint glands-250 psi working pressure (including gaskets & bolts)
Consolidated Pipe Supply	-30" x 30" x 30" D.I.M.J. Tee (less normal ductile accessories)

On motion of Commissioner Wagner, seconded by Commissioner Collins, and after discussion, the Board unanimously agreed to award the Taylor Mill Treatment Plant ultraviolet disinfection project to Fryman-Kuck and the authorize the District staff to execute appropriate contract documents.

On motion of Commissioner Collins, seconded by Commissioner Jackson, and after discussion, the Board unanimously agreed to increase the project budget for the Ripple Creek pump station improvement project to $240,000.00, to award the project to Winelco, Inc., and to authorize the District staff to execute appropriate contract documents.

On motion of Commissioner Wagner, seconded by Commissioner Collins, and after discussion, the Board unanimously agreed to award the contract for installation services for

Pump No. 4 at the Ohio River intake to Reynolds, Inc. and to authorize the District staff to execute appropriate contract documents.

On motion of Commissioner Collins, seconded by Commissioner Jackson, and after discussion, the Board unanimously agreed to approve the District Policy/Procedure Manual and the District Employee Handbook as the current authorized manual and handbook of the District, canceling all prior versions, and to authorize the President/CEO to make periodic changes to both as he deems appropriate with the requirement that any substantive policy changes be brought to the Board for approval on an annual basis.

The Board considered the election of officers. On motion of Commissioner Macke, seconded by Commissioner Collins, the Board unanimously agreed to elect Commissioner Koester to service as the Chairman of the Board. On motion of Commissioner Koester, seconded by Commissioner Jackson, the Board unanimously agreed to elect Commissioner Collins as the Secretary of the Board. On Motion of Commissioner Macke, seconded by Commissioner Collins, the Board unanimously agreed to elect Commissioner Wagner as the Treasurer of the Board.

The Board reviewed the District's financial reports and Department reports.

Commissioner Jackson departed the meeting.

Mr. Pangburn departed the meeting.

On motion of Commissioner Wagner, seconded by Commissioner Sommerkamp, the Commissioners present unanimously agreed to go into executive session under the provisions of KRS 61.810(1)(f) to discuss a personnel issue.

The Commissioners present returned to open session.

On motion of Commissioner Wagner, seconded by Commissioner Sommerkamp, the Commissioners present unanimously agreed to authorize and direct Commissioner Koester to execute an amendment to Mr. Lovan's employment agreement incorporating changes specified by the Board.

Other matters of a general nature were discussed.

There being no further business to come before the Board, the meeting was adjourned.

_____ _____

CHAIRMAN SECRETARY

Case No. 2007-00052
Exhibit D

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

PROJECT FINANCE INFORMATION

Customers Added and Revenue Effect

Debt Issuance and Source of Debt

Additional Costs for Operating and Maintenance

Depreciation Cost and Debt Service After Construction

There will be zero new customers added and no revenue effect as a result of the Taylor Mill Treatment Plant UV Disinfection Project.

The amount of debt issuance and source is $500,000 from Bond 2006 and $1,150,000 from BAN 2007.

Additional operating and maintenance costs incurred for the project are as follows:

Annual O&M	
Power	$11,000
Materials	$ 8,000
Labor	$ 5,000
License Patent	$24,000
	$48,000

Annual depreciation and debt service after construction are as follows:

Depreciation	$66,000/year over 25 years
Debt Service	$107,250/year over 25 years

WATER UTILITY PLANT CODES
(USED FOR DEPRECIATION)
RESPONSIBLE PERSON: Amy Kramer
SOURCE OF INFORMATION: Black & Veatch January 4, 2007 Cost Estimate

UsoA Accounting Code Description	Code	Engineering	Construction	Contingency	Total
Land and Land Rights (Land, Right-of-Way, Easements)	303	$0			$0
Structures & Improvements (sitework, yard piping, buildings, meters)	304	$62,500	$300,000	$50,000	$412,500
Collecting and Impounding Reservoirs (raw water)	305	$0			$0
Lake, River and Other Intakes (conduit, fence, pipes)	306	$0			$0
Supply Mains (raw water pipe, plant meters, restoration, inspection, valves)	309	$0			$0
Power Generation Equipment	310	$0			$0
Pumping Equipment (motor, pump, instruments, switching, power)	311	$0		$0	$0
Water Treatment Equipment (settling, filter, purification, chemical)	320	$187,500	$900,000	$150,000	$1,237,500
Distribution Reservoirs and Standpipes	330	$0			$0
Transmission and Distribution Mains (pipe, valves, fittings, shut-offs)	331	$0			$0
Services (pipe leading from water main and customer premise)	333	$0			$0
Meters and Meter Installation (meter for water delivered to customer)	334	$0			$0
Hydrants (begins at and includes fitting to connect to main)	335	$0			$0
Backflow Prevention Device	336	$0			$0
Other Plant and Miscellaneous Equipment	339	$0			$0
		$250,000	$1,200,000	$200,000	$1,650,000

Case No. 2007-00052
Exhibit E

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

PSC ANNUAL REPORT - 2005

Water Districts & Associations-Class A&B

Annual Report

Of

Northern Kentucky Water District
2835 Crescent Springs Road
Erlanger, KY 41018

To The

Public Service Commission

Of The

Commonwealth of Kentucky

211 Sower Boulevard
P.O. Box 615
Frankfort, Kentucky 40602

For the Calendar Year Ended December 31, 2005

CHECKLIST FOR THE ANNUAL REPORT

FOR CLASS A AND B WATER DISTRICTS AND WATER ASSOCIATIONS

TO BE COMPLETED AND RETURNED WITH THE ANNUAL REPORT

Page No.	Account No.		Page No.		Yes	No	If No, Explain Why
4-6	The identification pages have been completed				X		
7	101-106	agrees with	13	Total 101-106	X		
7	108-110	agrees with	15	Total 301-348 Cols c & h	X		
7	114-115	agrees with	16	Net Balance 114-115	X		
7	123	agrees with	17	Total 123	X		
7	124-125	agrees with	17	Total 124 and Total 125	X		
7	126	agrees with	17	Total 126	X		
7	127	agrees with	17	Total 127	X		
7	141-144	agrees with	18	Net Balance 141-144	X		
7	151-153	agrees with	19	Total 151-153	X		
7	162	agrees with	19	Total 162	X		
8	181	agrees with	20	Total 181	X		
8	182	agrees with	21	Total 182	X		
8	186	agrees with	20	Total 186	X		
9	214	agrees with	12	Total 214	X		
9	215.1	agrees with	12	Total 215.1	X		
9	215.2	agrees with	12	Total 215.2	X		
9	221	agrees with	23	Total Col 4	X		
9	221	agrees with	23	Total Col 12	X		
9	224	agrees with	22	Total Col f	X		
9	232	agrees with	24	Total 232	X		

CHECKLIST FOR THE ANNUAL REPORT

FOR CLASS A AND B WATER DISTRICTS AND WATER ASSOCIATIONS

TO BE COMPLETED AND RETURNED WITH THE ANNUAL REPORT

Page No.	Account No.		Page No.		Yes	No	If No, Explain Why
9	233	agrees with	24	Total 233	X		
9	234	agrees with	24	Total 234	X		
9	236	agrees with	25	Beginning and Ending Balance 236	X		
9	237	agrees with	25	Total 237 Cols b & e	X		
9	242	agrees with	26	Total 242	X		
9	251	agrees with	20	Total 251	X		
9	252	agrees with	21	Beginning and Ending Balance 252	X		
10	400	agrees with	27	Total Water Operating Revenue Col e	X		
10	401	agrees with	28	Total 601-675, Col c	X		
10	408.1 & 408.2	agrees with	25	Total Taxes Accrued 408.10-408.20	X		
11	427	agrees with	25	Total Interest Accrued Col c	X		
11	Net Income Before Contributions	agrees with	12	Balance Trans From Inc Col c	X		
13	101	agrees with	14	Total Water Plant Col f	X		
14	The analysis of water utility plant accounts Cols c through k has been completed				X		
15	The analysis of accumulated depreciation and amortization by primary account has been completed.				X		
20	186.1	agrees with	26	Total 186.1 Col c	X		
22	Schedule of Long-Term Debt has been completed				X		
23	Schedule of Bond Maturities has been completed				X		
27	Taxes collected (example: school tax, sales tax, franchise tax) have been excluded from Revenue and Expenses				X		
27	The analysis of water operating revenue Cols c, d, and e has been completed.				X		

CHECKLIST FOR THE ANNUAL REPORT

FOR CLASS A AND B WATER DISTRICTS AND WATER ASSOCIATIONS

TO BE COMPLETED AND RETURNED WITH THE ANNUAL REPORT

Page No.	Account No.	Page No.		Yes	No	If No, Explain Why
28	The analysis of water utility expense Cols c through k has been completed.			X		
29	Schedule of Pumping and Purchased Water Statistics has been completed.			X		
29	Total Col (d) agrees with	30	Line 4, Total Produced and Purchased	X		
29	Total Col (e) agrees with	30	Line 13, Total Water Sales	X		
30	466 Total Gals agrees with	30	Line 11, Sales For Resale (466)	X		
	Oath page has been completed.			X		

PUBLIC SERVICE COMMISSION OF KENTUCKY

PRINCIPAL PAYMENT AND INTEREST INFORMATION

FOR THE YEAR ENDING DECEMBER 31, 2005

1. Amount of Principal Payment during calendar year $ 4,674,000

2. Is Principal current? (Yes) X (No) _____

3. Is Interest current? (Yes) X (No) _____

SERVICES PERFORMED BY

INDEPENDENT CERTIFIED PUBLIC ACCOUNTANT

Are your financial statements examined by a Certified Public Accountant?

YES X NO _____

If yes, which service is performed?

Audit X

Compilation _____

Review _____

Please enclose a copy of the accountant's report with annual report.

Additional Requested Information

Utility Name	Northern Kentucky Water District
Contact Person	Jack Bragg, Jr.
Contact Person's E-Mail Address	jbragg@nkywater.org
Utility's Web Address	www.nkywater.org

Additional Information Required by Commission Orders

Provide any special information required by prior commission orders, as well as any narrative explanations necessary to fully explain the data. Examples of the types of Special information that may be required by commission orders include surcharge amounts collected, refunds issued, and unusual debt repayments.

Case No.	Date of Order	Item/Explanation	
96-234	8/26/1996	Merger of Campbell Co. Water District and Kenton Co. Water District No. 1. Effective date of Merger 1/1/97.	
97-330	9/2/1997	Defeasance of the former Campbell Co. KY Water District Bonds. Principal of the Issue	9,630,000
92-482	3/14/1992	Subdistrict A	
		a. Number of Customers as of 12/31/2003	433
		b. Total surcharge billed during 2003	66,918
		c. Accumulated surcharge billed.	1,012,473
		d. Remaining Debt service on debt which NKWD issued to finance facilities.	789,265
94-409	1/26/1995	Subdistrict B	
		a. Number of Customers as of 12/31/2003	262
		b. Total surcharge billed during 2003	62,154
		c. Accumulated surcharge billed.	524,278
		d. Remaining Debt service on debt which NKWD issued to finance facilities.	1,706,371
95-582	2/8/1996	Subdistrict R	
		a. Number of Customers as of 12/31/2003	232
		b. Total surcharge billed during 2003	51,391
		c. Accumulated surcharge billed.	390,284
		d. Remaining Debt service on debt which NKWD issued to finance facilities.	1,091,016
95-582	2/8/1996	Subdistrict RL	
		a. Number of Customers as of 12/31/2003	86
		b. Total surcharge billed during 2003	38,695
		c. Accumulated surcharge billed.	313,969
		d. Remaining Debt service on debt which NKWD issued to finance facilities.	755,488

97-468	9/4/1998	Per itm 7 on the order. See attached exhibit ML 1	
2000-329	7/21/2000	Subdistrict C	
		a. Number of Customers as of 12/31/2003	845
		b. Total surcharge billed during 2003	232,169
		c. Accumulated surcharge billed.	768,790
		d. Remaining Debt service on debt which NKWD issued to finance facilities.	6,769,039
2000-171	5/5/2000	Subdistrict D	
		a. Number of Customers as of 12/31/2003	58
		b. Total surcharge billed during 2003	23,925
		c. Accumulated surcharge billed.	47,910
2001-198	6/27/2001	Defeasance of the former Kenton County Water District Bonds and Newport WW Purchase Principal of the Issue.	45,485,000
2002-00363	10/1/2002	Defeasance of the former Kenton County Water District Bonds. Principal of the Issue.	10,575,000
2002-00468	3/1/2003	Defeasance of 1995 C Bonds with Issuance of 2003 A Bonds	1,615,000
2002-00105	4/30/2003	Water Rate Increase	
2002-00105	6/1/2003	Issue of 2003 B Bonds	30,270,000
2003-00404	12/2/2003	Defeasance of 1993, 1995 A and 1995 B Bonds with the Issuance of 2003 C Bonds	23,790,000

Major Water Projects

Instructions: Provide details about each major water project which is planned but has not yet been submitted for approval to the Public Service Commission. For the limited purpose of this report a "Major Project" is defined as one which is not in the ordinary course of business, and which will increase your current utility plant by at least 20%.

Brief Project Description (improvement, replacement, building construction, expansion. If expansion, provide the estimated number of new customers):

N/A

Projected Costs and Funding Sources/Amounts:

Approval Status: (Application for financial assistance filed, but not approved; or application approved, but have not advertised for construction bids)

Location: (community, area or nearby roads)

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HISTORY

1. Exact name of utility making this report. (Use the words: "The, Company, Incorporated or Incorporated" only when a part of the corporate name.)

   Northern Kentucky Water District

2. Give location including city, street and number, of the executive office:
   2835 Crescent Springs Road
   P.O. Box 18640
   Erlanger, KY 41018

3. Give name, title, address, and telephone number of the officer to whom correspondence concerning this report should be addressed:

   Jack Bragg, Jr.
   P.O. Box 18640, Erlanger, Kentucky 41018

4. Date of organization: **January 1, 1997**

5. If a consolidated or merger company, name all contingent and all merged companies. Give reference to charters or general laws governing each and all amendments of same:

   N/A

6. Date and authority for each consolidation and each merger:

   N/A

7. State whether respondent is a corporation, a joint stock association, a firm or partnership or an individual:

   Non-profit water utility
   Special District – State of Kentucky

8. Name all other operating departments:

N/A

9. Name of counties in which you furnish water service:

Campbell County, Kenton County, Boone County
Wholesale: Pendleton County

Report of: **Northern Kentucky Water District**
For Year Ended: **2005**
Location where books and records are located: **2835 Crescent Springs Road Erlanger, KY 41018**

Contacts:

Name	Title	Principal Business Address	Salary Charged Utility	Current Term Expires
Send correspondence to: Jack Bragg, Jr.	V.P. Finance	2835 Crescent Springs Rd. P.O. Box 18640 Erlanger, KY 41018	xxxxx	xxxxx
Report prepared by: Jack Bragg, Jr.	V.P. Finance	Same as above	xxxxx	xxxxx
Officers and Managers				
Douglas Wagner	Chair	Same as above	6,000.00	8/26/2009
Andrew Collins	Treasurer	Same as above	6,000.00	8/28/2007
Joseph Koester	Secretary	Same as above	6,000.00	7/26/2008
Dr. Patricia Sommerkamp	Commissioner	Same as above	6,000.00	8/21/2009
Fred A. Macke, Jr.	Commissioner	Same as above	6,000.00	8/29/2008
Frank Jackson	Commissioner	Same as above	6,000.00	8/28/2007
C. Ronald Lovan	President/CEO	Same as above	xxxxx	xxxxx
All Commissioners have completed six hours of training.				

COMPARATIVE BALANCE SHEET - ASSETS AND OTHER DEBITS

Account No. (a)	Account Name (b)	Ref. Page ©	Previous Year (d)	Current Year (e)
	UTILITY PLANT			
101-106	Utility Plant	13	$ 251,475,930	$ 268,102,484
108-110	Less: Accumulated Depreciation and Amortization	13,15-16	(48,288,707)	(53,201,141)
	Net Plant		$ 203,187,223	$ 214,901,343
114-115	Utility Plant Acquisition Adjustments (Net)	16	4,469,711	4,268,591
116	Other Utility Plant Adjustments			
	Total Net Utility Plant		$ 207,656,934	$ 219,169,934
	OTHER PROPERTY & INVESTMENTS			
121	Nonutility Property		$	$
122	Less: Accumulated Depreciation and Amortization			
	Net Nonutility Property		$	$
123	Investment in Asso. Companies	17		
124	Utility Investments	17	21,535,260	21,911,383
125	Other Investments	17	3,680,638	3,783,211
126-127	Special Funds	17		
	Total Other Property & Investments		$ 25,215,898	$ 25,694,594
	CURRENT AND ACCRUED ASSETS			
131	Cash		$ 831,017	$ 3,909,589
132	Special Deposits			
133	Other Special Deposits		11,453,379	17,997,953
134	Working Funds			
135	Temporary Cash Investments			
141-144	Accounts Receivable, Less Accumulated Provision for Uncollectible Accounts	18	4,717,008	3,732,614
145	Accounts Receivable from Associated Companies			
146	Notes Receivable from Associated Companies			
151-153	Materials & Supplies	19	1,241,337	1,150,975
161	Stores Expense			
162	Prepayments	19	2,894,399	2,340,939
171	Accrued Interest & Dividends Receivable			
172	Rents Receivable			
173	Accrued Utility Revenues		4,900,000	4,900,000
174	Misc. Current & Accrued Assets			
	Total Current & Accrued Assets		$ 26,037,140	$ 34,032,070

COMPARATIVE BALANCE SHEET - ASSETS AND OTHER DEBITS (CONT'D)

Account No. (a)	Account Name (b)	Ref. Page c	Previous Year (d)	Current Year (e)
	DEFERRED DEBITS			
181	Unamortized Debt Discount & Expense	20	$ 3,045,263	$ 2,956,387
182	Extraordinary Property losses	21		
183	Preliminary Survey & Investagation Charges			
184	Clearing Accounts			
185	Temporary Facilities			
186	Misc. Deferred Debits	20	5,216,390	6,924,182
187	Research & Development Expenditures			
	Total Deferred Debits		$ 8,261,653	$ 9,880,569
	TOTAL ASSETS AND OTHER DEBITS		$ 267,365,378	$ 288,777,167

COMPARATIVE BALANCE SHEET - EQUITY CAPITAL AND LIABILITIES

Account No. (a)	Account Name (b)	Ref. Page c	Previous Year (d)	Current Year (e)
	Equity Capital			
214	Appropriated Retained Earnings	12	$ 31,029,357	$ 39,336,654
215.1	Retained Earnings from Income Before Contributions	12	$ 30,416,476	$ 25,534,918
215.2	Donated Capital	12	$ 40,195,514	$ 43,095,791
	Total Equity Capital		$ 101,641,347	$ 107,967,363
	LONG-TERM DEBT			
221	Bonds	23	$ 153,125,000	$ 148,701,000
222	Reacquired Bonds			
223	Advances from Asso. Companies			
224	Other Long-Term Debt	22	2,625,000	2,375,000
	Total Long-Term Debt		$ 155;750,000	$ 151,076,000
	CURRENT & ACCRUED LIABILITIES			
231	Accounts Payable		$ 1,799,189	$ 3,620,486
232	Notes Payable	24	3,705,000	21,685,000
233	Acts. Payable to Asso. Co.	24		
234	Notes Payable to Asso. Co.	24		
235	Customer Deposits		2,250	2,949
236	Accrued Taxes	25		
237	Accrued Interest	25	2,593,452	2,737,097
239	Matured Long-Term Debt			
240	Matured Interest			
241	Tax Collections Payable			
242	Misc. Current & Accrued Liabilities	26	1,810,263	1,629,323
	Total Current & Accrued Liabilities		$ 9,910,154	$ 29,674,855
	DEFERRED CREDITS			
251	Unamortized Premium on Debt	20	$ 63,877	$ 58,949
252	Advances for Construction	21		
253	Other Deferred Credits			
	Total Deferred Credits		63,877	58,949
	OPERATING RESERVES			
	Accumulated Provision for:			
261	Property Insurance		$	$
262	Injuries & Damages			
263	Pensions & Benefits			
265	Miscellaneous Operating Reserves			
	Total Operating Reserves		$	$
	TOTAL EQUITY CAPITAL & LIABILITIES		$ 267,365,378	$ 288,777,167

COMPARATIVE OPERATING STATEMENT

Acct. No. (a)	Account Name (b)	Ref. Page c	Previous Year (d)	Current Year (e)
	Utility Operating Income			
400	Operating Revenues	27	$ 32,185,250	$ 34,846,622
401	Operating Expenses	28	$ 19,429,652	$ 20,479,276
403	Depreciation Expenses		5,128,169	5,361,019
406	Amortization of Utility Plant Acquisition Adjustment		201,120	201,120
407	Amortization Expense		378,960	378,960
408.1	Taxes Other Than Income	25	519,707	544,011
	Utility Operating Expenses		$ 25,657,608	$ 26,964,386
	Utility Operating Income		$ 6,527,642	7,882,236
413	Income From Utility Plant Leased to Others			
414	Gains (Losses) From Disposition of Utility Property		-	(7,249)
	Total Utility Operating Income		$ 6,527,642	$ 7,874,987
	Other Income and Deductions			
415	Revenues From Merchandising, Jobbing and Contract Deductions		$	$
416	Costs and Expenses of Merchandising, Jobbing and Contract Work			
419	Interest & Dividend Income		791,405	1,862,615
420	Allowance for Funds Used During Construciton			
421	Nonutility Income		31,138	12,681
426	Miscellaneous Nonutility Expense			
	Total Other Income & Deductions		$ 822,543	1,875,296
	TAXES APPLICABLE TO OTHER INCOME			
408.2	Taxes Other Than Income		$	$
	Total Taxes Applic. To Other Income		$	$

COMPARATIVE OPERATING STATEMENT

Acct. No. (a)	Account Name (b)	Ref. Page c	Previous Year (d)	Current Year (e)
	Utility Operating Income			
400	Operating Revenues	27	$ 32,185,250	$ 34,846,623
401	Operating Expenses	28	$ 19,429,652	$ 20,479,098
403	Depreciation Expenses		5,128,169	5,361,019
406	Amortization of Utility Plant Acquisition Adjustment		201,120	201,120
407	Amortization Expense		378,960	378,960
408.1	Taxes Other Than Income	25	519,707	544,011
	Utility Operating Expenses		$ 25,657,608	$ 26,964,208
	Utility Operating Income		$ 6,527,642	7,882,415
413	Income From Utility Plant Leased to Others			
414	Gains (Losses) From Disposition of Utility Property		-	(7,249)
	Total Utility Operating Income		$ 6,527,642	$ 7,875,166
	Other Income and Deductions			
415	Revenues From Merchandising, Jobbing and Contract Deductions		$	$
416	Costs and Expenses of Merchandising, Jobbing and Contract Work			
419	Interest & Dividend Income		791,405	1,862,615
420	Allowance for Funds Used During Construciton			
421	Nonutility Income		31,138	12,681
426	Miscellaneous Nonutility Expense			
	Total Other Income & Deductions		$ 822,543	1,875,296
	TAXES APPLICABLE TO OTHER INCOME			
408.2	Taxes Other Than Income		$	$
	Total Taxes Applic. To Other Income		$	$

$ +174 transporta

COMPARATIVE OPERATING STATEMENT - Continued

Account No. (a)	Account Name (b)	Ref. Page ©	Previous Year (d)	Current Year (e)
	INTEREST EXPENSE			
427	Interest Expense		$ 5,344,406	$ 6,126,890
428	Amortization of Debt Discount & Exp.		150,663	202,582
429	Amortization of Premiun on Debt		4,928	4,928
	Total Interest Expense		$ 5,490,141	$ 6,324,544
	EXTRAORDINARY ITEMS			
433	Extraordinary Income		$	$
434	Extraordinary Deductions			
	Total Extraordinarly Items		$ -	$ -
	NET INCOME		$ 1,860,044	$ 3,425,739

Statement of Retained Earnings

ACCT. No. (a)	(b)	Amount (c)
214	Appropriated Retained Earnings (state balance and purpose of each appropriated amount at year end):	
	Bond Proceeds	$ 17,242,047
	Debt Service and Reserve	$ 19,020,505
	Improvement, Repair and Replacement	$ 3,074,102
	Total Appropriated Retained Earnings	$ 39,336,654
215.1	Retained Earnings From Income Before Contributions:	
	Balance Beginning of Year	$ 30,416,472
435	Balance Transferred from Net Income Before Contributions	$ 3,425,739
	Other Changes to Account:	
436	Appropriations of Retained Earnings	$ (8,307,293)
439	Adjustments to Retained Earnings (requires Commission approval prior to use):	
	Credits (explain)	$
	Debits (explain)	$
	Balance End of Year	$ 25,534,918

215.2	Donated Capital:	Tapping Fees	Grants	Other	Total
	Balance Beginning of Year	4,735,018	5,759,358	29,701,138	40,195,514
	Credits:				
432	Proceeds from capital contributions	1,007,222	374,015	1,519,040	2,900,277
	Other Credits (explain)				
	Debits: (explain - Requires Commission Approval)				
	Balance End of Year	5,742,240	6,133,373	31,220,178	43,095,791

NET UTILITY PLANT (ACCTS. 101 - 106)

Account No.	Plant Accounts	Total
101	Utility Plant in Service	$ 248,118,189
102	Utility Plant Leased to Others	
103	Property Held for Future Use	
104	Utility Plant Purchased of Sold	
105	Construction Work in Progress	19,984,295
106	Completed Construction Not Classified	
	Total Utility Plant	$ 268,102,484

ACCUMULATED DEPRECIATION (ACCT. 108)

Description	Total
Balance first of year	$ 48,288,707
Credit during year:	
Accruals Charged to Account 108.1	5,361,019
Accruals Charged to Account 108.2	
Accruals Charged to Account 108.3	
Accruals Charged to Other Accounts (specify)	
Salvage	
Other Credits (specify)	
Total Credits	$ 5,361,019
Debits during year:	
Book Cost of Plant Retired	$ 448,585
Cost of Removal	
Other Debits (specify)	
Total Debits	$ 448,585
Balance end of year	$ 53,201,141

Water Utility Plant Accounts

Acct. No. Acct.	Account Name b	Previous Year Year c	Additions d	Retirement e	Current Year f	Intangible Plant g	Source of Supply & Pumping h	WT Plant i	Trans. & Distribu Plant J	General Plant K
301	Organization	$								
302	Franchises									
303	Land and Land Rights	605,416	-	-	605,416		29,200	72,496	205,403	298,317
304	Structure & Improvements	65,516,438	202,104		65,718,542		16,869,144	35,671,419	7,661,242	5,516,737
305	Collecting & Impounding Reservoirs									
306	Lake River & Other Intakes	1,524,592			1,524,592		1,524,592			
307	Wells & Springs									
308	Infiltration on Galleries & Tunnels									
309	Supply Mains	2,307,853			2,307,853		2,307,853			
310	Power Generation Equipment									
311	Pumping Equipment	8,661,832	19,805	4,666	8,676,971		2,496,219	833,197	5,347,555	
320	Water Treatment Equipment	9,285,428	181,449	750	9,466,127			9,466,127		
330	Distributuion Reservoirs & Standpipes	7,500,741			7,500,741				7,500,741	
331	Transmission & Distributuion Mains	-			-					
333	Services	106,184,511	4,360,534	418,823	110,126,222				110,126,222	
334	Meters & Meter Installation	18,787,274	868,458		19,655,732				19,655,732	
335	Hydrants	6,537,668	542,601		7,080,269				7,080,269	
339	Other Plant & Misc. Equipment	4,550,842	458,146		5,008,988				5,008,988	
340	Office Furniture & Equipment	3,374,076	12,708	1,683	3,385,101					3,385,101
341	Transportation Equipment	2,352,529	187,553	18,954	2,521,128					2,521,128
342	Stores Equipment	2,512,074	249,256	157,485	2,603,845					2,603,845
343	Tools, Shop & Garage Equip.									
344	Laboratory Equipment	284,376	-		284,376					284,376
345	Power Operated Equipment	-	60,600	-	60,600					60,600
346	Communication Equipment	542,549	158,059		700,608					700,608
347	Miscellaneous Equipment									
348	Other Tangible Plant	891,078			891,078					891,078
	Total Water Plant	241,419,277	7,301,272	602,361	248,118,189	-	23,227,008	46,043,239	162,586,152	16,261,790

Analysis of Accumulated Depreciation and Amortization by Primary Account

Acct. No. (a)	Account (b)	Balance Beginning of Year c	Credits During the Year		Charges During The Year		Balance End of Year (h)
			Charges to Dep. Exp. (d)	Other Credits (e)	Plant Retirements (f)	Other Charges (g)	
301	Organization	$	$	$	$	$	$
302	Franchises						
303	Limited Term Interest in Land and Land Rights						
304	Structures & Improvements	11,350,180	1,636,856		64		12,986,973
305	Collecting & Impounding Reservoirs						
306	Lake River & Other Intakes	601,663	77,488				679,151
307	Wells & Srpings						
309	Supply Mains	339,414	23,312				362,726
310	Power Generating Equip.						
311	Pumping Equipment	3,408,410	378,605		1,711		3,785,305
320	Water Treatment Equip.	2,717,676	401,104		750		3,118,030
330	Distribution Reservoirs & Standpipes	2,542,407	133,754				2,676,161
331	Transmissions & Distribution Mains	12,557,965	1,178,856		272,235		13,464,586
333	Services	5,832,871	402,138				6,235,009
334	Meters & Meter Installations	1,490,420	163,288				1,653,708
335	Hydrants	1,193,249	95,598				1,288,847
339	Other Plant & Misc. Equip.	1,143,633	327,355		1,666		1,469,322
340	Office Furniture & Equip.	1,756,251	242,311		14,676		1,983,886
341	Transportation Equip.	1,833,191	228,190		157,485		1,903,896
342	Service Equipment	-					
343	Tools, Shop & Garage Equip.	273,713	3,348				277,061
344	Shop Equipment	-					
345	Power Operated Equip.	398,481	50,127				448,608
346	Telecommunication Equipment	-					
347	Scada	-					
348	Other Tangible Plant	849,183	18,691				867,874
	Totals	$ 48,288,707	$ 5,361,019	$ -	$ 448,585	$ -	$ 53,201,141

ACCUMULATED AMORTIZATION (ACCT. 110)

Description	Total
Balance first of year	$ N/A
Credit during year:	
Accruals Charged to Account 110.1	$
Accruals Charged to Account 110.2	
Other Accruals (specify)	
Total Credits	$
Debits during year:	
Book Cost of Plant Retired	$
Other Debits (specify)	
Total Debits	$
Balance end of year	$

UTILITY PLANT ACQUISITION ADJUSTMENT (ACCTS. 114 - 115)

Report each acquisition adjustment and related accumulated amortization separately.
For any acquisition adjustment approved by the Commission, include the Order Number.

ACCOUNT NAME	TOTAL
Acquisition Adjustments (114)	
Original District 9-14-55	$ 263,366
District # 2 & 3 12-31-73	18,712
Mentor District 9-1-76	10,741
City of Cold Spring	228,253
City of Silver Grove	24,853
Newport Water Works	4,970,211
Total Plant Acquisition Adjustments	$ 5,516,136
Accumulated Amortization (115)	
Original District 9-14-55	$ 263,366
District # 2 & 3 12-31-73	18,712
Mentor District 9-1-76	10,741
City of Cold Spring	228,253
City of Silver Grove	24,853
Newport Water Works	701,620
Total Accumulated Amortization	$ 1,247,545
Net Acquisition Adjustments	$ 4,268,591

Investments and Special Funds (Acct. 123-127)

Report hereunder all investments and special funds carried in Account 123-127.

Description of Security or Special Fund (a)	Face or Par Value (b)	Year-End Book Cost c
Investment In Associated Companies (Acct. 123):		
	$	$
Total Investment in Asso. Companies		$
Utility Investments (Acct. 124):		
IRR Account	$	$ 3,074,102
Debt Service Account		6,547,631
Debt Service Reserve Account		12,289,650
Total Utility Investments		$ 21,911,383
Other Investments (Acct. 125):		
Boone County/Florence KY Settlement	$	$ 3,783,211
Total Other Investments:	$	$ 3,783,211
Special Funds (Acct. 126 & 127):		
Prepayment Reserve		
Total Special Funds		$ -

ACCOUNTS AND NOTES RECEIVABLE - NET (ACCOUNTS 141 - 144)

Report hereunder all accounts and notes receivable included in Accounts 141,142,and 144. Amounts included in Accounts 142 and 144 should be listed individually.

Description			Total
ACCOUNTS & NOTES RECEIVABLE:			
Customer Accounts Receivable (Acct. 141)			$ 3,681,014
Other Accounts Receivable (Acct. 142)			
Assessments	$	37,767	
Other		13,832	
			51,600
Notes Receivable (Acct. 144)			
	$		
Total Accounts and Notes Receivable			$ 3,732,614
Accumulated Provision for Uncollectable Accounts (Acct. 143)			
Balance first of year	$	-	
Add: Provision for uncollectables for current year	$		
Collections fo accounts previously written off			
Utility accounts			
Others			
Total Additions	$		
Deduct accounts written off during year:			
Utility Accounts	$		
Other			
Total accounts written off	$		
Balance end of year			$ -
Total Accounts and Notes Receivable			$ 3,732,614

Materials and Supplies (151 - 153)

Account Name	Total
Plant Materials and Supplies (Account 151)	$ 1,150,975
Merchandise (Account 152)	
Other Materials and Supplies (Account 153)	
Total Materials & Supplies	$ 1,150,975

Prepayments (Acct. 162)

Description	Total
Prepaid Insurance	$ 134,674
Prepaid Rents	
Prepaid Interest	
Prepaid Taxes	
Other Prepayments (Specify)	
Expenses/Services	$ 110,375
Water Tower Painting	2,095,890
Total Prepayments	$ 2,340,939

Miscellaneous Deferred Debits (Acct. 186)

Description	Total
Miscellaneous Deferred Debits (Acct. 186):	
Deferred Rate Case Expense 2003-2004	211,582.69
Deferred Rate Case Expense 2004-2006	26,874.69
Other Deferred Debits	6,685,725
Total Miscellaneous Deferred Debits	$ 6,924,182.10

Unamortized Debt Discount & Expense & Premium on Debt (Accts. 181 & 251)

Report the net discount & expense or premium separately for each security issue.

Description	Amount Written Off During Year	Year-End Balance
Unamortized Debt Discount & Expense (Acct. 181)		
Bond Issue Cost 1997	$ 4,916	$ 82,748
Bond Discount 1997	6,735	113,373
Bond Discount 1998	7,570	173,479
Bond Issue Costs 1998	3,147	72,137
Cost of Issue 2001 Bond	3,699	77,084
Discount 2001 Bond	13,038	271,636
Cost of Issue 2002 A	13,731	289,495
Bond Discount 2002 A	27,209	573,657
Cost of Issue 2002 B	9,300	111,214
Cost of Issue 2003 A	1,620	40,790
Bond Discount 2003 A	1,087	28,366
Cost of Issue 2003 B	11,760	262,670
Bond Discount 2003 B	8,520	190,993
Cost of Issue 2003 C	14,940	217,833
Discount 2003 C	7,404	104,297
Cost of issue 2004A BAN	11,004	2,743
Discount 2004A BAN	7,824	1,954
Cost of issue 2004A Bonds	3,252	77,456
Discount 2004A Bond	7,920	188,662
Cost of issue 2005A BAN	14,648	29,294
Discount 2005 BAN	23,256	46,506
Total Unamortized Debt Discount & Expense	**$ 202,580**	**$ 2,956,387**
Unamortized Premium on Debt (Acct. 251):		$
Premium on 2002 B Bond	63,877	58,949
Total Unamortized Premium on Debt	$ 63,877	$ 58,949

Miscellaneous Deferred Debits (Acct. 186)

Description	Total
Miscellaneous Deferred Debits (Acct. 186):	
Deferred Rate Case Expense 2002-2003	$ 72,543
Deferred Rate Case Expense 2003-2004	103,450
Deferred Rate Case Expense 2004-2006	211,583
Other Deferred Debits	6,536,606
Total Miscellaneous Deferred Debits	$ 6,924,182

Unamortized Debt Discount & Expense & Premium on Debt (Accts. 181 & 251)

Report the net discount & expense or premium separately for each security issue.

Description	Amount Written Off During Year	Year-End Balance
Unamortized Debt Discount & Expense (Acct. 181)		
Bond Issue Cost 1997	$ 4,916	$ 82,748
Bond Discount 1997	6,735	113,373
Bond Discount 1998	7,570	173,479
Bond Issue Costs 1998	3,147	72,137
Cost of Issue 2001 Bond	3,699	77,084
Discount 2001 Bond	13,038	271,636
Cost of Issue 2002 A	13,731	289,495
Bond Discount 2002 A	27,209	573,657
Cost of Issue 2002 B	9,300	111,214
Cost of Issue 2003 A	1,620	40,790
Bond Discount 2003 A	1,087	28,366
Cost of Issue 2003 B	11,760	262,670
Bond Discount 2003 B	8,520	190,993
Cost of Issue 2003 C	14,940	217,833
Discount 2003 C	7,404	104,297
Cost of issue 2004A BAN	11,004	2,743
Discount 2004A BAN	7,824	1,954
Cost of issue 2004A Bonds	3,252	77,456
Discount 2004A Bond	7,920	188,662
Cost of issue 2005A BAN	14,648	29,294
Discount 2005 BAN	23,256	46,506
Total Unamortized Debt Discount & Expense	**$ 202,580**	**$ 2,956,387**
Unamortized Premium on Debt (Acct. 251):		$
Premium on 2002 B Bond	63,877	58,949
Total Unamortized Premium on Debt	$ 63,877	$ 58,949

EXTRAORDINARY PROPERTY LOSSES (ACCT. 182)

Report each item separately.

Description	Total
Extraordinary Property Losses (Acct. 182) :	
N/A	$
	$
	$
	$
Total Extraordinary Property Losses	$

ADVANCES FOR CONSTRUCTION (ACCT. 252)

DESCRIPTION N/A	TOTAL
Balance first of year.....	$
Add credits during year.....	$
Deduct charges during year.....	$
Balance end of year.....	$

LONG TERM DEBT (ACCT. 224)

Description of Obligation and Amount of Original Issue (a)	Date of Issue (b)	Date of Maturity (c)	Interest Expense for Year		Principal Per Balance Sheet Date (f)
			Rate (d)	Amount (e)	
Notes Payable Taylor Mill	Mar-04	7/1/2018	0		2,375,000
Total long term Debt				-	2,375,000

Northern Kentucky Water Service District

Attachment 22A

Bond Issue: 11,225,000 , Dated September 1, 1997

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	1998	4.700%	210,000.00	210,000.00	
Registered	1999	4.700%	580,000.00	580,000.00	
Registered	2000	4.700%	610,000.00	610,000.00	
Registered	2001	4.700%	640,000.00	640,000.00	
Registered	2002	4.700%	670,000.00	670,000.00	
Registered	2003	4.700%	700,000.00	700,000.00	
Registered	2004	4.700%	735,000.00	735,000.00	
Registered	2005	4.700%	770,000.00	770,000.00	
Registered	2006	4.700%	810,000.00		810,000.00
Registered	2007	4.700%	850,000.00		850,000.00
Registered	2008	4.750%	890,000.00		890,000.00
Registered	2009	4.750%	930,000.00		930,000.00
Registered	2010	4.750%	975,000.00		975,000.00
Registered	2011	4.750%	1,025,000.00		1,025,000.00
Registered	2012	4.750%	60,000.00		60,000.00
Registered	2013	4.750%	60,000.00		60,000.00
Registered	2014	4.750%	65,000.00		65,000.00
Registered	2015	4.750%	70,000.00		70,000.00
Registered	2016	4.750%	70,000.00		70,000.00
Registered	2017	4.750%	75,000.00		75,000.00
Registered	2018	4.750%	80,000.00		80,000.00
Registered	2019	4.750%	80,000.00		80,000.00
Registered	2020	4.750%	85,000.00		85,000.00
Registered	2021	4.750%	90,000.00		90,000.00
Registered	2022	4.750%	95,000.00		95,000.00
TOTALS			11,225,000.00	4,915,000.00	6,310,000.00

Northern Kentucky Water Service District

Attachment 22-B

Bond Issue: 11,355,000 Dated December 1, 1998

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	02/01/1999	4.700%	250,000.00	250,000.00	
Registered	02/01/2000	4.700%	200,000.00	200,000.00	
Registered	02/01/2001	4.700%	200,000.00	200,000.00	
Registered	02/01/2002	4.700%	210,000.00	210,000.00	
Registered	02/01/2003	4.700%	220,000.00	220,000.00	
Registered	02/01/2004	4.700%	230,000.00	230,000.00	
Registered	02/01/2005	4.700%	240,000.00	240,000.00	
Registered	02/01/2006	4.700%	255,000.00		255,000.00
Registered	02/01/2007	4.700%	265,000.00		265,000.00
Registered	02/01/2008	4.750%	280,000.00		280,000.00
Registered	02/01/2009	4.750%	280,000.00		280,000.00
Registered	02/01/2010	4.750%	295,000.00		295,000.00
Registered	02/01/2011	4.750%	310,000.00		310,000.00
Registered	02/01/2012	4.750%	325,000.00		325,000.00
Registered	02/01/2013	4.800%	340,000.00		340,000.00
Registered	02/01/2014	4.850%	360,000.00		360,000.00
Registered	02/01/2015	4.875%	375,000.00		375,000.00
Registered	02/01/2016	4.875%	395,000.00		395,000.00
Registered	02/01/2017	4.875%	415,000.00		415,000.00
Registered	02/01/2018	4.875%	435,000.00		435,000.00
Registered	02/01/2019	4.875%	455,000.00		455,000.00
Registered	02/01/2020	4.875%	480,000.00		480,000.00
Registered	02/01/2021	4.875%	505,000.00		505,000.00
Registered	02/01/2022	4.875%	530,000.00		530,000.00
Registered	02/01/2023	4.875%	555,000.00		555,000.00
Registered	02/01/2024	4.875%	585,000.00		585,000.00
Registered	02/01/2025	4.875%	610,000.00		610,000.00
Registered	02/01/2026	4.875%	645,000.00		645,000.00
Registered	02/01/2027	4.875%	675,000.00		675,000.00
Registered	02/01/2028	4.875%	435,000.00		435,000.00
TOTALS			11,355,000.00	1,550,000.00	9,805,000.00

Northern Kentucky Water Service District					Attachment 22-C
FhMA Load 2,287,000		2000			
Year	Maturity Date	Interest Rate	Principle Amount	Principle Paid	Outstanding
2000			0.00	0.00	
2001			0.00	0.00	
2002			21,000.00	21,000.00	
2003			22,000.00	22,000.00	
2004			24,000.00	24,000.00	
2005			24,000.00	24,000.00	
2006			26,000.00		26,000.00
2007			27,000.00		27,000.00
2008			28,000.00		28,000.00
2009			30,000.00		30,000.00
2010			31,000.00		31,000.00
2011			33,000.00		33,000.00
2012			34,000.00		34,000.00
2013			36,000.00		36,000.00
2014			38,000.00		38,000.00
2015			40,000.00		40,000.00
2016			42,000.00		42,000.00
2017			44,000.00		44,000.00
2018			46,000.00		46,000.00
2019			49,000.00		49,000.00
2020			51,000.00		51,000.00
2021			54,000.00		54,000.00
2022			56,000.00		56,000.00
2023			59,000.00		59,000.00
2024			62,000.00		62,000.00
2025			65,000.00		65,000.00
2026			68,000.00		68,000.00
2027			72,000.00		72,000.00
2028			75,000.00		75,000.00
2029			79,000.00		79,000.00
2030			83,000.00		83,000.00
2031			87,000.00		87,000.00
2032			92,000.00		92,000.00
2033			96,000.00		96,000.00
2034			102,000.00		102,000.00
2035			107,000.00		107,000.00
2036			112,000.00		112,000.00
2037			118,000.00		118,000.00
2038			124,000.00		124,000.00
2039			130,000.00		130,000.00
TOTALS	0.00	0.00	2,287,000.00	91,000.00	2,196,000.00

Northern Kentucky Water Service District

Attachment 22-D

Bond Iusse $16,325,000.00 Dated 10-23-2001

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	2/1/2002	2.700%	285,000.00	285,000.00	
Registered	2/1/2003	3.000%	235,000.00	235,000.00	
Registered	2/1/2004	3.250%	240,000.00	240,000.00	
Registered	2/1/2005	3.450%	230,000.00	230,000.00	
Registered	2/1/2006	3.600%	215,000.00		215,000.00
Registered	2/1/2007	3.750%	195,000.00		195,000.00
Registered	2/1/2008	3.900%	170,000.00		170,000.00
Registered	2/1/2009	4.000%	155,000.00		155,000.00
Registered	2/1/2010	4.100%	75,000.00		75,000.00
Registered	2/1/2011	4.200%	80,000.00		80,000.00
Registered	2/1/2012	4.350%	80,000.00		80,000.00
Registered	2/1/2013	4.450%	735,000.00		735,000.00
Registered	2/1/2014	4.550%	770,000.00		770,000.00
Registered	2/1/2015	4.670%	810,000.00		810,000.00
Registered	2/1/2016	4.750%	845,000.00		845,000.00
Registered	2/1/2017	4.820%	890,000.00		890,000.00
Registered	2/1/2018	4.850%	930,000.00		930,000.00
Registered	2/1/2019	4.900%	980,000.00		980,000.00
Registered	2/1/2020	4.950%	1,030,000.00		1,030,000.00
Registered	2/1/2021	5.000%	1,080,000.00		1,080,000.00
Registered	2/1/2022	5.000%	1,135,000.00		1,135,000.00
Registered	2/1/2023	5.000%	1,195,000.00		1,195,000.00
Registered	2/1/2024	5.100%	1,255,000.00		1,255,000.00
Registered	2/1/2025	5.100%	1,320,000.00		1,320,000.00
Registered	2/1/2026	5.100%	1,390,000.00		1,390,000.00
TOTALS			16,325,000.00	990,000.00	15,335,000.00

Northern Kentucky Water Service District

Attachment 22-E

Bond Iusse $45,485,000.00 Dated 2/1/2002

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	2/1/2003				
Registered	2/1/2003	4.50%	350,000.00	350,000.00	
Registered	2/1/2004	4.50%	345,000.00	345,000.00	
Registered	2/1/2005	4.50%	360,000.00	360,000.00	
Registered	2/1/2006	4.50%	370,000.00		370,000.00
Registered	2/1/2007	4.50%	380,000.00		380,000.00
Registered	2/1/2008	4.50%	410,000.00		410,000.00
Registered	2/1/2009	4.50%	365,000.00		365,000.00
Registered	2/1/2010	4.50%	465,000.00		465,000.00
Registered	2/1/2111	4.50%	485,000.00		485,000.00
Registered	2/1/2012	4.50%	1,530,000.00		1,530,000.00
Registered	2/1/2013	4.50%	950,000.00		950,000.00
Registered	2/1/2114	4.50%	990,000.00		990,000.00
Registered	2/1/2115	4.65%	1,035,000.00		1,035,000.00
Registered	2/1/2116	4.75%	1,100,000.00		1,100,000.00
Registered	2/1/2117	4.75%	1,625,000.00		1,625,000.00
Registered	2/1/2118	4.75%	2,520,000.00		2,520,000.00
Registered	2/1/2119	4.75%	2,640,000.00		2,640,000.00
Registered	2/1/2020	5.00%	3,080,000.00		3,080,000.00
Registered	2/1/2021	5.00%	3,240,000.00		3,240,000.00
Registered	2/1/2022	5.00%	3,405,000.00		3,405,000.00
Registered	2/1/2023	5.00%	3,580,000.00		3,580,000.00
Registered	2/1/2024	5.00%	3,765,000.00		3,765,000.00
Registered	2/1/2025	5.00%	3,960,000.00		3,960,000.00
Registered	2/1/2026	5.00%	4,160,000.00		4,160,000.00
Registered	2/1/2027	5.00%	4,375,000.00		4,375,000.00
TOTALS			45,485,000.00	1,055,000.00	44,430,000.00

Attachment 22-F

Northern Kentucky Water Service District

Bond Iusse $10,575,000.00 Dated 12/5/2002

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	12/5/2002				
Registered	2/1/2003	3.00%	535,000.00	535,000.00	
Registered	2/1/2004	3.00%	455,000.00	455,000.00	
Registered	2/1/2005	3.00%	490,000.00	490,000.00	
Registered	2/1/2006	3.00%	530,000.00		530,000.00
Registered	2/1/2007	3.50%	580,000.00		580,000.00
Registered	2/1/2008	3.50%	625,000.00		625,000.00
Registered	2/1/2009	3.50%	745,000.00		745,000.00
Registered	2/1/2010	3.75%	775,000.00		775,000.00
Registered	2/1/2111	4.00%	805,000.00		805,000.00
Registered	2/1/2012	4.00%	835,000.00		835,000.00
Registered	2/1/2013	4.00%	870,000.00		870,000.00
Registered	2/1/2114	4.00%	900,000.00		900,000.00
Registered	2/1/2115	4.00%	930,000.00		930,000.00
Registered	2/1/2116	4.00%	965,000.00		965,000.00
Registered	2/1/2117	4.00%	535,000.00		535,000.00
TOTALS			10,575,000.00	1,480,000.00	9,095,000.00

Northern Kentucky Water Service District — Attachment 22-G

2003 Series A

Bond Issue $1,615,000.00 Dated 3/13/03

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	2/1/2004	1.20%	35,000.00	35,000.00	
Registered	2/1/2005	1.38%	35,000.00	35,000.00	
Registered	2/1/2006	1.75%	35,000.00		35,000.00
Registered	2/1/2007	2.20%	35,000.00		35,000.00
Registered	2/1/2008	2.60%	35,000.00		35,000.00
Registered	2/1/2009	3.00%	40,000.00		40,000.00
Registered	2/1/2010	3.30%	40,000.00		40,000.00
Registered	2/1/2011	3.55%	40,000.00		40,000.00
Registered	2/1/2012	3.70%	40,000.00		40,000.00
Registered	2/1/2113	3.85%	45,000.00		45,000.00
Registered	2/1/2014	3.95%	45,000.00		45,000.00
Registered	2/1/2015	4.05%	45,000.00		45,000.00
Registered	2/1/2116	4.15%	50,000.00		50,000.00
Registered	2/1/2117	4.25%	50,000.00		50,000.00
Registered	2/1/2118	4.50%	55,000.00		55,000.00
Registered	2/1/2119	4.50%	55,000.00		55,000.00
Registered	2/1/2020	4.50%	60,000.00		60,000.00
Registered	2/1/2121	4.50%	60,000.00		60,000.00
Registered	2/1/2022	4.50%	65,000.00		65,000.00
Registered	2/1/2023	4.55%	65,000.00		65,000.00
Registered	2/1/2024	4.55%	70,000.00		70,000.00
Registered	2/1/2025	4.55%	75,000.00		75,000.00
Registered	2/1/2026	4.55%	75,000.00		75,000.00
Registered	2/1/2027	4.55%	80,000.00		80,000.00
Registered	2/1/2028	4.60%	85,000.00		85,000.00
Registered	2/1/2029	4.60%	85,000.00		85,000.00
Registered	2/1/2030	4.60%	90,000.00		90,000.00
Registered	2/1/2031	4.60%	95,000.00		95,000.00
Registered	2/1/2032	4.60%	30,000.00		30,000.00
TOTALS			1,615,000.00	70,000.00	1,545,000.00

Attachment 22-H

Northern Kentucky Water Service District
2003 Series B
Bond Iusse $30,270,000.00 Dated 8/1/2003

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	2/1/2004	0.02	825,000.00	825,000.00	
Registered	2/1/2005	2.00%	845,000.00	845,000.00	
Registered	2/1/2006	2.00%	860,000.00		860,000.00
Registered	2/1/2007	2.00%	880,000.00		880,000.00
Registered	2/1/2008	2.00%	895,000.00		895,000.00
Registered	2/1/2004	2.25%	915,000.00		915,000.00
Registered	2/1/2010	2.75%	940,000.00		940,000.00
Registered	2/1/2011	3.00%	965,000.00		965,000.00
Registered	2/1/2012	3.13%	995,000.00		995,000.00
Registered	2/1/2013	3.13%	1,030,000.00		1,030,000.00
Registered	2/1/2014	3.13%	1,060,000.00		1,060,000.00
Registered	2/1/2015	3.25%	1,095,000.00		1,095,000.00
Registered	2/1/2016	3.50%	1,135,000.00		1,135,000.00
Registered	2/1/2017	4.00%	1,175,000.00		1,175,000.00
Registered	2/1/2018	4.00%	1,225,000.00		1,225,000.00
Registered	2/1/2019	4.00%	1,275,000.00		1,275,000.00
Registered	2/1/2020	4.13%	1,325,000.00		1,325,000.00
Registered	2/1/2021	4.13%	1,380,000.00		1,380,000.00
Registered	2/1/2022	1.43%	1,440,000.00		1,440,000.00
Registered	2/1/2023	4.13%	1,500,000.00		1,500,000.00
Registered	2/1/2024	4.13%	1,565,000.00		1,565,000.00
Registered	2/1/2025	4.13%	1,630,000.00		1,630,000.00
Registered	2/1/2026	4.13%	1,700,000.00		1,700,000.00
Registered	2/1/2027	4.13%	1,770,000.00		1,770,000.00
Registered	2/1/2028	4.13%	1,845,000.00		1,845,000.00
TOTALS			30,270,000.00	1,670,000.00	28,600,000.00

Northern Kentucky Water Service District

Attachment 22-I

2003 Series C

Bond Iusse $23,790,000.00 Dated 12/18/2003

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	2/1/2004	2.00%	1,430,000.00	1,430,000.00	
Registered	2/1/2005	2.00%	1,160,000.00	1,160,000.00	
Registered	2/1/2006	2.00%	1,180,000.00		1,180,000.00
Registered	2/1/2007	2.25%	1,215,000.00		1,215,000.00
Registered	2/1/2008	2.50%	1,235,000.00		1,235,000.00
Registered	2/1/2009	2.75%	1,270,000.00		1,270,000.00
Registered	2/1/2010	3.00%	1,305,000.00		1,305,000.00
Registered	2/1/2111	3.25%	1,350,000.00		1,350,000.00
Registered	2/1/2012	3.50%	1,395,000.00		1,395,000.00
Registered	2/1/2013	3.50%	1,445,000.00		1,445,000.00
Registered	2/1/2114	4.00%	1,505,000.00		1,505,000.00
Registered	2/1/2115	4.00%	1,565,000.00		1,565,000.00
Registered	2/1/2116	4.00%	1,625,000.00		1,625,000.00
Registered	2/1/2117	4.00%	1,690,000.00		1,690,000.00
Registered	2/1/2118	4.00%	1,595,000.00		1,595,000.00
Registered	2/1/2119	4.13%	1,665,000.00		1,665,000.00
Registered	2/1/2020	4.25%	1,160,000.00		1,160,000.00
TOTALS			23,790,000.00	2,590,000.00	21,200,000.00

Northern Kentucky Water Service District

Attachment 22-J

Bond Iusse — Dated 2/1/2002

Bond Number	Maturity Date	Interest Rate	Principle Amount	Amounts Paid	Outstanding
Registered	2/1/2005		270,000.00	270,000.00	
Registered	2/1/2006		275,000.00		275,000.00
Registered	2/1/2007		285,000.00		285,000.00
Registered	2/1/2008		290,000.00		290,000.00
Registered	2/1/2009		295,000.00		295,000.00
Registered	2/1/2010		305,000.00		305,000.00
Registered	2/1/2111		315,000.00		315,000.00
Registered	2/1/2012		325,000.00		325,000.00
Registered	2/1/2013		335,000.00		335,000.00
Registered	2/1/2114		345,000.00		345,000.00
Registered	2/1/2115		360,000.00		360,000.00
Registered	2/1/2116		375,000.00		375,000.00
Registered	2/1/2117		390,000.00		390,000.00
Registered	2/1/2118		405,000.00		405,000.00
Registered	2/1/2119		425,000.00		425,000.00
Registered	2/1/2020		460,000.00		460,000.00
Registered	2/1/2021		485,000.00		485,000.00
Registered	2/1/2022		505,000.00		505,000.00
Registered	2/1/2023		530,000.00		530,000.00
Registered	2/1/2024		555,000.00		555,000.00
Registered	2/1/2025		580,000.00		580,000.00
Registered	2/1/2026		605,000.00		605,000.00
Registered	2/1/2027		635,000.00		635,000.00
Registered	2/1/2028		665,000.00		665,000.00
TOTALS			10,015,000.00	270,000.00	9,745,000.00

Account 221, BONDS

Line No.	Par Value of Actual Issue	Cash Realized on Actual Issue	Par Value of Amount Held by or for Respondent	Actually Outstanding at Close of year	Interest During Year	
					Accrued	Actually Paid
	1	2	3	4	5	6
1	11,225,000	11,131,694		6,310,000	301,911	316,990
2	11,355,000	11,141,619		9,805,000	476,086	480,836
3	2,287,000	2,287,000		2,196,000	110,200	110,400
4	16,325,000	15,835,250		15,335,000	729,746	733,100
5	48,485,000	44,121,624		44,430,000	2,169,790	2,176,540
6	10,575,000	10,525,204		9,095,000	350,581	356,706
7	1,615,000	1,583,553		1,545,000	64,878	65,078
8	30,270,000	30,068,115		28,600,000	1,032,108	139,150
9	23,790,000	23,532,357		21,200,000	738,277	747,944
10	10,455,000	10,195,116		10,185,000	403,081	303,323
Total	166,382,000	160,421,532	36,332,688	148,701,000	6,376,659	5,430,067

Schedule of Bond Maturities

Line No.	Bond Numbers	Maturity Date	Interest Rate	Principal Amount	Amount Paid	Remaining Bonds Outstanding
	7	8	9	10	11	12
1						
2		**See Attachments 22-A Through 22-I**				
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Notes Payable (Acct. 232 & 234)

a	Nominal Date of Issue b	Date of Maturity c	INTEREST Rate d	INTEREST Amount of payment e	Principal Amount per Balance Sheet f
Account 232 - Note Payable					
Kenton Co. Fiscal Court				$	$ 100,000
BAN 2004A	Apr-04	2006	1.70%	61,285.00	3,605,000
BAN 2005A	May-05	2007		876,920.00	17,980,000
Total Account 232				$	$ 21,685,000
Account 234 - Notes Payable To Associated Companies		N/A		$	$
Total Account 234				$	$

Accounts Payable to Associated Companies (Acct. 233)

Show Payable to Each Associated Company Separately	Amount
	$
N/A	
Total	$

TAXES ACCRUED (ACCOUNT 236)

ACCT. NO. (a)	DESCRIPTION (b)	TOTAL ©
	Balance first of year	$ -
	Accruals Charged:	
408.1	Utility regulatory assessment fees	
408.11	Property taxes	
408.12	Payroll taxes	544,011
408.13	Other taxes and licenses	
408.2	Taxes other than income, other income and deductions	
	Total taxes accrued	$ 544,011
	Taxes paid during year:	
408.1	Utility regulatory assessment fees	
408.11	Property taxes	
408.12	Payroll taxes	544,011
408.13	Other taxes and licenses	
408.2	Taxes other than income, other income and deductions	
	Total taxes paid	$ 544,011
	Balance end of year	$ -

ACCRUED INTEREST (ACCOUNT 237)

DESC. DEBT (a)	BALANCE BEGINNING OF YEAR (b)	INTEREST ACCRUED DURING YEAR (c)	INTEREST PAID DURING YEAR (d)	BALANCE END OF YEAR (e)
Acct. No. 237.1 - Accured Interest on Long-term Debt				
Series 1997	139,619	301,911	316,990	124,540
Series 1998	202,724	476,086	480,836	197,973
2000 RUS Loan	18,500	110,200	110,400	18,300
Series 2001	307,135	729,746	733,100	303,781
Series 2002 A	910,268	2,169,789	2,176,540	903,517
Series 2002 B	151,689	350,582	356,706	145,565
Series 2003 A	27,216	64,878	65,078	27,016
Series 2003 B	436,499	1,032,109	1,039,150	429,458
Series 2003 C	316,476	738,278	747,944	306,810
Series 2004 A	68,005	402,735	303,323	167,417
Total Acct No. 237.1	$ 2,578,131	$ 6,376,314	$ 6,330,068	$ 2,624,376
Acct. No. 237.2 - Accured Interest on Other Liabilities:				
2004 BAN # 1	$ 15,321	$ 61,285	$ 61,285	$ 15,321
2005 BAN # 2		374,965	277,566	97,399
		-		-
Total Acct No. 237.2	$ 15,321	$ 436,250	$ 338,851	$ 112,720
Total Acct No 237	$ 2,593,452	$ 6,812,565	$ 6,668,919	$ 2,737,096

TAXES ACCRUED (ACCOUNT 236)

ACCT. NO. (a)	DESCRIPTION (b)	TOTAL ©
	Balance first of year	$ -
	Accruals Charged:	
408.1	Utility regulatory assessment fees	
408.11	Property taxes	
408.12	Payroll taxes	544,011
408.13	Other taxes and licenses	
408.2	Taxes other than income, other income and deductions	
	Total taxes accrued	$ 544,011
	Taxes paid during year:	
408.1	Utility regulatory assessment fees	
408.11	Property taxes	
408.12	Payroll taxes	544,011
408.13	Other taxes and licenses	
408.2	Taxes other than income, other income and deductions	
	Total taxes paid	$ 544,011
	Balance end of year	$ -

ACCRUED INTEREST (ACCOUNT 237)

DESC. DEBT (a)	BALANCE BEGINNING OF YEAR (b)	INTEREST ACCRUED DURING YEAR (c)	INTEREST PAID DURING YEAR (d)	BALANCE END OF YEAR (e)
Acct. No. 237.1 - Accured Interest on Long-term Debt				
Series 1997	139,619	301,911	316,990	124,540
Series 1998	202,724	476,086	480,836	197,973
2000 RUS Loan	18,500	110,200	110,400	18,300
Series 2001	307,135	729,746	733,100	303,781
Series 2002 A	910,268	2,169,789	2,176,540	903,517
Series 2002 B	151,689	350,582	356,706	145,565
Series 2003 A	27,216	64,878	65,078	27,016
Series 2003 B	436,499	1,032,109	1,039,150	429,458
Series 2003 C	316,476	738,278	747,944	306,810
Series 2004 A	68,005	402,735	303,323	167,417
Total Acct No. 237.1	$ 2,578,131	$ 6,376,313	$ 6,330,068	$ 2,624,376
Acct. No. 237.2 - Accured Interest on Other Liabilities:				
2004 BAN # 1	$ 30,643	$ 45,964	$ 61,285	$ 15,321
2005 BAN # 2		374,965	277,566	97,399
		-		-
Total Acct No. 237.2	$ 30,643	$ 420,929	$ 338,851	$ 112,720
Total Acct No 237	$ 2,608,774	$ 6,797,242	$ 6,668,919	$ 2,737,097

Miscellaneous Current & Accrued Liabilities (Account 242)

Description (a)	Balance End of Year (b)	
Accrued Payroll Taxes	$ 3,265	
Accrued Payroll	141,235	
Accrued Sales Taxes	58,086	241-0007-000
Accrued Pension	118,462	
Accrued Vacation/Sick	742,606	
Subdistrict Surcharges Payable	565,669	
Total Miscellaneous Current & Accrued Liabilities.....	$ 1,629,323	

Regulatory Commission Expense (Accounts 666 and 667)

DESCRIPTION OF CASE (DOCKET #) (a)	TOTAL INCURRED DURING YEAR (b)	AMOUNT TRANSFERRED TO ACCOUNT # 186.1 (c)	EXPENSED DURING YEAR	
			ACCT. (d)	AMOUNT (e)
Rate Case 2005-0148 (Case still pending as of 12/31/05)	211,583	211,583		
Rate Case 2002-0105			667	$ 145,116
Rate Case 2003-0234			667	$ 62,076

Miscellaneous Current & Accrued Liabilities (Account 242)

Description (a)	Balance End of Year (b)	
Accrued Payroll Taxes	$ 3,265	
Accrued Payroll	141,235	
Accrued Sales Taxes	58,086	241-0007-000
Accrued Pension	118,462	
Accrued Vacation/Sick	742,606	
Subdistrict Surcharges Payable	565,669	
Total Miscellaneous Current & Accrued Liabilities.....	$ 1,629,323	

Regulatory Commission Expense (Accounts 666 and 667)

DESCRIPTION OF CASE (DOCKET #) (a)	TOTAL INCURRED DURING YEAR (b)	AMOUNT TRANSFERRED TO ACCOUNT # 186.1 (c)	EXPENSED DURING YEAR	
			ACCT. (d)	AMOUNT (e)
Rate Case 2005-0148 (Case still pending as of 12/31/05)	195,519	211,583		
Rate Case 2002-0105			667	$ 145,116
Rate Case 2003-0234			667	$ 62,076

WATER OPERATING REVENUE

Acct. No Acct.	b	Beginning Year No. Customers c	Year End No. Customers d		Amounts e
	Operating Revenues:				
460	Unmetered Water Revenue				
461	Metered Water Revenue				
461.1	Sales to Residential Customers	57,852	72,563	$	20,045,989
461.2	Sales to Commercial Customers	3,861	4,509		5,445,797
461.3	Sale to Industrial Customers	106	116		2,472,461
461.4	Sales to Public Authorities	379	491		1,937,221
461.5	Sales to Multiple Family Dwellings	1,087	1,551		2,404,094
461.6	Sales through Bulk Loading Stations	1	-		4,538
	Total Metered Sales	63,286	79,230		32,310,100
462	Fire Protection Revenue:				
462.1	Public Fire Protection				
462.2	Private Fire Protection	367	450		73,995
	Total Fire Protection Revenue	367	450		73,995
464	Other Sales to Public Authorities				
465	Sales to Irrigation Customers				
466	Sales for Resale	7	3		845,183
467	Miscellaneous Sales	1	2		
	Total Sales of Water	63,661	79,685		33,229,278
	Other Water Revenues:				
470	Forfeited Discounts			$	752,736
471	Miscellaneous Service Revenues				
472	Rents from Water Property				506,326
473	Interdepartmental Rents				
474	Other Water Revenues				358,282
475	Provision for Rate Refunds				
	Total Other Water Revenues:				1,617,344
	Total Water Operating Revenues			$	34,846,622

Water Utility Expense Accounts

			Water Expense Account Matrix							
			0.1	0.2	0.3	0.4	.5.	0.6	0.7	0.8
Acct. No. a	Account Name b	Current Year c	Source of Supply & Expenses Operation d	Source of Supply & Expenses Mainten. e	Water Treatment Expemses/ Operation f	Water Treatment Expenses/ Maint. g	Trans. & Distribut Expenses Operation h	Trans. & Dist. Expenses Maint. I	Customer Accounts Expense j	Adminis-trative Gen Expenses k
601	Salaries and Wages - Employees	$ 6,811,773	-	46	1,449,102	493,118	618,775	1,969,869	1,634,355	646,507
603	Salaries and Wages - Officers, Directors & Majority Stockholders	656,510	-	-	100,256		105,227	-	89,586	361,442
604	Employee Pensions and Benefits	2,413,137	-	-	507,288	93,400	425,806	458,966	579,157	348,520
610	Purchased Water	-	-	xxx	xxx	xxx	xxx	xxx	xxx	xxx
615	Purchased Power	2,121,220	609,258	xxx	355,921	xxx	1,047,697	xxx	-	108,344
616	Fuel for Power Production	-	-	-	-	-	-	-	-	-
618	Chemicals	1,035,885	-	-	1,035,885	-	-		xxx	xxx
620	Materials & Supplies	1,680,127		29,684	157,892	155,011	98,372	797,313	218,988	222,867
631	Contractual Services - Eng.	95,651	-	-			78,527	17,124	-	-
632	Contractual Services - Acct.	16,875	-	-	-	-	-	-	-	16,875
633	Contractual Services - Legal	114,219	-	-	4,579	-	19,707	-	3,341	86,592
634	Contractual Services - Management Fees	3,211	-	-	-	-	-	-	-	3,211
635	Contracttual Services - Other	3,541,011	1,776	136,443	506,785	186,092	157,126	1,718,312	117,541	716,936
641	Rental of Bldg./Real Property	10,689	-	-	-	-	-	-	-	10,689
642	Rental of Equipment	-	-	-	-		-	-	-	-
650	Transportation Expenses	414,604	-	174	35,809	392	36,412	246,986	89,377	5,454
656	Insurance - Vehicle	86,502	-	-	16,459	-	42,456	-	23,807	3,780
657	Insurance - General Liability	272,040	-	-	87,048	-	144,180	-	27,204	13,608
658	Insurance - Worker's Comp	223,343	-	-	57,808	-	77,548	-	57,947	30,040
659	Insurance - Other	139,539	-	-	35,090	-	-	-	-	104,449
660	Advertising Expense	10,743	xxx	xxx	xxx	xxx	xxx	xxx	xxx	10,743
666	Regulatory Commission Exp/ Amortization of Rate Case Exp.	-	xxx	xxx	xxx	xxx	xxx	xxx	xxx	
667	Regulatory Commission Exp/Other	258,404	-	-	-	-	-	-	258,404	-
670	Bad Debt Expense	524,536	xxx	xxx	xxx	xxx	xxx	xxx	524,536	xxx
675	Miscellaneous Expenses	49,257	-		5,387	187	6,886	8,333	9,402	19,062
	Total Water Utility Expenses	$ 20,479,276	611,034	166,347	4,355,309	928,200	2,858,719	5,216,903	3,633,645	2,709,119

Water Utility Expense Accounts

Acct. No. a	Account Name b	Current Year c	Water Expense Account Matrix 0.1 Source of Supply & Expenses Operation d	0.2 Source of Supply & Expenses Mainten. e	0.3 Water Treatment Expemses/ Operation f	0.4 Water Treatment Expenses/ Maint. g	.5. Trans. & Distribut Expenses Operation h	0.6 Trans. & Dist. Expenses Maint. I	0.7 Customer Accounts Expense j	0.8 Adminis-trative Gen Expenses k
601	Salaries and Wages - Employees	$ 6,811,773	-	46	1,449,102	493,118	618,775	1,969,869	1,634,355	646,507
603	Salaries and Wages - Officers, Directors & Majority Stockholders	656,510	-	-	100,256		105,227	-	89,586	361,442
604	Employee Pensions and Benefits	2,413,136	-	-	507,288	93,400	425,806	458,966	579,157	348,519
610	Purchased Water	-	-	xxx	xxx	xxx	xxx	xxx	xxx	xxx
615	Purchased Power	2,121,220	609,258	xxx	355,921	xxx	1,047,697	xxx	-	108,344
616	Fuel for Power Production	-	-	-	-	-	-	-	-	-
618	Chemicals	1,035,885	-	-	1,035,885	-	-		xxx	xxx
620	Materials & Supplies	1,680,127		29,684	157,892	155,011	98,372	797,313	218,988	222,867
631	Contractual Services - Eng.	95,651	-	-			78,527	17,124	-	-
632	Contractual Services - Acct.	16,875	-	-	-	-	-	-	-	16,875
633	Contractual Services - Legal	114,219	-	-	4,579	-	19,707	-	3,341	86,592
634	Contractual Services - Management Fees	3,211	-	-	-	-	-	-	-	3,211
635	Contracttual Services - Other	3,541,008	1,776	136,443	506,785	186,092	157,126	1,718,312	117,541	716,933
641	Rental of Bldg./Real Property	10,689	-	-	-	-	-	-	-	10,689
642	Rental of Equipment	-	-	-	-		-	-	-	-
650	Transportation Expenses	414,430	-	-	35,809	392	36,412	246,986	89,377	5,454
656	Insurance - Vehicle	86,502	-	-	16,459	-	42,456	-	23,807	3,780
657	Insurance - General Liability	272,040	-	-	87,048	-	144,180	-	27,204	13,608
658	Insurance - Worker's Comp	223,343	-	-	57,808	-	77,548	-	57,947	30,040
659	Insurance - Other	139,539	-	-	35,090	-	-	-	-	104,449
660	Advertising Expense	10,743	xxx	xxx	xxx	xxx	xxx	xxx	xxx	10,743
666	Regulatory Commission Exp/ Amortization of Rate Case Exp.	-	xxx	xxx	xxx	xxx	xxx	xxx	xxx	
667	Regulatory Commission Exp/Other	258,404	-	-	-	-	-	-	258,404	-
670	Bad Debt Expense	524,536	xxx	xxx	xxx	xxx	xxx	xxx	524,536	xxx
675	Miscellaneous Expenses	49,257	-		5,387	187	6,886	8,333	9,402	19,062
	Total Water Utility Expenses	$ 20,479,098	611,034	166,173	4,355,309	928,200	2,858,719	5,216,903	3,633,645	2,709,115

Pumping and Purchased Water Statistics

a	Water Purchased for Resale (Omit 000's) b	Water Pumped From Plants (Omit 000's) c'	Total Water Pumped and Purchased (Omit 000's) d	Water Sold to Customers (Omit 000's) e
January		817,046.0	817,046.0	578,988.5
February		717,280.0	717,280.0	522,693.4
March		798,635.0	798,635.0	797,018.2
April		813,137.2	813,137.2	536,147.7
May		899,865.0	899,865.0	519,882.4
June		1,042,279.0	1,042,279.0	887,043.5
July		1,057,621.0	1,057,621.0	675,504.6
August		1,107,166.0	1,107,166.0	639,786.1
September		908,699.0	908,699.0	1,211,747.3
October		870,173.2	870,173.2	763,043.8
November		788,829.0	788,829.0	706,168.1
December		812,867.9	812,867.9	965,766.0
Total for year		10,633,598.3	10,633,598.3	8,803,789.6

Maximum gallons pumped by all methods in any one day: 44,476.0
8/4/2005

Minimum gallons pumped by all methods in any one day (Omit 000's): 21,915.0
12/25/2005

If water is purchased for resale, indicate the folloinwg:
Vendor:
Point of delivery:

If water is sold to other water utilities for redistribution, list names of such utilities below:

Pendleton County Water District

City of Walton

Bullock Pen Water District

Sales for Resale (466)

Line	Company	Gallons(000's)	Avg. Rate (Cents)	Amount
1	Pendleton County Water Dist.	97,415.9	2.40	$235,541.76
2	City of Walton	168,960.8	2.40	$406,099.56
3	Bullock Pen Water District	84,449.0	2.40	$203,541.96
4				
5				
6				
7				
8				
Total		**350,825.7**		**$845,183.28**

WATER STATISTICS

Line	Item	Gallons (000's)
1	**WATER PRODUCED, PURCHASED, & DISTRIBUTED**	
2	Water Produced	10,633,598
3	Water Purchased	
4	**TOTAL PRODUCED AND PURCHASED**	**10,633,598**
5		
6	**WATER SALES:**	
7	Residential	5,931,183
8	Commercial	1,659,182.2
9	Industrial	847,058.4
10	Irrigation	-
11	Resale	350,825.7
12	Other Sales	15,541
13	**TOTAL WATER SALES**	**8,803,789.6**
14		
15	**OTHER WATER USED (estimate portions not metered)**	
16	Utility/water treatment plant	175,351.9
17	Wastewater plant	0.0
18	System flushing	190,433.0
19	Water main breaks/leaks	97,238.0
20	Storage tank overflow	0.0
21	Fire Department	8,300.0
22	Other (construction, flushing, disinfection, ect.)	4,240.0
23	**TOTAL OTHER WATER USED**	**475,562.9**
24		
25	**UNACCOUNTED-FOR WATER LOSS:**	
26	Line 4 - (Line 13 + Line 23)	**1,354,245.8**
27		
28	**UNACCOUNTED-FOR WATER LOSS PERCENTAGE**	
29	Line 26 divided by Line 4	12.74%

WATER STATISTICS

Line	Item	Gallons (000's)
1	**WATER PRODUCED, PURCHASED, & DISTRIBUTED**	
2	Water Produced	10,633,598
3	Water Purchased	
4	**TOTAL PRODUCED AND PURCHASED**	**10,633,598**
5		
6	**WATER SALES:**	
7	Residential	5,931,183
8	Commercial	1,659,182.2
9	Industrial	847,058.4
10	Irrigation	-
11	Resale	350,825.7
12	Other Sales	15,541
13	**TOTAL WATER SALES**	**8,803,789.6**
14		
15	**OTHER WATER USED (estimate portions not metered)**	
16	Utility/water treatment plant	175,351.9
17	Wastewater plant	0.0
18	System flushing	190,433.0
19	Water main breaks/leaks	97,238.0
20	Storage tank overflow	0.0
21	Fire Department	8,300.0
22	Other (construction, flushing, disinfection, ect.)	4,240.0
23	**TOTAL OTHER WATER USED**	**475,562.9**
24		
25	**UNACCOUNTED-FOR WATER LOSS:**	
26	Line 4 - (Line 13 + Line 23)	**1,354,245.8**
27		
28	**UNACCOUNTED-FOR WATER LOSS PERCENTAGE**	
29	Line 26 divided by Line 4	12.74%

PLANT STATISTICS

Give the following information:

1 Number of fire hydrants, by size.
2 Number of private fire hydrants, by size.
3 Wheter water supply is river, impounded streams, well, springs, artificial lake or collector type well.
4 Wether supply is by gravity, pumping, or a combination .
5 Type, capacity, and elevation of resrviors at overflow and ground level.
6 Miles of main by size and kind.
7 Types of filters: gravity or pressure, number of units, and total rated capacity in gallons per minute.
8 Type of chlornators, number of units and capacity in pounds per 24 hours.
9 Station equipment. List each pump separately, giving type and capacity and H.P. of driving unit and character of driving unit (steam, electric, or internal combustion). State whether pump is high or low duty.
10 Quantity of fuel used: coal in pounds, gas in cu. ft., oil in gallons, and electric in KWH .
11 Give a description and total cost of any sizable additions or retirements to plant in service outside the normal system growth for the period covered by this report.
12 Capacity of clear well.
13 Peak month, in gallons of water sold.
14 Peak day, in gallons of water sold.

1) Kenton County **5541**, Campbell County **2423**.

2) **48**.

3) Rivers: Ohio River and the Liking River.

4) Plants are pumped; Distribution is combination of pumped and gravity.

5) See attached **31A.**

6) See attached **31B.**

7) Fort Thomas Treatment Plant
12 - Gravity, each 560 sq. ft.

Taylor Mill Treatment Plant
8 - Gravity, each 560 sq. ft. @ 5 gallons per sq. ft. per minute

8) See attached **31C**

9) See attached **31D**

10) **N/A**

11) None

Water Storage Facilities
Northern Kentucky Water District
Updated: 4/26/2006

Attachment 31A

Storage Location	Address	City Location	Type Of Storage	Year In Service	Structure Height (Feet)	Base Elevation (Feet)	Top Elevation (Feet)	Overflow Elevation (Feet)	Normal Elevation (Feet)	Normal Elevation (Feet)	Diameter (Feet)	Capacity (Gallons)
Aqua Drive	100 Aqua Drive	Cold Spring	Hydropillar		184			1017				2,000,000
Barrington Road	2 Barrington Road	Ft. Wright	Hydropillar	1969	141	916.5	1057.5	1046.7	1045.0	1040.0	74	1,000,000
Bromley	1674 Highwater Road	Bromley	Ground Storage	1966	103	670.0	773.0	764.0	763.0	750.0	75	3,000,000
Dayton Avenue	2816 Dayton St.	Dayton	Ground Storage		50			829.0				500,000
Devon	US 25	Florence	Hydropillar	1991	156	939.5		1082.0		1042.0	100	2,000,000
Dudley Pike	796 Dudley Pike	Edgewood	Ground Storage	1964	59	831.0	889.5	876.0	874.0	866.0	140	5,000,000
Dudley Pike	796 Dudley Pike	Edgewood	Ground Storage	1990	59	831.0	889.5	876.0	874.0	866.0	140	5,000,000
Ft. Thomas Plant	700 Alexandria Pike	Ft. Thomas	Clearwell	1936	31	734.0	765.3	764.5	762.0	760.0		3,000,000
Ft. Thomas Plant	700 Alexandria Pike	Ft. Thomas	Clearwell	1990	35	730.0	778.5	764.5	763.5	757.5	130	3,500,000
Harrison Ave.	2361 Harrison Ave.	Bellevue	Ground Storage		60			829.0				600,000
Ida Spence	Tower Place	Covington	Elevated Tank	1952	175	840.0	1015.0	1005.0	1003.0	1000.0	57	500,000
Independence	5685 Madison Pike	Independence	Hydropillar	1981	137	943.5		1080.0		1039.5	74	1,000,000
Industrial Park	Industrial Rd. & US 25	Florence	Hydropillar	1961	146	945.5	1091.5	1083.5	1081.0	1062.0	50	500,000
John's Hill Road	Knollwood Dr.	Highland Hts.	Elevated Tank		113			1017.0				500,000
Kenton Lands Rd.	25 Kenton Lands Road	Erlanger	Elevated Tank	1953	158	896.0	1054.0	1045.0	1043.0	1033.0	50	500,000
Lumley Tank	R47 Lumley Ave.	Fort Thomas	Elevated Tank	1937	187			1017.0				275,000
Main St. Tank	Main St. & US 27	Alexandria	Elevated Tank	1962	152			1017.0				300,000
Memorial Pkwy. Plant	2055 Memorial Pkwy.	Fort Thomas	Clearwell					741.0				3,000,000
Old St. 4 Tank	Old St. Road #4	Claryville	Elevated Tank	1976	143			1017.0				1,000,000
Rossford Tank	Marion Dr.	Fort Thomas	Elevated Tank	1962	191			1017.0				300,000
South Newport Tank	Kentucky Drive	Newport	Elevated Tank		155			965.0				1,000,000
Taylor Mill Plant	608 Grand Ave.	Taylor Mill	Clearwell		15	509.5	524.5	522.0	520.0	518.0		1,000,000
Taylor Mill Standpipe	5907 Taylor Mill Rd.	Taylor Mill	Standpipe		143			1010.0	130.0	110.0		329,000
											Total storage owned by NKWSD:	**35,804,000**

NORTHERN KY. WA[illegible] ERVICE DISTRICT
MILES OF [illegible] ANALYSIS

Att[illegible]nt 31B

Size	Type	Prior Years	2004 Additions	2004 Retirements	2004 YTD TOTAL	2004 Miles	2004 Percent	2005 Additions	2005 Retirements	2005 YTD TOTALS	2005 Miles	2005 Percent
2"	Cast Iron	45.00			45.00	0.01	0.001%			45.00	0.009	0.001%
3"	Cast Iron				-	-	0.000%			-	0.000	0.000%
4"	Cast Iron	397,128.68	1,240.00	875.00	397,493.68	75.28	6.930%	2,094.00	3,100.00	396,487.68	75.092	6.827%
6"	Cast Iron	1,853,356.38	95,753.36	9,529.00	1,939,580.74	367.34	33.816%	737.00	6,765.00	1,933,552.74	366.203	33.291%
8"	Cast Iron	938,829.93	168,204.24	609.00	1,106,425.17	209.55	19.290%	16,786.00	12,978.00	1,110,233.17	210.271	19.116%
10"	Cast Iron	89,794.10	46,057.44		135,851.54	25.73	2.368%		350.00	135,501.54	25.663	2.333%
12"	Cast Iron	583,797.32	12,557.16	5,109.00	591,245.48	111.98	10.308%	21,555.00	1,440.00	611,360.48	115.788	10.526%
16"	Cast Iron	280,160.80	8,410.28	55.00	288,516.08	54.64	5.030%	1,500.00		290,016.08	54.927	4.993%
18"	Cast Iron	3,345.00			3,345.00	0.63	0.058%	104.00	1,500.00	1,949.00	0.369	0.034%
20"	Cast Iron	128,008.79	1,540.00		129,548.79	24.54	2.259%			129,548.79	24.536	2.231%
24"	Cast Iron	93,062.00	4,460.00		97,522.00	18.47	1.700%			97,522.00	18.470	1.679%
30"	Cast Iron	28,563.00			28,563.00	5.41	0.498%			28,563.00	5.410	0.492%
36"	Cast Iron	22,434.21	2,365.00	2,538.00	22,261.21	4.22	0.388%			22,261.21	4.216	0.383%
42"	Cast Iron	17,845.00			17,845.00	3.38	0.311%			17,845.00	3.380	0.307%
							0.000%					0.000%
20"	Concrete	6,050.00			6,050.00	1.15	0.105%			6,050.00	1.145	0.104%
24"	Concrete	21,530.00			21,530.00	4.08	0.375%			21,530.00	4.077	0.371%
36"	Concrete	35,000.00			35,000.00	6.63	0.610%			35,000.00	6.629	0.603%
							0.000%					0.000%
2"	Galvanized	375.00			375.00	0.07	0.007%			375.00	0.071	0.006%
							0.000%					0.000%
4"	Transite	50,335.00			50,335.00	9.53	0.878%			50,335.00	9.533	0.867%
6"	Transite	96,598.00		120.00	96,478.00	18.27	1.682%			96,478.00	18.272	1.661%
							0.000%					0.000%
1 1/2"	Steel	226.00			226.00	0.04	0.004%			226.00	0.043	0.004%
2"	Steel	677.00			677.00	0.13	0.012%			677.00	0.128	0.012%
4"	Steel	83.00			83.00	0.02	0.001%			83.00	0.016	0.001%
6"	Steel	11.00			11.00	0.00	0.000%			11.00	0.002	0.000%
8"	Steel	31.00			31.00	0.01	0.001%			31.00	0.006	0.001%
10"	Steel	15.00			15.00	0.00	0.000%			15.00	0.003	0.000%
12"	Steel	1,681.00			1,681.00	0.32	0.029%			1,681.00	0.318	0.029%
16"	Steel	582.00			582.00	0.11	0.010%			582.00	0.110	0.010%
24"	Steel	5,227.00		3,178.00	5,227.00	0.99	0.091%		1,500.00	5,272.00	0.998	0.091%
							0.000%					

Attachment 31B

Size	Type	Prior Years	2004 Additions	2004 Retirements	2004 YTD TOTAL	2004 Miles	2004 Percent	2005 Additions	2005 Retirements	2005 YTD TOTALS	2005 Miles	2005 Percent
3/4"	Copper	52.00			52.00	0.01	0.001%			52.00	0.010	0.001%
1"	Copper	3,787.00			3,787.00	0.72	0.066%			3,787.00	0.717	0.065%
1 1/2"	Copper	4,150.00			4,150.00	0.79	0.072%			4,150.00	0.786	0.071%
2"	Copper	12,648.30			12,648.30	2.40	0.221%			12,648.30	2.396	0.218%
							0.000%					0.000%
1"	Plastic	2,973.00			2,973.00	0.56	0.052%			2,973.00	0.563	0.051%
1 1/2"	Plastic	2,292.00			2,292.00	0.43	0.040%			2,292.00	0.434	0.039%
2"	Plastic	66,168.00	2,120.00		68,288.00	12.93	1.191%	2,551.00		70,839.00	13.416	1.220%
3"	Plastic	114,986.00			114,986.00	21.78	2.005%			114,986.00	21.778	1.980%
4"	Plastic	29,539.00			29,539.00	5.59	0.515%			29,539.00	5.595	0.509%
6"	Plastic	123,346.60	7,320.00		130,666.60	24.75	2.278%	6,499.00		137,165.60	25.978	2.362%
8"	Plastic	347,923.00	36,101.00		384,024.00	72.73	6.695%	37,848.00		421,872.00	79.900	7.264%
12"	Plastic	5,839.00			5,839.00	1.11	0.102%	8,555.00		14,394.00	2.726	0.248%
	TOTAL	5,368,495.11	386,128.48	22,013.00	5,735,788.59	1,086.32	100.0%	98,229.00	27,633.00	5,804,379.59	1,099.99	100.0%

Northern Kentucky Water District
Chlorinators and Sodium Hypochlorite Feeders In System
Updated 4/26/2006

Attachment 31C

Location	# of Units	Form of Chlorine	Type	Capacity (ea.)
Bromley Pump Station	1	Sodium Hypochlorite	Jesco Pump	1.3 GPH
West Covington Pump Station	1	Sodium Hypochlorite	Jesco Pump	2.8 GPH
Bristow Road Pump Station	1	Sodium Hypochlorite	Watson Marlow	5 GPH
Dudley Pump Station	2	Sodium Hypochlorite	US Filter Wallace & Tiernan Encore 700	12 GPH
Fort Thomas Treatment Plant	1	Sodium Hypochlorite	Watson Marlow	
	7		US Filter Wallace & Tiernan Encore 700	77 GPH
Taylor Mill Treatment Plant	2	Sodium Hypochlorite	US Filter Wallace & Tiernan Encore 700	5 GPH
	3		US Filter Wallace & Tiernan Encore 700	22.5 GPH
Ohio River Pump Station	4	Sodium Hypochlorite	Milton Roy Max Roy B	195 GPH
Memorial Pky Treatment Plant	1	Sodium Hypochlorite	Watson Marlow	9.1 GPH
	2		Seepex	8 GPH

Rev. 7/19/2004

KENTUCKY PUBLIC SERVICE COMMISSION

REPORT OF GROSS OPERATING REVENUES DERIVED FROM INTRA-KENTUCKY BUSINESS FOR THE YEAR ENDING DECEMBER 31, 20 06

NORTHERN KENTUCKY WATER DISTRICT (Utility Reporting)

100 AQUA DRIVE - P.O. BOX 220 - COLD SPRING (Address)

FEIN # (Federal Employer Identification Number)

6	1	-	1	3	1	1	6	9	5

(DO NOT INCLUDE TAXES COLLECTED)

(1) Gross Revenues of Electric Utility.....$ _____

(2) Gross Revenues of Gas Utility.....$ _____

(3) Gross Revenues of Water Utility.....$ 33,229,279.00

(4) Gross Revenues of Sewer Utility.....$ _____

(5) Other Operating Revenues.....$ 1,716,334.00

***** TOTAL GROSS REVENUES.....$ 34,945,623.00**

OATH

State of...KENTUCKY.....)
) ss.
County of...CAMPBELL.....)

JACK BRAGG, CPA, CMA (Officer) being duly sworn, states that he/she is

VICE-PRESIDENT OF FINANCE (Official Title) of the NORTHERN KENTUCKY WATER DISTRICT (Utility Reporting) that the above report of gross revenues is in exact accordance with NORTHERN KENTUCKY WATER DISTRICT (Utility Reporting) and that such books accurately show the gross revenues of: NORTHERN KENTUCKY WATER DISTRICT (Utility Reporting), derived from Intra-Kentucky business for the calendar year ending December 31, 20 06.

(Officer) VICE-PRESIDENT OF FINANCE (Title)

This the 30 day of March, 20 06

Ronda J. Barrow (Notary Public) Campbell (County) 4-8-08 (Commission Expires)

NOTE: ANY DIFFERENCE BETWEEN THE AMOUNT OF THE GROSS REVENUES SHOWN IN THE ANNUAL REPORT AND THE AMOUNT APPEARING ON THIS STATEMENT MUST BE RECONCILED ON THE REVERSE OF THIS REPORT.

OATH

Commonwealth of Kentucky):
County of Kenton): SS:

Jack Bragg, Jr. makes oath and says

that he is Vice President of Finance of

Northern Kentucky Water District ;

that it is his duty to have supervision over the books of account of the respondent and to control the manner in which such books are kept; that he knows that such books have, during the period covered by the foregoing report, been kept in good faith in accordance with the accounting and other orders of the Public Service Commission of Kentucky, effective during the said period; that he has carefully examined the said report and to the best of his knowledge and belief the entries contained in the said report have, so far as they relate to matters of account, been accurately taken from the said books of account and are in exact accordance therewith; that he believes that all other statements of fact contained in the said report are true; and that the said report is a correct and complete statement of the business and affairs of the above-named respondent during the period of time from and including

January 1, 2005, to and including December 31, 2005

Signature of official

Subscribed and sworn to before me, a NOTARY PUBLIC in and for the State and County above named, this 27 day of April, 2001.

(Apply Seal Here)

My commission expires: 1-14-09

(Signature of officer authorized to administer oath)

Commonwealth of Kentucky
Public Service Commission
211 Sower Blvd.
P.O. Box 615
Frankfort, Kentucky 40602-0615
Telephone: (502) 564-3940
Fax: (502) 564-3460
psc.ky.gov

March 28, 2006

Hon. John N. Hughes
Attorney At Law
124 W. Todd Street
Frankfort, KY 40601

RE: Northern Kentucky Water District

Dear Mr. Hughes:

Your request, on behalf of Northern Kentucky Water District, for an extension of time to May 1, 2006, for filing of the 2005 annual report of Northern Kentucky Water District is being granted, with the understanding that every effort will be made to complete and file the annual report at an earlier date.

An extension for filing the Report of Gross Operating Revenues Derived From Intra-Kentucky Business can not be granted. It is to be filed before March 31, 2006. Failure to comply with Commission Regulation 807 KAR 5:006, Section 3(1) and KRS 278.140, may result in the imposition of penalties as provided in KRS 278.990 and **WILL** result in the revocation of the extension for filing the Annual Report.

Sincerely,

Bill Feldman
Assistant Director
Filings Division

cc: Northern Kentucky Water District

JOHN N. HUGHES
ATTORNEY AT LAW
PROFESSIONAL SERVICE CORPORATION
124 WEST TODD STREET
FRANKFORT, KENTUCKY 40601

TELEPHONE: (502) 227-7270 [illegible] TELEFAX (502) 875-7059

March 27, 2006

RECEIVED
MAR 27 2006
PUBLIC SERVICE COMMISSION

Beth O'Donnell
Executive Director
Public Service Commission
211 Sower Blvd.
Frankfort, KY 40601

Dear Beth:

Northern Kentucky Water District requests an extension of time up to and including May 1, 2006 to file its 2005 Annual Report. The District has not received the Independent Auditor's final report and is in the process of moving into its new office facility. Given the lack of final audited information and the disruption of the staff's daily routine due to the relocation, the District will be unable to file the report when due. For these reasons, the extension is being requested.

If there are any questions about this, please contact me.

Very truly yours,

John N. Hughes

Attorney for Northern Kentucky
Water District

Case No. 2007-00052
Exhibit F

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

SCHEDULE OF MORTGAGES, BONDS, NOTES, AND OTHER INDEBTEDNESS

Northern Kentucky Water District

Bonds Payable and Current Portion

Account No.	Description	Bond Payable Dec 31 2006	Current Portion Payment 2007	As of Dec 31, 2006 Bond Payable 2006
220-0007-000	Bonds Payable 1997	$5,500,000	$850,000	$4,650,000
220-0008-000	Bonds Payable 1998	$9,550,000	$265,000	$9,285,000
220-0009-000	Rural Development Loan Payable(2000)	$2,170,000	$27,000	$2,143,000
220-0010-000	2001 Bonds Payable	$15,120,000	$200,000	$14,920,000
220-0011-000	2002 A Bonds Payable	$44,060,000	$380,000	$43,680,000
220-0012-000	2002 B Payable-Refunding	$8,565,000	$580,000	$7,985,000
220-0013-000	2003 A Refunding Bonds Payable	$1,510,000	$35,000	$1,475,000
220-0014-000	Series 2003 B Bonds Payable	$27,740,000	$880,000	$26,860,000
220-0015-000	2003 C Refunding Bonds Payable	$20,020,000	$1,215,000	$18,805,000
220-0016-000	Series 2004 A Bonds Payable	$9,910,000	$285,000	$9,625,000
220-0017-000	Series 2006 A Bonds Payable	$29,000,000	$300,000	$28,700,000
	Total Long Term Debt	$173,145,000	$5,017,000	$168,128,000
232-0100-000	Note Payable City of Taylor Mill	$2,125,000	$250,000	$1,875,000
232-0000-000	Note Payable CC Fiscal Court	$100,000	-	100,000
	Grand Total	$ 175,370,000	$ 5,267,000	$ 170,103,000

Case No. 2007-00052
Exhibit G

NORTHERN KENTUCKY WATER DISTRICT

Project
Taylor Mill Treatment Plant UV Disinfection

Kenton County
184-0439

CURRENT BALANCE SHEET AND INCOME STATEMENT

Northern Kentucky Water District
Balance Sheet
As of December 31, 2006

	2006	2005
ASSETS		
CURRENT ASSETS		
Cash and Cash Equivalents	$ 4,618,177	6,478,053
Accounts Receivable		
Customers	4,390,760	3,681,014
Unbilled Customers	4,900,000	4,900,000
Other	315,200	259,169
Assessments Receivable	35,998	37,767
Inventory Supplies for New Installation		
and Maintenance, at Cost	1,287,374	1,150,975
Prepaid Expenses	2,161,969	842,700
TOTAL CURRENT ASSETS	$ 17,709,478	17,349,678
RESTRICTED ASSETS		
Bond Proceeds Fund	$ 13,149,342	17,242,047
Debt Service Reserve Account	13,157,181	12,472,874
Debt Service Account	7,713,194	6,547,631
Improvement, Repair & Replacement	1,932,787	3,074,102
Boone/Florence Settlement Account	3,023,965	3,344,622
TOTAL RESTRICTED ASSETS	$ 38,976,469	42,681,276
NONCURRENT ASSETS		
Miscellaneous Deferred Charges	$ 9,355,219	9,821,617
Capital Assets:		
Land, System, Buildings and Equipment	$ 256,430,962	253,634,326
Construction in Progress	32,662,579	19,738,958
Total Capital Assets before accumulated depreciation	$ 289,093,541	273,373,284
Less Accumulated Depreciation	(60,089,807)	(54,448,687)
Total capital assets, net of accumulated depreciation	$ 229,003,734	218,924,597
TOTAL NONCURRENT ASSETS	$ 238,358,953	228,746,214
TOTAL ASSETS	$ 295,044,900	288,777,168

Northern Kentucky Water District
Balance Sheet
As of December 31, 2006

		2006		2005
LIABILITIES AND RETAINED EARNINGS				
CURRENT LIABILITIES				
Current Portion of Long Term Debt	$	5,267,000		4,806,000
Accounts Payable		2,135,910		2,005,332
Accrued Payroll & Liabilities		340,186		273,867
Other Accrued Liabilities		187,199		161,957
TOTAL CURRENT LIABILITIES	$	7,930,295		7,247,156
CURRENT LIABILITIES PAYABLE				
FROM RESTRICTED ASSETS				
Accounts Payable	$	1,538,689		2,870,554
Accrued Interest Payable		2,944,301		2,737,097
TOTAL CURRENT LIABILITIES PAYABLE				
FROM RESTRICTED ASSETS	$	4,482,990		5,607,651
LONG-TERM DEBT				
Long-Term Portion of Bonded Indebtedness	$	168,128,000		144,145,000
Bond Anticipation Notes Payable				21,585,000
Note Payable - Taylor Mill Purchase		1,875,000		2,125,000
Deferred Note Payable		100,000		100,000
TOTAL LONG-TERM DEBT	$	170,103,000		167,955,000
TOTAL LIABILITIES	$	182,516,285		180,809,807
RETAINED EARNINGS	$	112,528,615		107,967,361
TOTAL LIABILITIES AND RETAINED EARNINGS	$	295,044,900		288,777,168

DRAWINGS FOR

NORTHERN KENTUCKY WATER DISTRICT

TAYLOR MILL, KENTUCKY

TAYLOR MILL TREATMENT PLANT

UV DISINFECTION

BLACK & VEATCH
building a world of difference™
ENERGY WATER INFORMATION GOVERNMENT
Black & Veatch Corporation
Cincinnati, Ohio

11/20/06

11/20/06

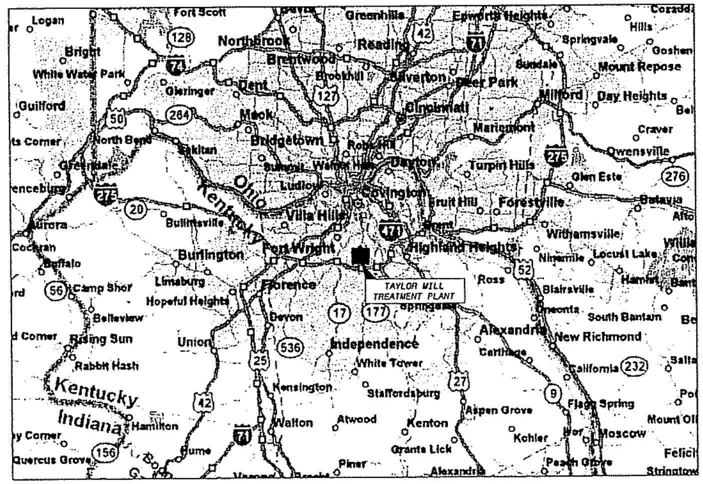
B&V P.N. 143757

2006

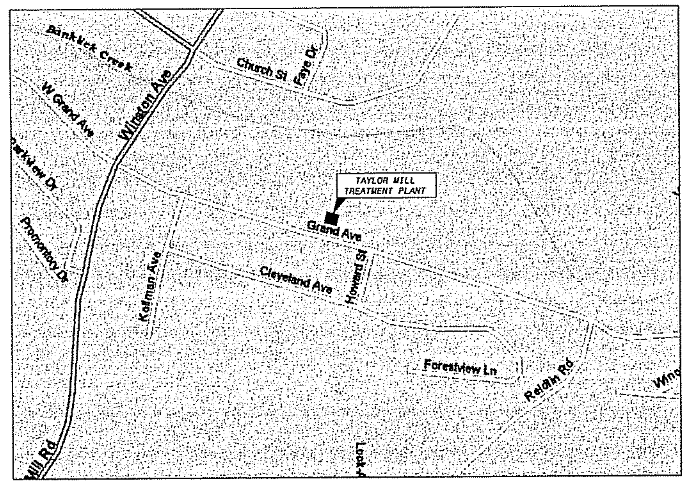
Case No. 2007-00052

DRAWING LIST

DRAWING		TITLE
		COVER
1	G1	GENERAL - DRAWING LIST AND LOCATION MAPS
2	G2	GENERAL - ABBREVIATIONS AND LEGENDS
3	G3	GENERAL - GENERAL NOTES AND DESCRIPTION OF FACILITIES
4	G4	GENERAL - SITE PLAN
5	G5	GENERAL - SITE DEMOLITION PLAN, SITE DETAILS AND ELECTRICAL VAULT PLANS AND SECTIONS
6	C1	CIVIL - BASEMENT AND FILTER PIPE GALLERY DEMOLITION PLAN
7	C2	CIVIL - BASEMENT AND FILTER PIPE GALLERY DEMOLITION SECTIONS
8	C3	CIVIL - BASEMENT AND FILTER PIPE GALLERY PLAN
9	C4	CIVIL - BASEMENT AND FILTER PIPE GALLERY SECTIONS
10	C5	CIVIL - MISCELLANEOUS DETAILS
11	C6	CIVIL - STANDARD CONCRETE DETAILS
12	C7	CIVIL - STANDARD CONCRETE DETAILS
13	E1	ELECTRICAL - LEGENDS, ABBREVIATIONS AND GENERAL NOTES
14	E2	ELECTRICAL - POWER DISTRIBUTION FUNCTIONAL DIAGRAM
15	E3	ELECTRICAL - TRANSFORMER AND UTILITY CONNECTION SITE PLAN AND ELECTRIC VAULT POWER/LIGHTING PLAN
16	E4	ELECTRICAL - POWER ONE-LINE DIAGRAMS
17	E5	ELECTRICAL - CONTROL ONE-LINE DIAGRAMS
18	E6	ELECTRICAL - BASEMENT AND FILTER PIPE GALLERY POWER PLAN
19	E7	ELECTRICAL - SCHEMATICS, SCHEDULES AND DETAILS
20	P1	PROCESS - P&ID LEGEND AND ABBREVIATIONS, SHEET 1 OF 3
21	P2	PROCESS - P&ID LEGEND AND ABBREVIATIONS, SHEET 2 OF 3
22	P3	PROCESS - P&ID LEGEND AND ABBREVIATIONS, SHEET 3 OF 3
23	P4	PROCESS - ULTRAVIOLET DISINFECTION SYSTEM P&ID
24	I1	INSTRUMENTATION - INSTRUMENT INSTALLATION DETAILS



LOCATION MAP
NO SCALE



ENLARGED LOCATION MAP
NO SCALE

NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	WHA
DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK

CYGNET ID: 143757.3000-WTUP-C-00000YOT | XREF1: R&D.dif
WF: G1.dwg | XREF2: 100mmB.DWG
SAVED: DUN38005, 8/29/2006 2:58:22 PM | XREF3:
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USER: DUN38005 | DWG VER: 4.3 | XREF5:

STATE OF KENTUCKY — DONNIE H. GINN — 20340 — LICENSED PROFESSIONAL ENGINEER — 11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

GENERAL
DRAWING LIST AND LOCATION MAPS

DESIGNED: WHA
DETAILED: DAD, ERH
CHECKED: RLK
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

G1
SHEET 1 OF 24

FD6000 08008

ABBREVIATIONS

A	AREA	E	EAST, ELECTRIC, ELECTRICAL	LAB	LABORATORY	REV	REVISION, REVISED, REVERSED
AB	ANCHOR BOLT	EA	EACH	LAM	LAMINATE(D)	RFG	ROOFING
AC	AIR CONDITIONING UNIT	EC	END CURVE	LAV	LAVATORY	RH	ROOF HOOD, RIGHT HAND,
ACST	ACOUSTIC	ECC	ECCENTRIC	LB(S)	POUND(S)		ROUND HEAD
AD	ACCESS DOOR, AREA DRAIN	EF	EACH FACE	LH	LEFT HAND	RHMS	ROUND HEAD MACHINCE SCREW
ADH	ADHESIVE	EJ	EXPANSION JOINT	LIN	LINEAL, LINEAR	RHWS	ROUND HEAD WOOD SCREW
ADJ	ADJUSTABLE, ADJACENT	EL	ELEVATION	LLH	LONG LEG HORIZONTAL	RO	ROUGH OPENING
ADMIN	ADMINISTRATION	ELEC	ELECTRICAL	LO	LOUVER OPENING	RR	RAILROAD
AF	AIR FLOW	ELEV	ELEVATION	LS	LABORATORY SINK, LEVEL	RT	RIGHT
AFF	ABOVE FINISH FLOOR	EMER	EMERGENCY		SWITCH, LIMIT SWITCH	RV	REGULATING VALVE
AH	AHEAD	END	ELECTRICAL MANHOLE	LT	LEFT	RHW	RIGHT OF WAY
AHU	AIR HANDLING UNIT	EOL	END OF LINE				
AL	ACTIVE LEAF	EPV	ECCENTRIC PLUG VALVE	MAS	MASONRY	S	SOUTH, SPEAKER
ALT	ALTERNATE	EQ	EQUAL	MAX	MAXIMUM	SAN SWR	SANITARY SEWER
ALUM	ALUMINUM	EQUIP	EQUIPMENT	MB	MACHINE BOLT	SCHED	SCHEDULE
APPROX	APPROXIMATE	EW	EACH WAY	MC	MECHANICAL COUPLING	SEC	SECOND
AR	ALARM RELAY	EWEF	EACH WAY EACH FACE	MCC	MOTOR CONTROL CENTER	SECT	SECTION
ARCH	ARCHITECTURAL	EWT&B	EACH WAY TOP & BOTTOM	MECH	MECHANICAL	SG	SLUICE GATE, SUPPLY GRILLE
ASSY	ASSEMBLY	EXIST	EXISTING	MED	MEDIUM	SH	SHEET
AUTO	AUTOMATIC	EXP	EXPANSION, EXPOSED	MET	METAL	SIM	SIMILAR
AUX	AUXILIARY	EXT	EXTENSION, EXTERIOR, EXTERNAL	MFR	MANUFACTURER	SM	SHEET METAL
AWG	AMERICAN WIRE GAGE			MG	MILLION GALLONS	SP	SUMP PUMP
		F TO F	FACE TO FACE	MGD	MILLION GALLONS PER DAY	SPA	SPACING, SPACES
B TO B	BACK TO BACK	FB	FACE BRICK	MH	MANHOLE	SPEC	SPECIFICATIONS
BA	BLOCKING AREA, BEARING AREA	FC	FLEXIBLE CONNECTION, FLOW CONTROL	MIN	MINIMUM	SQ	SQUARE
		FCA	FLANGED COUPLING ADAPTER	MISC	MISCELLANEOUS	SS	STAINLESS STEEL
BC	BEGIN CURVE	FD	FLOOR DRAIN	MJ	MECHANICAL JOINT	SSK	SERVICE SINK
BD	BOARD	FDN	FOUNDATION	MO	MASONRY OPENING, MOTOR OPERATED	ST SWR	STORM SEWER
BF	BLIND FLANGE	FE	FIRE EXTINGUISHER	MP	METERING PUMP	STA	STATION
BFV	BUTTERFLY VALVE	FH	FIRE HYDRANT	MS	MACHINE SCREW	STD	STANDARD
BITUM	BITUMINOUS	FHMS	FLAT HEAD MACHINE SCREW	MT	MOUNT	STL	STEEL
BK	BACK	FIN	FINISH	MTL	MATERIAL	STOR	STORAGE
BLDG	BUILDING	FIN GR	FINISH GRADE			STR	STRUCTURAL
BLK	BLOCK	FL	FLOOR, FLOW LINE	N	NORTH	SV	SHUTOFF VALVE
BM	BENCHMARK	FLEX	FLEXIBLE	NIA	NOT APPLICABLE	SW	SERVICE WATER
BOP	BOTTOM OF BASEPLATE	FLG	FLANGE	NBC	NAIL IN BOTTLE CAP	SYM	SYMMETRICAL
BOT	BOTTOM	FLR	FLOOR	NC	NORMALLY CLOSED	SYS	SYSTEM
BPMK NO	BASEPLATE MARK NUMBER	FRP	FIBERGLASS REINFORCED PLASTIC	N & F	NAIL & FLAG	T	TREAD
BRG	BEARING	FS	FAR SIDE, FLOOR SLEEVE, FLOAT SWITCH	NO	NORMALLY OPEN	TAN	TANGENT
BRK	BRICK			NO.	NUMBER	TAB	TOP AND BOTTOM
B&S	BELL AND SPIGOT	FT	FOOT, FEET	NOM	NOMINAL	TBM	TEMPORARY BENCH MARK
BU	BELL UP	FTG	FOOTING	NPT	NATIONAL PIPE THREAD	TEL	TELEPHONE, TELESCOPING
BUR	BUILT UP ROOFING	FURN	FURNISHED	NPW	NONPOTABLE WATER	TEMP	TEMPERATURE, TEMPORARY
BV	BALL VALVE			NTS	NOT TO SCALE	T&G	TONGUE AND GROOVE
BVC	BEGIN VERTICAL CURVE					TH	TEST HOLE
		GA	GAUGE	OC	ON CENTER	THK	THICK, THICKNESS
CB	CATCH BASIN	GAL	GALLONS	OD	OUTSIDE DIAMETER	TOC	TOP OF CONCRETE, TOP OF CURB
C TO C	CENTER TO CENTER	GALV	GALVANIZED	OF	OUTSIDE FACE, OVERFLOW	TOM	TOP OF MASONRY
CFM	CUBIC FEET PER MINUTE	GLV	GLOBE VALVE	OH	OVERHEAD	TOS	TOP OF STEEL
CHKD	CHECKERED	GPM	GALLONS PER MINUTE	OL	OVERLOAD	TYP	TYPICAL
CHKD PL	CHECKERED PLATE	GR	GRADE	OPER	OPERATING		
CI	CAST IRON	GV	GATE VALVE	OPNG	OPENING	UH	UNIT HEATER
CIMH	CAST IRON MANHOLE	GYP	GYPSUM	OPP	OPPOSITE	UNO	UNLESS NOTED OTHERWISE
CIP	CAST IRON PIPE			OSL	OUTSTANDING LEG	UR	URINAL
CISP	CAST IRON SOIL PIPE	H	HIGH	OZ	OUNCE	USGS	UNITED STATES GEOGRAPHICAL SURVEY
CJT	CONTROL JOINT	HB	HOSE BIBB				
CLR	CLEARANCE	HC	HOLLOW CORE	PC	POINT OF CURVATURE		
CMP	CORRUGATED METAL PIPE	HDR	HEADER	PCCP	PRESTRESSED CONCRETE CYLINDER PIPE	V	VOLT
CMU	CONCRETE MASONRY UNIT	HEX	HEXAGONAL	PE	PLAIN END	VAC	VACUUM
CO	CLEANOUT	HF	HOSE FAUCET	PI	POINT OF INTERSECTION	VB	VACUUM BREAKER
COL	COLUMN	HMC	HARNESSED MECHANICAL COUPLING	PIHC	POINT OF INTERSECTION ON HORIZONTAL CURVE	VC	VERTICAL CURVE, VICTAULIC
COMB SWR	COMBINED SEWER	HMJ	HARNESSED MECHANICAL JOINT			VCP	VITRIFIED CLAY PIPE
CONC	CONCRETE	HORIZ	HORIZONTAL	PL	PLATE	VERT	VERTICAL
CONN	CONNECTION	HP	HIGH POINT, HORSEPOWER	PLCS	PLACES	VNR	VENEER
CONST	CONSTRUCTION	HR	HOUR, HANDRAIL	POT	POINT ON TANGENT		
CONT	CONTINUATION	HV	HOSE VALVE	PP	POWER POLE	W	WEST, WIDE
CONTR	CONTRACTOR	HVAC	HEATING, VENTILATION AND AIR CONDITIONING	PR	PAIR	W/	WITH
CORR	CORRIDOR, CORRUGATED			PROJ	PROJECTION	WC	WATER CLOSET
CPLG	COUPLING	HW	HOT WATER	PRV	POWER ROOF VENTILATOR, PRESSURE REDUCING VALVE	WD	WOOD, WIDTH
CRNR	CORNER	HWY	HIGHWAY			WF	WALL FITTING
CTS	COURSES			PS	PIPE SUPPORT	WH	WALL HYDRANT
CS	CUP SINK			PSI	POUNDS PER SQUARE INCH	WO	WINDOW OPENING
CSK	COUTERSUNK	ID	INSIDE DIAMETER	PSIG	POUNDS PER SQUARE INCH GUAGE	W/O	WITHOUT
CT	CHEMICAL TANK, CERAMIC TILE	IF	INSIDE FACE	PT	POINT OF TANGENCY	WP	WEATHER PROOF
CTRS	CENTERS	IN	INCHES	PV	PLUG VALVE	WS	WATERSTOP
CU	CUBIC	INC	INCORPORATED	PVC	POLYVINYL CHLORIDE	WT	WEIGHT
CU YD	CUBIC YARD	INCR	INCREASE	PVMT	PAVEMENT	WW	WETWELL
CV	CHECK VALVE	INT	INTERIOR, INTERNAL	PW	POTABLE WATER	WWF	WELDED WIRE FABRIC
CW	COLD WATER	INV	INVERT				
		IPS	IRON PIPE SIZE, INCHES PER SECOND			X	BY, TIMES
DEPT	DEPARTMENT			R	RADIUS		
DET	DETAIL			RCP	REINFORCED CONCRETE PIPE		
DF	DRINKING FOUNTAIN	JB	JUNCTION BOX	RCCP	REINFORCED CONCRETE CYLINDER PIPE	YH	YARD HYDRANT
DI	DROP INLET	JF	JOINT FILLER				
DIA	DIAMETER	JT	JOINT	RD	ROOF DRAIN, ROAD	&	AND
DIM	DIMENSION			RDL	ROOF DRAIN LEADER	@	AT
DIP	DUCTILE IRON PIPE	KO	KNOCK OUT	RED	REDUCER	CL	CENTERLINE
DIST	DISTRIBUTION	KS	KITCHEN SINK	REG	REGULATOR, REGULATING	#	NUMBER
DN	DOWN	KV	KILOVOLT	REF	REFERENCE	%	PERCENT
DO	DOOR OPENING, DISSOLVED OXYGEN	KVA	KILOVOLT AMPERE	REINF	REINFORCE, (D), (ING), (MENT)		
DWG(S)	DRAWING(S)			REQD	REQUIRED		
DWLS	DOWELS			RET	RETURN		

MATERIALS LEGEND

- EARTH OR GRADE
- GRANULAR FILL (CRUSHED ROCK OR GRAVEL)
- ROCK
- NEW CONCRETE
- EXISTING CONCRETE, PRECAST OR PRESTRESSED CONCRETE
- CONCRETE MASONRY UNITS (CMU)
- CUT STONE OR SAND FILL, GROUT, MORTAR, AND PLASTER
- WOOD, STUDS, BEAMS, JOISTS, ETC.
- RIPRAP
- CHECKERED PLATE
- STEEL (FOR 1"SCALE & LARGER)
- STEEL OR ALUMINUM (FOR 3/4" SCALE & SMALLER)
- BAR GRATING (LINES IN DIRECTION OF SPAN)
- ALUMINUM
- INSULATION (RIGID)
- GRATING
- EXISTING ASPHALT PAVEMENT
- NEW ASPHALT PAVEMENT
- ENGINEERED FILL
- COMPACTED BACKFILL
- COMPACTED CLAY FILL
- DEMOLITION

GENERAL LEGEND

- HEDGE, BRUSH, SHRUBS
- HEDGE, BRUSH, SHRUBS
- SURFACED STREET, ROAD OR DRIVE
- SURFACED STREET, ROAD OR DRIVE WITH CURBS
- BUILDINGS, STRUCTURES
- STRUCTURES UNDERGROUND
- FUTURE BUILDINGS, STRUCTURES
- FENCE
- EXISTING FENCE
- FENCE, WOOD
- RAILROAD, EACH TRACK
- CENTERLINE
- CONCRETE WALK
- CB — CATCH BASIN
- MANHOLE
- DRAINAGE COURSE OR FLOW LINE
- EXISTING GROUND CONTOUR
- 326 — FINISH GRADE CONTOUR
- BANK OR SLOPE LINES
- #3 OR TB # / 83 — TEST BORING AND NUMBER
- SURVEY LINE WITH PI, PT, OR POT
- CONCRETE ENCASEMENT-PLAN
- CONCRETE REACTION BLOCKING AT BEND, PLUG OR TEE
- DRAINS OR CULVERTS
- TUNNEL CASING - PLAN
- SMALLER THAN 24" / 24" AND LARGER — EXISTING
- GENERAL LAYOUT YARD PIPING
- SMALLER THAN 24" / 24" AND LARGER — NEW
- NEW WATER LINE OR SEWER IN PROFILE

- NON-CONNECTING PIPING
- CONSTRUCTION EASEMENT LINE
- EASEMENT LINE
- RIGHT-OF-WAY LINE
- PROPERTY LINE
- PERMANENT EASEMENT LINE
- TEMPORARY EASEMENT LINE
- UTILITY EASEMENT LINE
- SURVEY LINE / SECTION LINE
- W — WATER LINE
- G — GAS LINE
- T — TELEPHONE (UNDERGROUND)
- OE — ELECTRICAL (OVERHEAD)
- E — ELECTRICAL (UNDERGROUND)
- P — T — POWER OR TELEPHONE LINES (OVERHEAD)
- (G) / (W) — WATER OR GAS VALVE
- (GM) / (GW) — WATER OR GAS METER
- TELEPHONE OR POWER POLE WITH GUY ANCHOR
- FIRE HYDRANT
- YARD HYDRANT
- STREET LIGHT POLE

PIPING ACCESSORIES LEGEND

- BLIND FLANGE
- CAP OR PLUG
- CO — CLEANOUT
- CROSS
- DIAPHRAGM SEAL
- ELBOW
- ELBOW DOWN
- ELBOW TURNING UP
- SIZE — HOSE CONNECTION
- QUICK COUPLING
- REDUCER
- RUPTURE DISK
- TEE
- TEE LINE DOWN
- TEE LINE UP
- WYE
- WYE STRAINER
- WYE STRAINER WITH BLOWOFF
- DRAIN OR BELL-UP
- VENT - SCREENED
- VENT
- EXPANSION COMPENSATOR
- ELECTROMAGNETIC/ ULTRASONIC FLOWMETER
- FM — FLOW METER

MISCELLANEOUS EQUIPMENT

- STATIC MIXER
- VERTICAL MIXER
- SIGHT GLASS
- CENTRIFUGE
- CHANNEL DIFFUSER
- COMPRESSOR OR BLOWER
- PIPE ANCHOR
- PUMP
- SLUICE GATE
- SLIDE GATE
- STOP PLATE
- BAR SCREEN
- EXPANSION TANK
- SCREW (LIFT) PUMP
- FLUME
- WEIR

SYMBOLS LEGEND

- T / AC45 — SECTION NUMBER OR DETAIL LETTER; DRAWING NUMBER ON WHICH SECTION OR DETAIL APPEARS; OR WHERE SECTION IS CUT OR DETAIL IS NOTED
- DOOR, WINDOW AND LOUVER SCHEDULE REFERENCE
- T / A045 — WALL ELEVATION
- ABBREVIATION
- D / 4 — SCHEDULE NUMBER
- F102 — ROOM NUMBER
- AREA DESIGNATION
- PV-10 — EQUIPMENT OR VALVE IDENTIFICATION CODE; EQUIPMENT NUMBER
- PV-10 — EQUIPMENT OR VALVE IDENTIFICATION CODE; EQUIPMENT NUMBER
- EQUIP / CALLOUT — EQUIPMENT REPRESENTATION WITH CALLOUT
- EXISTING FACILITY TO BE DEMOLISHED OR REMOVED
- BENCHMARK

VALVE LEGEND

- BACKFLOW PREVENTER
- PLUG VALVE, ECCENTRIC
- PLUG VALVE, NON-ECCENTRIC
- BUTTERFLY VALVE
- GATE VALVE
- BALL VALVE
- GLOBE VALVE
- CHECK VALVE

NOTE
SYMBOLS ON THIS SHEET WHICH ARE TO BE SHOWN AS EXISTING SHALL BE DELINEATED AS SCREENED
THOSE SYMBOLS WHICH ARE TO BE SHOWN AS NEW SHALL BE DELINEATED AS SOLID (HEAVY)

				1	DWG VAR 4.3
NOV 2005	REVISED SUBSEQUENT TO 100% REVIEW				
DATE	REVISIONS AND ISSUED OF ISSUE				
STACKET ID:	143757-3000-4YDC-0.dgn	XREF1:	143757-3000-4YDC-0.dgn	XREF3:	
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PLOTTED:	11/19/2005 11:46:53 AM			XREF5:	
USER:	DAVISBOOS				

DONNA H. DAVIS — 20156 — STATE OF KENTUCKY — PROFESSIONAL ENGINEER — 11/29/05

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

GENERAL
ABBREVIATIONS AND LEGENDS

DESIGNED: MHA
DETAILED: DAD, ERH
CHECKED: WLK
APPROVED:
DATE: 11/20/05

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

G2
SHEET
2 OF 24

FDS500
050819

TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

GENERAL NOTES FOR CIVIL DRAWINGS

1. EXISTING SITE INFORMATION BASED ON SURVEY COMPLETED IN MAY, 1997 BY VIOX AND VIOX INC., AND SURVEY COMPLETED IN OCTOBER, 2001 BY GREGORY C. SCHULTZ. COORDINATE SYSTEM INDICATED IS ESTABLISHED FOR THIS PROJECT ONLY. THE SOUTHEAST CORNER OF THE SLUDGE HANDLING BUILDING IS N 1000 E 1000.

2. ELEVATIONS ARE BASED ON USGS DATUM. BENCHMARKS AND/OR STRUCTURE ELEVATIONS FROM EXISTING SURVEYS OR REFERENCE DRAWINGS MAY RESULT IN VARIANCES WITH ELEVATIONS INDICATED ON THE DRAWINGS FOR EXISTING FACILITIES.

3. EXISTING UTILITIES AND STRUCTURES (UNDERGROUND, SURFACE, OR OVERHEAD) ARE INDICATED ONLY TO THE EXTENT THAT SUCH INFORMATION WAS KNOWN, OR MADE AVAILABLE TO, OR DISCOVERED BY THE ENGINEER IN PREPARING THE DRAWINGS. THE LOCATIONS, CONFIGURATIONS, AND ELEVATIONS OF SUBSURFACE FACILITIES AND UTILITIES ARE APPROXIMATE, AND NOT ALL UTILITIES AND FACILITIES MAY BE INDICATED. OVERHEAD UTILITIES ARE NOT INDICATED IN ARCHITECTURAL ELEVATIONS, PROFILE OR SECTION DRAWINGS. THE ENGINEERING INVESTIGATIONS, LOCATION, AND DESIGNATION OF SUBSURFACE UTILITIES INDICATED IN THESE CONTRACT DOCUMENTS HAS BEEN PERFORMED TO QUALITY LEVEL C IN ACCORDANCE WITH GENERALLY ACCEPTED ENGINEERING PRINCIPLES AND PRACTICES AS OUTLINED IN ASCE STANDARD AND GUIDELINE BULLETIN CI/ASCE 38-02 UNLESS OTHERWISE DESIGNATED. WHERE SUCH ACTIVITIES HAVE BEEN TO A HIGHER LEVEL OF QUALITY, THE HIGHER QUALITY LEVEL FOR THE AFFECTED AREAS IS INDICATED IN THE CONTRACT DOCUMENTS.

4. 'SCREENED' (LIGHT) DELINEATION INDICATED ON THE DRAWINGS DENOTES EXISTING FACILITIES. 'SCREENED' INFORMATION WAS TAKEN FROM EXISTING CONSTRUCTION DRAWINGS AND DATA, IS FOR REFERENCE ONLY, AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO THE ORDERING OF MATERIALS AND BEGINNING OF CONSTRUCTION. 'BOLD' DELINEATION IS NEW WORK TO BE CONSTRUCTED UNDER THIS CONTRACT.

5. CONTRACTOR'S STAGING, PARKING AND MATERIAL STORAGE SHALL BE LIMITED TO THE SPACE(S) DESIGNATED ON THE DRAWINGS. PROVIDING ADDITIONAL STORAGE OR PARKING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

6. CALL BEFORE YOU DIG. VERIFY PRECISE LOCATIONS AND ELEVATIONS OF ALL UTILITIES AND STRUCTURES, WHETHER INDICATED ON THE DRAWINGS OR NOT, IN THE FIELD IN ADVANCE OF EXCAVATING, BY CONTACTING ALL UTILITIES AND OTHER AGENCIES, AND BY PROSPECTING. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL, DEMOLITION, RECONSTRUCTION, AND RECONNECTION OF EXISTING FACILITIES AS REQUIRED TO COMPLETE THE WORK. IF REQUIRED AFTER FIELD VERIFICATION, CONTRACTOR SHALL COORDINATE WITH THE OWNER AND ENGINEER TO DETERMINE ANY NECESSARY MODIFICATIONS TO PROPOSED NEW WORK.

7. BEFORE CONSTRUCTION IS STARTED, COORDINATE WITH THE OWNER OF EACH UTILITY AND DEFINE THE REQUIREMENTS AND METHODS TO ACCOMMODATE THE PROTECTION, TEMPORARY SUPPORT, ADJUSTMENT, OR RELOCATION OF ANY UTILITIES AFFECTED BY THE PROPOSED NEW WORK.

8. COMPLY WITH THE GOVERNING AGENCY, NPDES CONSTRUCTION REQUIREMENTS, AND PROVIDE APPROPRIATE MITIGATION MEASURES OR PROTECTION AND RESTORATION AT ALL LOCATIONS AS REQUIRED BY THEIR OPERATIONS, AND AS DIRECTED BY ENGINEER. SPECIAL CONSTRUCTION REQUIREMENTS, TEMPORARY PROTECTIVE FENCING OR BARRICADES, SHEETING, SHORING, EROSION PROTECTION, AND SURFACE RESTORATION AT CERTAIN LOCATIONS ARE INDICATED ON THE DRAWINGS TO BRING CONTRACTOR'S ATTENTION TO SENSITIVE AREAS.

9. PROTECT ALL PROPERTY CORNER MARKERS. PROPERTY CORNER MARKERS DAMAGED BY CONSTRUCTION ACTIVITIES SHALL BE REESTABLISHED BY A PROFESSIONAL SURVEYOR LICENSED IN THE STATE OF KENTUCKY.

10. PROTECT AND MAINTAIN ALL EXISTING TREES, SHRUBS, AND PLANTS UNLESS OTHERWISE NOTED.

11. INSTALL ALL PIPELINES, PAVING, WALKWAYS, AND CURB AND GUTTER AT A UNIFORM GRADE BETWEEN ELEVATIONS DEPICTED ON THE DRAWINGS.

12. FOR ALL SITE GRADING, SMOOTH PARABOLIC TRANSITIONS SHALL BE MADE BETWEEN CHANGES IN SLOPE. PARABOLIC ROUNDING SHALL APPLY TO ALL CUT AND FILL SECTIONS.

13. FINISHED GRADE ELEVATION AT THE BUILDING FACE, WHERE NOT ADJACENT TO PAVEMENT, SHALL BE APPROXIMATELY 6 INCHES BELOW FINISHED FLOOR ELEVATION UNLESS OTHERWISE NOTED.

14. THE CONTRACTOR'S OPERATIONS SHALL CONFORM TO THE RULES AND REGULATIONS OF THE STATE CONSTRUCTION SAFETY ORDERS PERTAINING TO EXCAVATION AND TRENCHING.

15. THE DRAWINGS INDICATE TYPES OF PIPE SUPPORT SYSTEMS AT VARIOUS LOCATIONS. HOWEVER, All PIPE SUPPORTS, HANGERS, BRACKETS, INSERTS OR BRACES ARE NOT SHOWN. CONTRACTOR SHALL REFER TO THE SPECIFICATIONS AND PROVIDE A COMPLETE SUPPORT SYSTEM AS REQUIRED.

16. THE TERM 'BY OTHERS' AS INDICATED ON THE DRAWINGS MEANS THE ITEM IS DESIGNED OR PLANNED TO BE PROVIDED BY OWNER OR OTHERS SEPARATE FROM THIS CONTRACT. THE TERM 'FUTURE' AS INDICATED ON THE DRAWINGS REFERS TO THE ENGINEER'S INTERPRETATION OF THE ITEM FOR THE FUTURE, BASED ON AVAILABLE INFORMATION.

17. THE EXISTING PROCESS FACILITIES SHALL REMAIN IN OPERATION CONTINUOUSLY THROUGHOUT THE CONSTRUCTION ACTIVITIES. INDIVIDUAL PROCESS FACILITIES CAN BE TAKEN OUT OF SERVICE FOR LIMITED PERIODS OF TIME TO FACILITATE CONSTRUCTION AS SPECIFIED IN THE CONTRACT DOCUMENTS.

18. STRUCTURES SUCH AS CURBS AND GUTTERS, CONCRETE AND ASPHALT DRIVES AND WALKWAYS, PAVING BRICKS, FENCING, RETAINING WALLS, ETC., CROSSED BY THE PIPELINE ARE NOT ALL INDICATED IN PROFILE. CONTRACTOR SHALL RESTORE ANY EXISTING STRUCTURES THAT ARE DISTURBED, DAMAGED OR REMOVED BY CONSTRUCTION TO MATCH EXISTING.

19. FIELD VERIFY PRECISE LOCATION, ELEVATION, AND ARRANGEMENT OF CONNECTIONS OF NEW PIPELINES WITH EXISTING PIPELINES BASED ON FIELD CONDITIONS, INCLUDING EXPOSING EXISTING PIPING PRIOR TO FABRICATING NEW PIPING. CONTRACTOR SHALL PROVIDE FITTINGS, ADAPTERS, SOLID SLEEVE CLOSURES, AND HARNESSED MECHANICAL COUPLING; ROTATE FITTINGS; DEFLECT JOINTS; AND MODIFY EXISTING PIPING AS APPLICABLE AND AS REQUIRED TO MAKE CONNECTIONS, INCLUDING ADJUSTMENTS FOR ANY OFFSETS IN CENTERLINE ELEVATIONS BETWEEN PIPELINES. CONTRACTOR SHALL PROVIDE TEMPORARY PLUG WITH FACTORY OUTLET SIZED AS REQUIRED FOR CONTRACTOR'S TESTING AND DISINFECTION WORK BEFORE MAKING CONNECTION, WHEN APPLICABLE. CONTRACTOR SHALL COORDINATE MAKING EACH CONNECTION WITH THE OWNER AND ENGINEER.

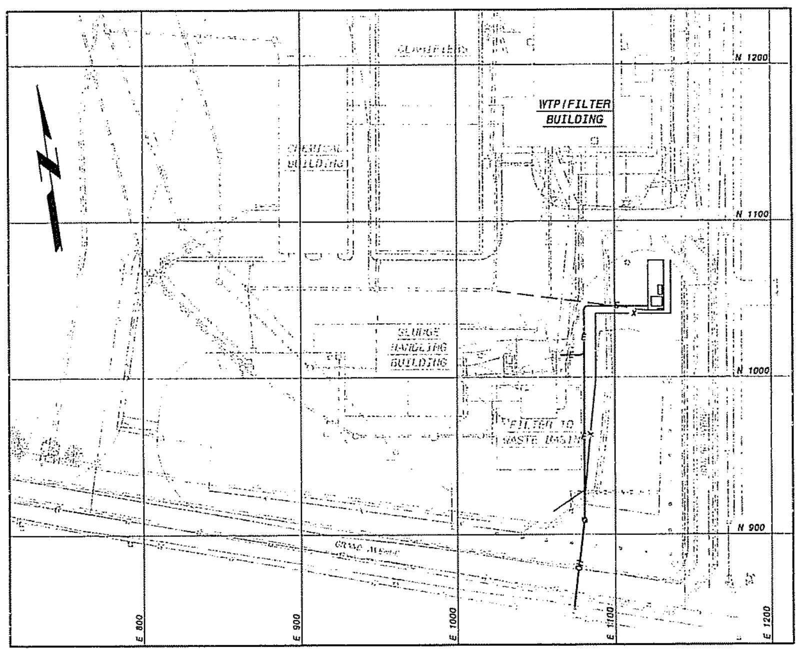
DESIGN INFORMATION

DESIGN FLOWS

PLANT DESIGN FLOW, MGD	12
ANNUAL AVERAGE FLOW, MGD	6
PLANT MINIMUM FLOW, MGD	4

ULTRAVIOLET DISINFECTION SYSTEM

NUMBER OF UNITS	2
TYPE	MEDIUM PRESSURE
CAPACITY, MGD	12
DESIGN UV TRANSMITTANCE, %	89
DESIGN DOSE, mJ/cm²	40



KEY PLAN
1" = 40'-0"

NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	
DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK

CYGNET ID: 143757-3000-WTUP-C-00000SCHT | XREF1: Existing Site Plan.DWG
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SAVED: DUN38005, 11/17/2006 3:48:18 PM | XREF3:
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USER: DUN38005 | DWG VER: 4.5 | XREF5:

STATE OF KENTUCKY DONNIE H. GINN 20348 LICENSED PROFESSIONAL ENGINEER 11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

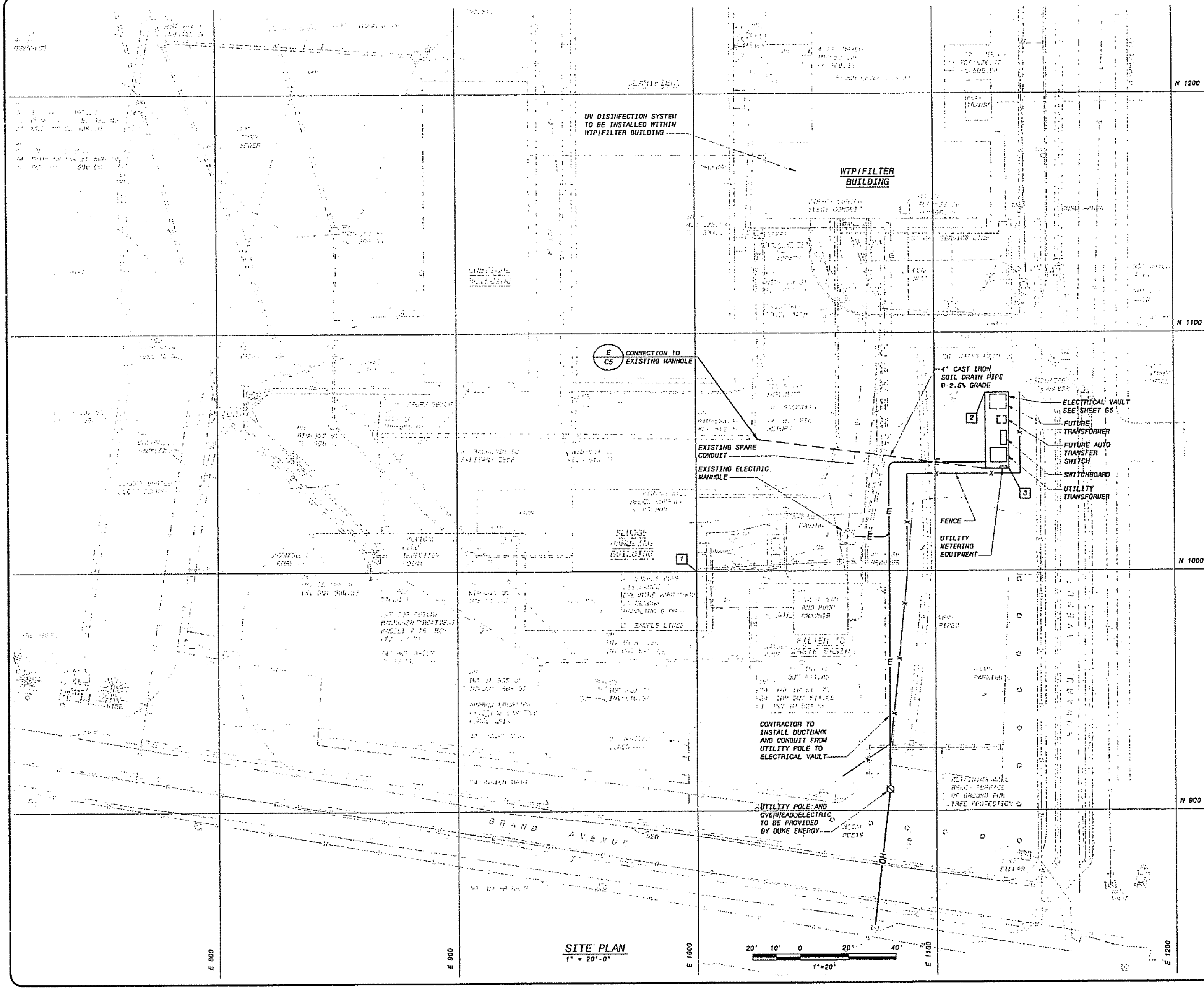
GENERAL
GENERAL NOTES AND DESCRIPTION OF FACILITIES

DESIGNED: MHA
DETAILED: DAD, ERH
CHECKED: WLK
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

G3
SHEET 3 OF 24



SITE PLAN
1" = 20'-0"

ID NO.	LOCATION	COORDINATES
1	SE CORNER OF SLUDGE HANDLING BUILDING	N 1000.00 E 1000.00
2	NW CORNER OF ELECTRICAL VAULT	N 1074.70 E 1121.20
3	SE CORNER OF ELECTRICAL VAULT	N 1042.70 E 1131.20

NOTES:

1. COORDINATE FINAL FENCE LOCATION WITH OWNER AND ENGINEER.
2. ENSURE THAT NOISE AND DISTURBANCE DUE TO CONSTRUCTION IS KEPT TO A MINIMUM DURING SCHOOL HOURS SO AS NOT TO INTERFERE WITH SCHOOL ACTIVITIES.

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK
1	NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	DAD	MHA

CYDNEY ID: 143757-2000-WTUP-C-B0000BCYX
XREF1: Existing Site Plan.DWG
XREF2: Site Plan.DWG
XREF3: NKWD-28.PHASE2.dwg
SAVED: DUN38005, 11/17/2006 3:50:56 PM
DWG VER: 4.5

STATE OF KENTUCKY
DONNIE H. DUNN
PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

GENERAL
SITE PLAN

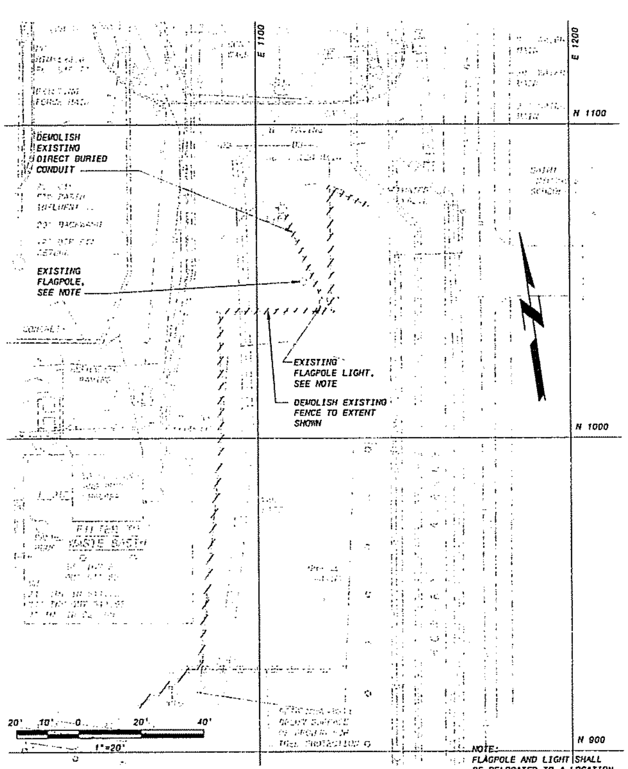
DESIGNED: MHA
DETAILED: DAD, ERH
CHECKED: MLK
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

G4
SHEET
4 OF 24

FD6000
D6009

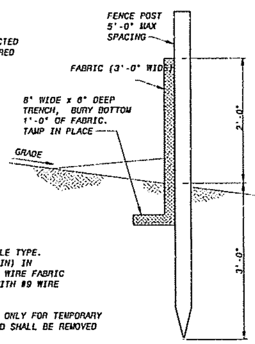


NOTE:
FLAGPOLE AND LIGHT SHALL BE RELOCATED TO A LOCATION ACCEPTABLE TO OWNER.

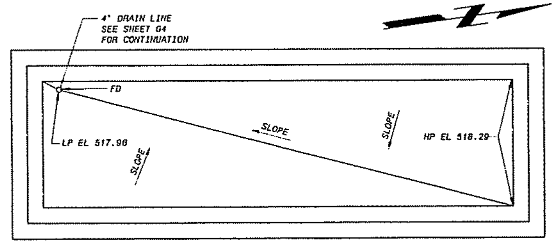
SITE DEMOLITION PLAN
1" = 20'-0"

NOTES:

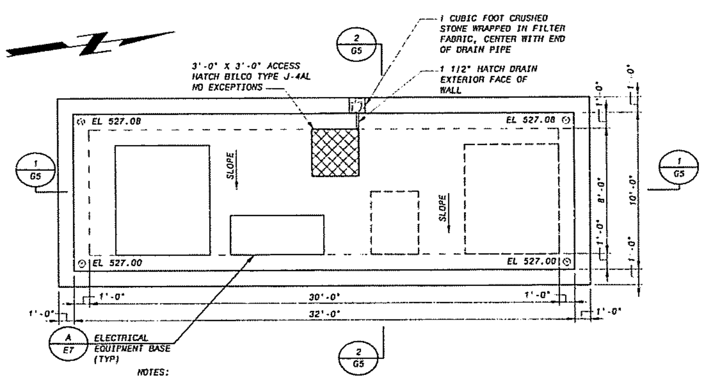
1. SILT FENCE MAY BE FIELD CONSTRUCTED AND INSTALLED OR A PREMANUFACTURED FENCE MAY BE USED.
2. FOR FIELD CONSTRUCTED FENCE:
   A. WIRE SHALL BE 32" (MIN) IN WIDTH AND HAVE 6 WIRES (MIN) WITH 12" STAY SPACING.
   B. FILTER FABRIC SHALL BE MIRA 100X, AMOCO CONSTRUCTION FABRIC SILT STOPPER OR APPROVED EQUAL.
   C. FILTER FABRIC SHALL BE 36" WIDE (MIN) AND SHALL BE ADEQUATELY FASTENED TO THE WIRE.
   D. STEEL POSTS SHALL BE 5'-0" (MIN) HEIGHT AND BE OF THE SELF-FASTENING ANGLE TYPE.
   E. WOOD POSTS SHALL BE 5'-0" (MIN) IN HEIGHT AND 3" (MIN) IN DIA. WIRE FABRIC SHALL BE FASTENED TO POSTS WITH #9 WIRE STAPLED (MIN) 1 1/2" LONG.
3. SILT FENCING SHALL BE INSTALLED ONLY FOR TEMPORARY EROSION AND SEDIMENT CONTROL AND SHALL BE REMOVED FOLLOWING PROJECT COMPLETION.
4. SILT FENCE SHALL BE INSTALLED AROUND THE ENTIRE PERIMETER OF THE CONSTRUCTION SITE AND SHALL BE MAINTAINED THROUGHOUT THE PROJECT ACCEPTABLE TO THE OWNER.
5. SILT FENCE SHALL NOT BE REMOVED UNTIL AN ACCEPTABLE STAND OF VEGETATION HAS BEEN PROVIDED OR SURFACE RESTORATION IS COMPLETE.



SILT FENCE (A)
NO SCALE



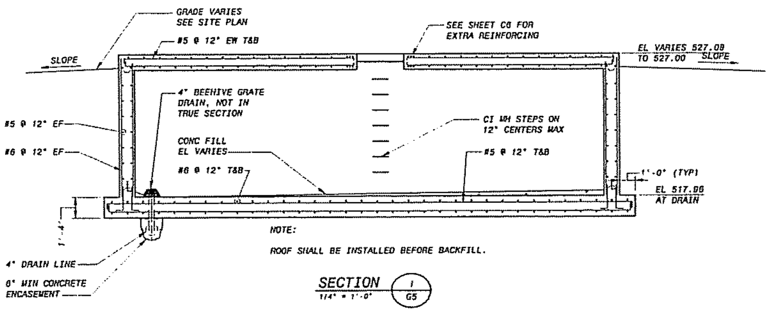
ELECTRICAL VAULT PLAN @ EL 517.96
1/4" = 1'-0"



NOTES:

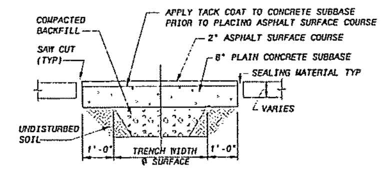
1. ACCESS HATCH SHALL BE MANUFACTURED BY BILCO WITH SS HARDWARE WITHOUT EXCEPTION. THE DRAIN OPENING FOR THE ACCESS HATCH FRAME SHALL BE PIPED TO THE FLOOR DRAIN INSIDE THE VAULT OR TO A 2'-0"L X 2'-0"H X 2'-0"W GRAVEL PACK NEAR THE VAULT. THE GRAVEL PACK SHALL BE COVERED BY FILTER FABRIC ALL AROUND.
2. CONTRACTOR SHALL COORDINATE LOCATIONS OF ELECTRICAL WALL AND SLAB PENETRATIONS.

ELECTRICAL VAULT PLAN
1/4" = 1'-0"



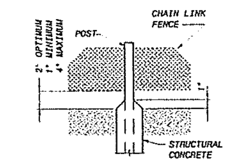
NOTE:
ROOF SHALL BE INSTALLED BEFORE BACKFILL.

SECTION (1 / G5)
1/4" = 1'-0"



NOTE:
1. TYPICAL FOR ALL ASPHALT DRIVES AND PARKING AREAS.

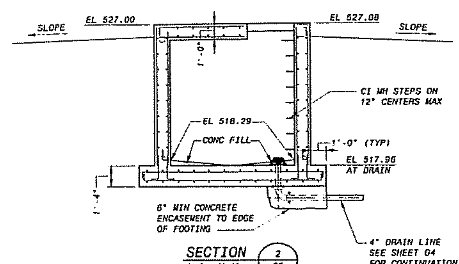
ASPHALT PAVEMENT REPAIR DETAIL (B)
NO SCALE



NOTES:

1. PLACE CONCRETE 1" ABOVE GROUND SURFACE AT POST AND SLOPE TO THE GROUND TO KEEP MOISTURE FROM ACCUMULATING AROUND POST. CONCRETE SURFACE TO BE FLOATED.
2. POST SPACING SHALL BE 10'-0" MAX. CENTER TO CENTER.
3. POST SHALL BE SET MIN. 3'-0" BELOW GRADE W/ CONCRETE MIN 6" ALL AROUND.

FENCE POST (C)
NO SCALE



SECTION (2 / G5)
1/4" = 1'-0"

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK.
NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	

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WP: G5.DWG
SAVED: DUN38005, 11/17/2006 3:52:29 PM
PLOTTED:
USER: DUN38005
XREF1: Existing Site Plan.DWG
XREF2: Site Plan.DWG
XREF3:
XREF4:
XREF5:
DWG VER: 4.6

STATE OF KENTUCKY
DONNIE H. GINN
20346
PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

GENERAL
SITE DEMOLITION PLAN, SITE DETAILS AND ELECTRICAL VAULT PLANS AND SECTIONS

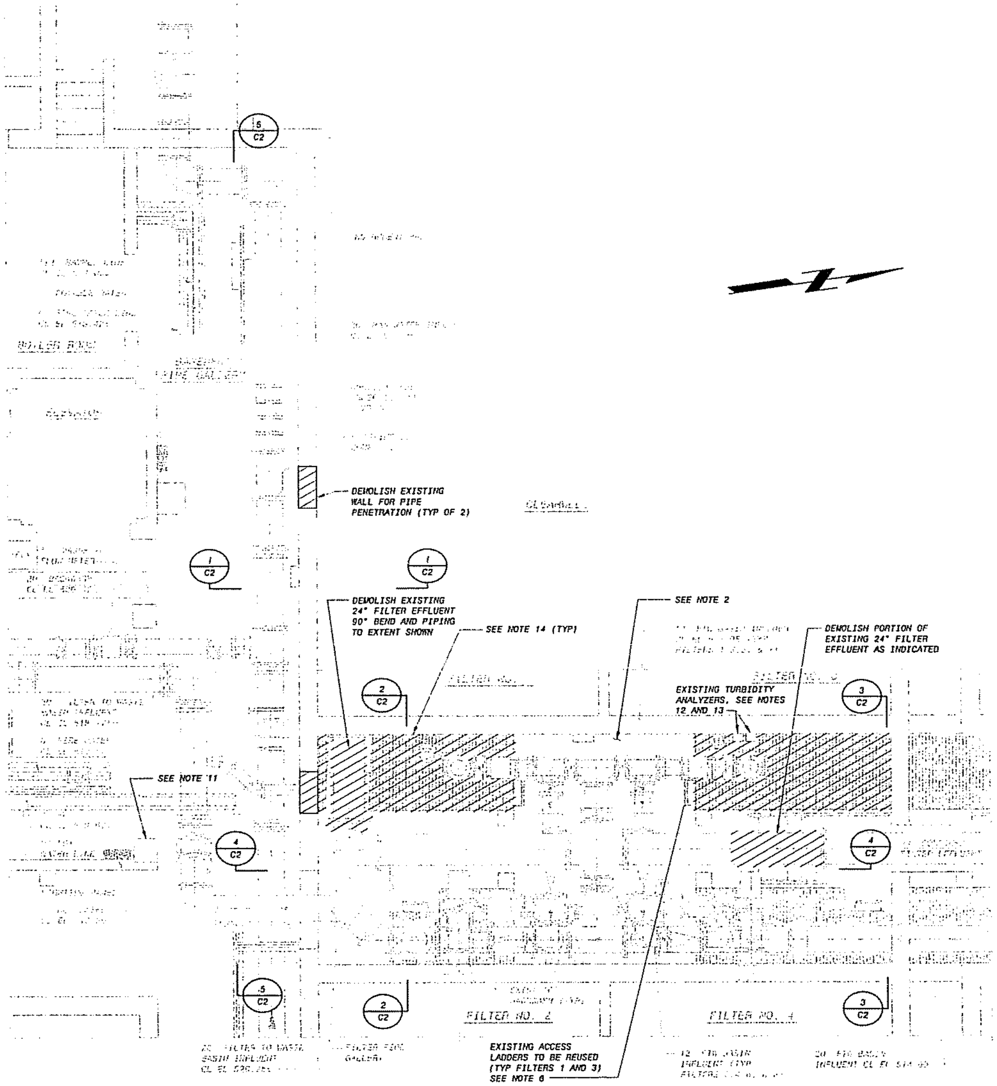
DESIGNED: WHA, ES
DETAILED: DAD
CHECKED: MLK
APPROVED:
DATE: 11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

G5
SHEET
5 OF 24

F08000
D6009



PLAN
1/4" = 1'-0"

NOTES:

1. FITTING CALLOUTS, REMOVAL AND RELOCATIONS ARE TYPICAL ABOUT THE CENTERLINE OF THE FILTER PIPE GALLERY.
2. EXISTING TURBIDITY ANALYZERS, LOSS OF HEAD TRANSMITTERS, HOSE REEL, ASSOCIATED SMALL DIAMETER PIPING, ELECTRICAL AND OTHER MISCELLANEOUS APPURTENANCES SHALL BE RELOCATED FOR FILTERS 1 AND 3 AND THE EXISTING LOSS OF HEAD PIPING AND INSTRUMENTATION SHALL BE MODIFIED AND RELOCATED TO NEW LOCATIONS AS SHOWN ON THE ELECTRICAL DRAWINGS.
3. A MAXIMUM OF TWO (2) FILTERS ARE ALLOWED TO BE OUT OF SERVICE AT A TIME. CONTRACTOR SHALL PLAN OPERATIONS SUCH THAT FILTER CAN BE BROUGHT BACK INTO SERVICE WITHIN 48 HOURS, IF OWNER REQUIRES.
4. CONTRACTOR SHALL TAKE ALL MEASURES NECESSARY TO PROTECT EXISTING PIPING, VALVES AND OTHER ITEMS DURING CONSTRUCTION ACCEPTABLE TO OWNER AND ENGINEER.
5. EXISTING PIPE SUPPORTS AND OTHER MISCELLANEOUS APPURTENANCES NOT SHOWN. CONTRACTOR SHALL INSPECT EXISTING FACILITIES PRIOR TO SUBMITTING A BID TO DETERMINE ALL CONSTRAINTS THAT MAY AFFECT CONSTRUCTION ACTIVITIES, AND INCLUDE ALL COST ASSOCIATED WITH THEM IN ITS BID.
6. EXISTING ACCESS LADDERS FOR FILTERS 1 AND 3 SHALL BE RELOCATED AS ACCEPTABLE TO OWNER AND ENGINEER.
7. CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS AND DIMENSIONS AND SHALL MAKE MODIFICATIONS AS REQUIRED FOR NEW WORK, ACCEPTABLE TO OWNER AND ENGINEER.
8. SEE SHEET C3 AND C4 FOR NEW PIPING SYSTEMS AND NEW LOCATIONS OF ITEMS INDICATED TO BE RELOCATED.
9. REMOVE EXISTING SAMPLE PUMP INCLUDING ASSOCIATED ACCESSORIES, PIPING AND ELECTRICAL. CAP EXISTING SAMPLE LINES LOCATED ON EAST WALL ACCEPTABLE TO OWNER.
10. THE EXISTING 1/2" SAMPLE LINE SHALL BE MODIFIED AS REQUIRED TO AVOID INTERFERENCE WITH THE NEW PIPING.
11. THE EXISTING ELECTRICAL CONDUIT SHALL BE MODIFIED AS ACCEPTABLE TO THE ENGINEER SO AS TO AVOID INTERFERENCE WITH NEW EQUIPMENT, PIPING, VALVES AND ASSOCIATED ELECTRICAL AND INSTRUMENTATION.
12. THE EXISTING TURBIDITY ANALYZERS AND LOSS OF HEAD TRANSMITTERS FOR FILTERS 1 AND 3 SHALL BE RELOCATED. SEE ELECTRICAL DRAWINGS FOR NEW LOCATION. ALL WATER PIPING ASSOCIATED WITH THE TURBIDITY ANALYZERS AND LOSS OF HEAD TRANSMITTER PIPING SHALL BE RIGID PVC.
13. THE TURBIDITY ANALYZERS ARE CONNECTED TO THE EXISTING TURBIDITY ANALYZER CONTROL PANEL SHOWN. ALL SIGNAL CABLES ASSOCIATED WITH THE RELOCATED TURBIDITY ANALYZERS SHALL BE ROUTED IN NEW CONDUITS FROM THE ANALYZER TO CONTROL PANEL. CONTRACTOR TO COORDINATE THE ASSOCIATED WORK WITH THE ELECTRICAL CONTRACTOR.
14. COORDINATE DEMOLITION OF EXISTING PLATFORM AND HANDRAIL WITH OWNER AND ENGINEER. A TEMPORARY PLATFORM SHALL BE PROVIDED TO PERMIT ACCESS TO PIPING AND VALVES AS NEEDED BY OWNER. TEMPORARY PLATFORM SHALL BE SUBMITTED TO ENGINEER FOR REVIEW.

NO.	BY	CK	DATE	REVISIONS AND RECORD OF ISSUE
1	DAD		NOV 2006	REVISED SUBSEQUENT TO ADDX REVIEW

CYGNET ID: 143757-3000-WTUP-C-00000BCPO | XREF1: C-FPG-BASEMENT-DEMO.DWG
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PLOTTED: | XREF4:
USER: DUN38005 | DWG VER: 4.5 | XREF5:

STATE OF KENTUCKY DONNIE H. GINN 20140 PROFESSIONAL ENGINEER 11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

CIVIL
BASEMENT AND FILTER PIPE GALLERY
DEMOLITION PLAN

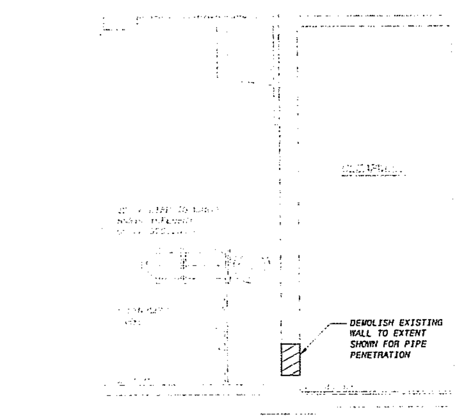
DESIGNED: WNA
DETAILED: DAD
CHECKED: WLK
APPROVED:
DATE: 11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

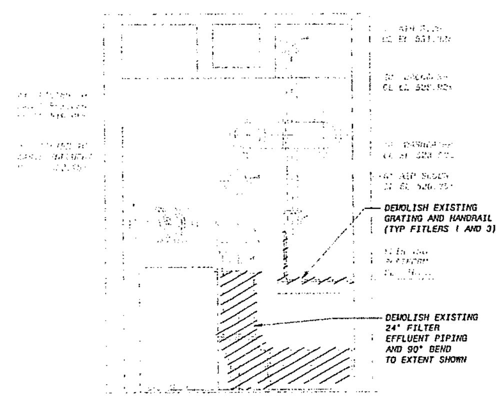
PROJECT NO. 143757

C1
SHEET 6 OF 24

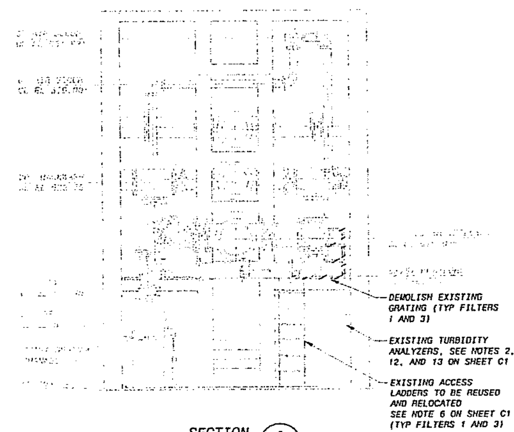
F06000
06009



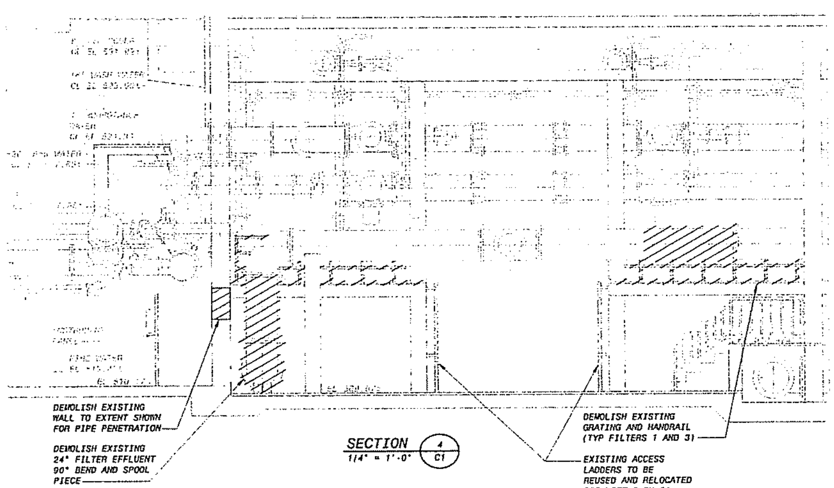
SECTION 1/C1
1/4" = 1'-0"



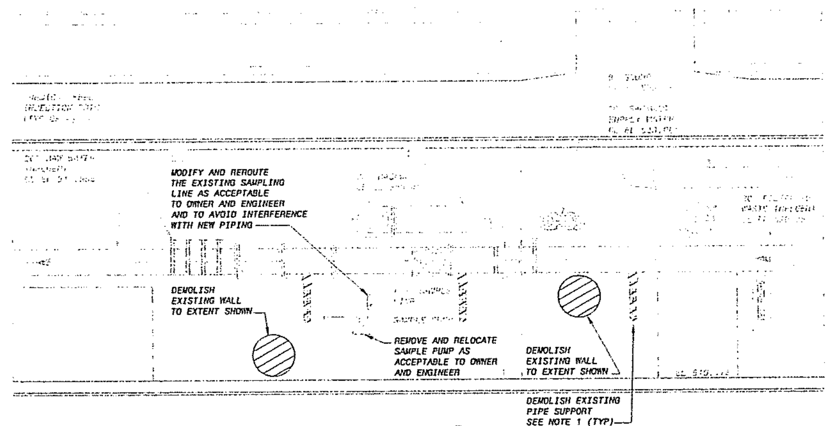
SECTION 2/C1
1/4" = 1'-0"



SECTION 3/C1
1/4" = 1'-0"



SECTION 4/C1
1/4" = 1'-0"



SECTION 5/C1
1/4" = 1'-0"

NOTE:

1. COORDINATE DEMOLITION OF PIPE SUPPORTS FOR 20" RAW WATER PIPE WITH OWNER AND ENGINEER. TEMPORARY PIPE SUPPORTS SHALL BE PROVIDED AS REQUIRED TO SUPPORT EXISTING PIPING DURING CONSTRUCTION. TEMPORARY PIPE SUPPORTS SHALL BE SUBMITTED TO ENGINEER FOR REVIEW.

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK
NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	MHA

CYGNET ID: 143757-3000-WTUP-C-B0008CPL XREF1: C-FPG-BASEMENT-DEMO.DWG
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SAVED: DUN38005, 11/20/2006 10:08:37 AM XREF3:
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USER: DUN38005 DAD VER: 4.4 XREF5:

STATE OF KENTUCKY DONNIE H. GINN 20345 PROFESSIONAL ENGINEER 11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

CIVIL
BASEMENT AND FILTER PIPE GALLERY
DEMOLITION SECTIONS

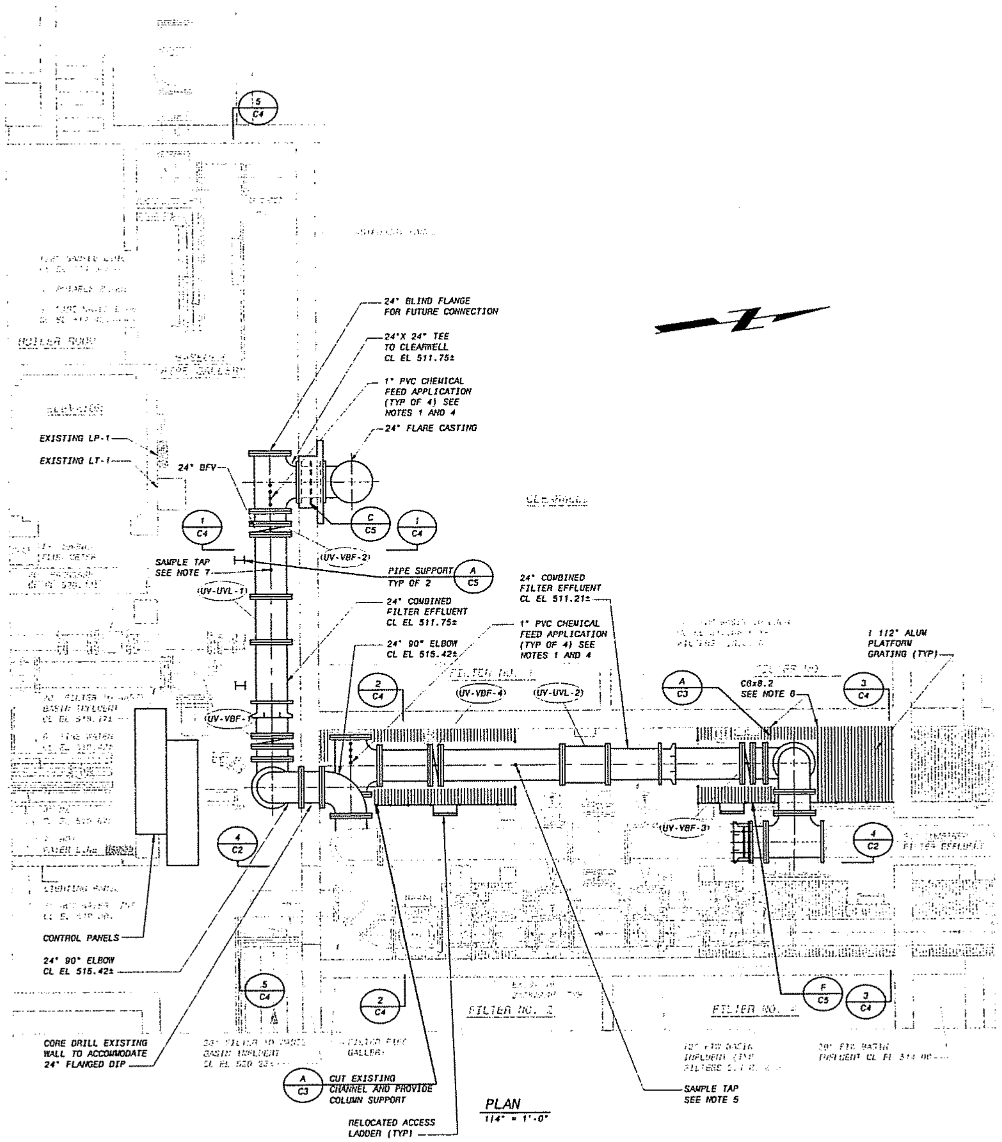
DESIGNED: MHA
DETAILED: DAD
CHECKED: WLK
APPROVED:
DATE: 11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

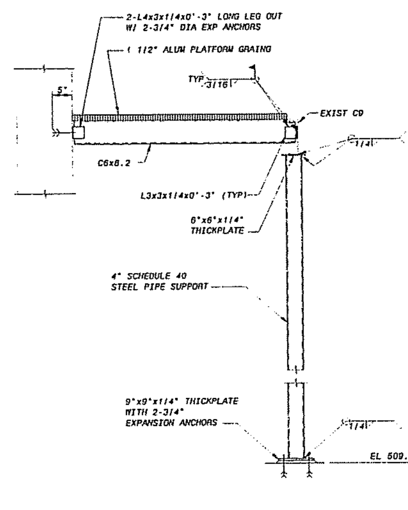
PROJECT NO. 143757

C2
SHEET 7 OF 24

F06000
06009



PLAN
1/4" = 1'-0"



GRATING SUPPORT (A / C3)
NO SCALE

NOTES:

1. NEW CHEMICAL APPLICATION TAPS SIMILAR TO EXISTING QUICK CONNECT HOSE COUPLING AS REQUIRED FOR COMPLETE OPERATIONAL SYSTEM. COORDINATE WITH OWNER.
2. SEE ELECTRICAL DRAWINGS FOR NEW LOCATION OF TURBIDITY ANALYZERS, CHLORINE RESIDUAL ANALYZERS, AND LOSS OF HEAD INSTRUMENTATION.
3. NEW PIPING IN THE FILTER GALLERY SHALL BE SUPPORTED TO MATCH EXISTING PIPING.
4. ROUTE THE CHEMICAL FEED PIPING FROM THE EXISTING PIPING TO THE APPLICATION TAP AS ACCEPTABLE TO OWNER AND ENGINEER. NOT ALL FEED PIPING IS SHOWN. REFER TO SHEET P4. ALL PIPING SHALL BE LABELED TO INDICATE THE SERVICE AND FEED LOCATION.
5. SAMPLE TAP SHALL BE INSTALLED AT PIPE INVERT IN A LOCATION ACCEPTABLE TO OWNER AND ENGINEER.
6. EXISTING PLATFORM GRATING SUPPORTS SHALL BE UTILIZED. WHERE 24" DIP PASSES THROUGH PLATFORM ADDITIONAL SUPPORTS SHALL BE INSTALLED AND CONNECTED TO EXISTING STRUCTURE.
7. LOCATION OF SAMPLE TAP SHALL BE ACCEPTABLE TO OWNER AND ENGINEER. SAMPLE TAP SHALL BE EASILY ACCESSIBLE AND ORIENTED DOWN.

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK
NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	MHA

CYGNET ID: 143757-3000-NTUP-C-B0000BCPU | XREF1: C-FPG-BASEMENT-DEMO.DWG
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SAVED: DUN38005, 11/20/2006 10:10:18 AM | XREF3:
PLOTTED: | XREF4:
USER: DUN38005 DWG VER: 4.4 | XREF5:

STATE OF KENTUCKY DONNIE H. GINN 20346 LICENSED PROFESSIONAL ENGINEER 11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT TAYLOR MILL TREATMENT PLANT UV DISINFECTION

CIVIL
BASEMENT AND FILTER PIPE GALLERY PLAN

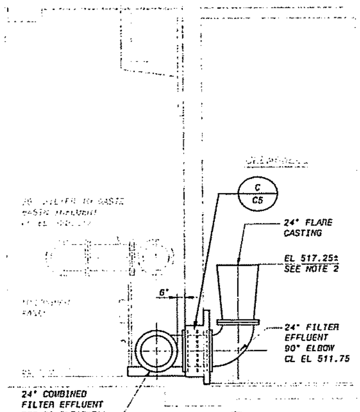
DESIGNED: MHA
DETAILED: DAD
CHECKED: WLR
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

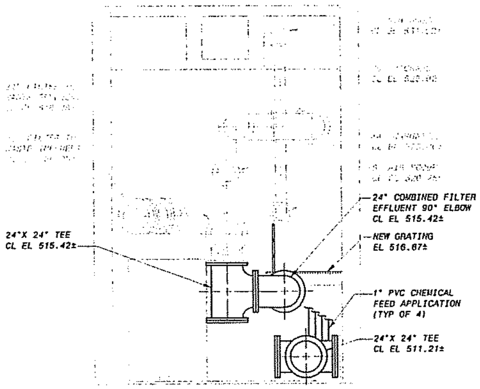
PROJECT NO. 143757

C3
SHEET 8 OF 24

F06000 D6009



SECTION 1/C3
1/4" = 1'-0"



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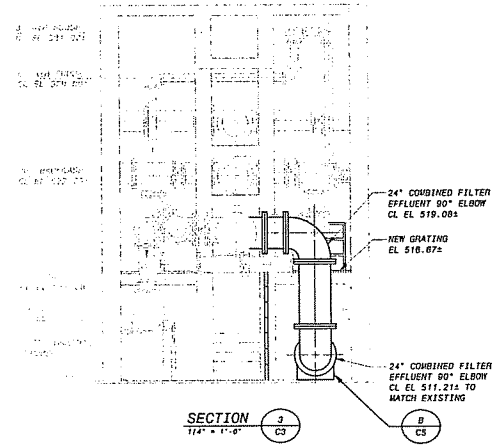
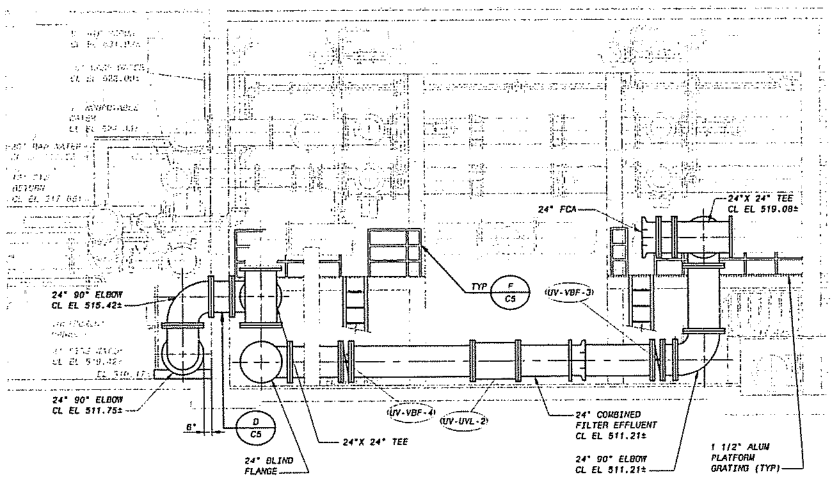
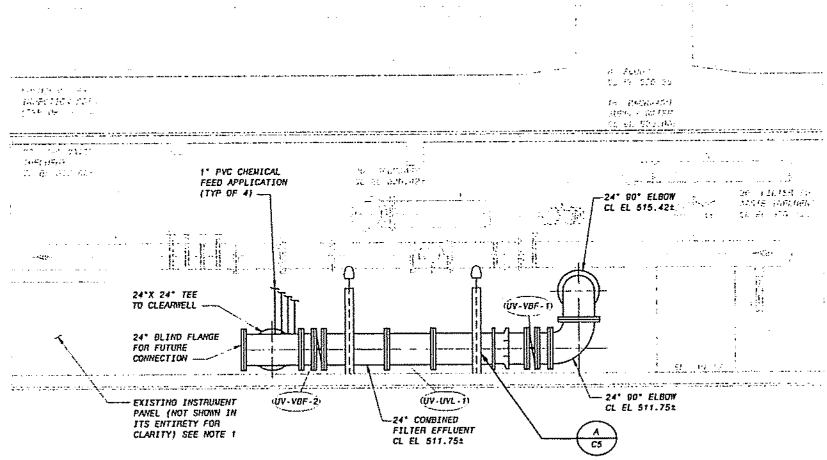


SECTION 3/C3
1/4" = 1'-0"



SECTION 4/C3
1/4" = 1'-0"



SECTION 5/C3
1/4" = 1'-0"

NOTES:

1. UV EQUIPMENT DRAIN FOR UV-UVL-1 SHALL CONNECT TO EXISTING INSTRUMENTATION PANEL DRAIN. ROUTE DRAIN PIPING FROM THE NEW UV EQUIPMENT AND EXISTING INSTRUMENTATION PANEL TO EXISTING SUMP AS ACCEPTABLE TO OWNER AND ENGINEER. NOT ALL DRAIN PIPING IS SHOWN. REFER TO SHEET P4.
2. TOP ELEVATION OF FLARE CASTING TO MATCH THE ELEVATION OF EXISTING CLEARWELL ENTRANCE.
3. UV EQUIPMENT DRAIN FOR UV-UVL-2 SHALL BE ROUTED TO EXISTING TRENCH DRAIN.

NOV 2009	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	WHA
DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK.

CYGNET ID: 143757-3000-WTUP-C-B00000CPH | XREF1: C-FPG-BASEMENT-DEMO.DWG
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PLOTTED: | XREF4:
USER: DUN38005 | DWG VER: 4.8 | XREF5:

STATE OF KENTUCKY
DONNIE H. GINN
20348
PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

CIVIL
BASEMENT AND FILTER PIPE GALLERY SECTIONS

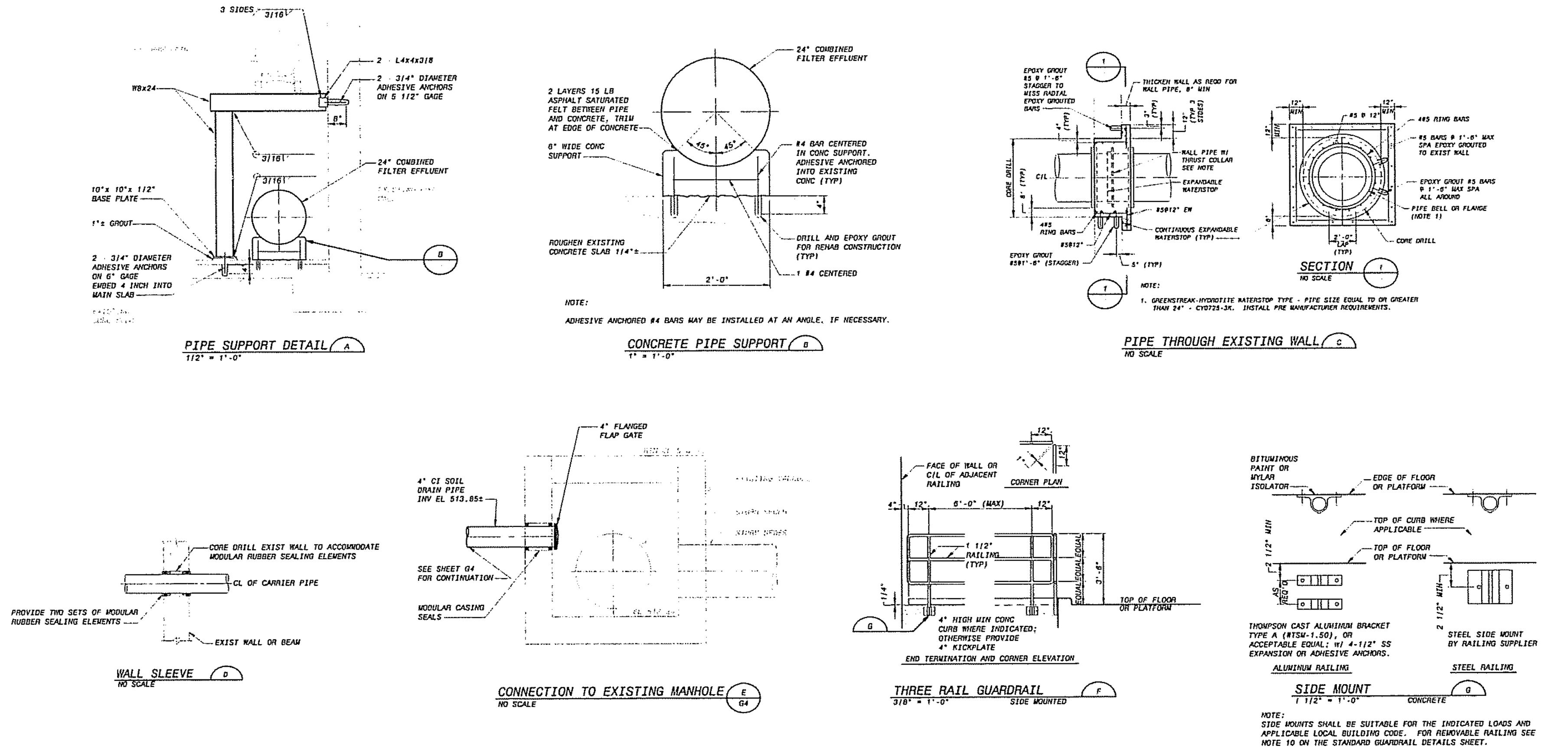
DESIGNED:	WHA
DETAILED:	DAD
CHECKED:	WLK
APPROVED:	
DATE:	11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

C4
SHEET
9 OF 24

FD6000
D6000



1	NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW		
NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK

CYDKEY ID: 143757-3000-WTUP-C-80000BCPO
XREF1:
XREF2:
XREF3:
XREF4:
XREF5:
SAVED: DUN38005, 11/17/2006 3:45:20 PM
PLOTTED:
USER: DUN38005
DWG VER: 4.6

STATE OF KENTUCKY
DONNIE GINN
20346
PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

CIVIL
MISCELLANEOUS DETAILS

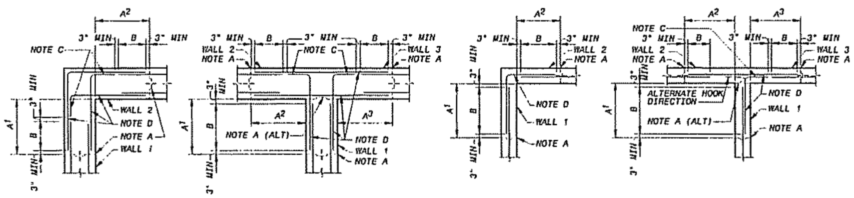
DESIGNED: MHA, BSB
DETAILED: DAD
CHECKED: WLK
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

C5
SHEET 10 OF 24

F06009
06009



A = VERTICAL CONSTRUCTION JOINT NEAREST TO WALL CORNER.

A(ALT) = ALTERNATE VERTICAL CONSTRUCTION JOINT NEAREST TO WALL CORNER IN T WALL JOINT WHICH DOES NOT REQUIRE WATERSTOP.

Ax = DISTANCE FROM INSIDE CORNER FACE TO NEAREST VERTICAL CONSTRUCTION JOINT IN SIMILARLY NUMBERED WALL. Ax SHALL NOT BE LESS THAN DIMENSIONS INDICATED BY THESE DETAILS; NOR GREATER THAN INDICATED ON PLAN DRAWINGS; BUT IN ANY CASE SHALL NOT EXCEED 30 FEET IN LIQUID CONTAINMENT STRUCTURES OR 40 FEET IN OTHER STRUCTURES. IN T WALL JOINTS WHICH DO NOT REQUIRE WATERSTOP, A1 MAY BE ZERO.

B = OPTIONAL SPLICE LOCATION UNLESS SPECIFICALLY NOTED ON PLAN DRAWINGS. SPLICE LENGTH SHALL NOT BE LESS THAN THAT REQUIRED FOR TOP BARS AS SHOWN IN TABLE ON THIS SHEET. USE SPLICE LENGTH FOR THE SMALLER OF THE TWO BARS BEING SPLICED.

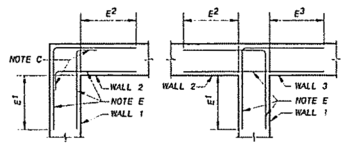
C = STANDARD HOOK

D = TYPICAL CORNER REINFORCEMENT. SIZE SHALL MATCH LARGEST ADJACENT WALL HORIZONTAL REINFORCEMENT; SPACING SHALL MATCH MINIMUM ADJACENT WALL HORIZONTAL REINFORCEMENT SPACING.

MAIN REINFORCEMENT FOR ALL STRUCTURES

TYPICAL HORIZONTAL CORNER REINFORCING DETAILS

NOTES:
1. VERTICAL REINFORCING NOT SHOWN
2. THESE DETAILS SHALL BE APPLICABLE TO ALL WALL CORNERS UNLESS NOTED OTHERWISE ON THE DRAWINGS.



E = WHERE SPECIFICALLY NOTED ON THE DRAWINGS, ADDITIONAL CORNER REINFORCEMENT SHALL BE PLACED IN BOTH FACES OF THE INDICATED CORNER OVER THE FULL HEIGHT. ADDITIONAL CORNER REINFORCEMENT SHALL BE OF THE SAME SIZE AND SPACING AS THE MAIN CORNER REINFORCEMENT. PLACE ADDITIONAL REINFORCEMENT ALTERNATELY WITH, AND EQUAL DISTANCE BETWEEN, MAIN CORNER REINFORCEMENT.

E = DISTANCE FROM INSIDE CORNER FACE TO TERMINATION OF ADDITIONAL CORNER REINFORCEMENT IN SIMILARLY NUMBERED WALL. Ex SHALL NOT BE LESS THAN .20 THE CLEAR SPAN DISTANCE MEASURED HORIZONTALLY BETWEEN THIS CORNER AND THE NEXT OR .40 THE CLEAR SPAN DISTANCE OR CANTILEVERED DISTANCE MEASURED VERTICALLY, WHICHEVER IS SMALLER, BUT NOT LESS THAN 3'-0".

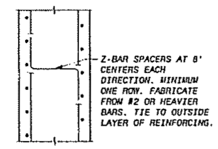
CONTRACTOR'S OPTION:
REBAR TAILS MAY BE SPLICED USING LAPPED SPLICE LENGTHS FOR TOP BARS. SPLICES SHALL NOT BE LOCATED IN THE CORNER AREA COMMON TO BOTH WALLS AND SHALL CLEAR HOOK ENDS BY 3" MIN.

ADDITIONAL REINFORCEMENT WHERE SPECIFICALLY NOTED ON THE DRAWINGS

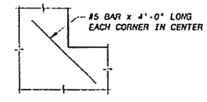
DETAIL (A)
NO SCALE

NOTES

1. DETAILS ON THIS DRAWING APPLY TO ALL DRAWINGS UNLESS OTHERWISE NOTED.
2. WORK THIS DRAWING WITH THE STANDARD CONCRETE JOINT DETAILS.

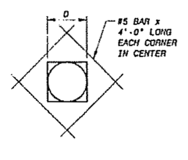


SPACERS FOR WALL REINFORCEMENT

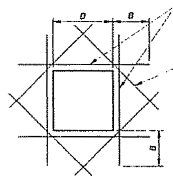


TYPICAL EXTRA REINFORCING AT ISOLATED RE-ENTRANT CORNERS

(TYPICAL REQUIRED UNLESS ADDITIONAL REINFORCEMENT SPECIFICALLY INDICATED AT OPENINGS ON DRAWINGS)



FOR OPENINGS 12" <= D <= 21"



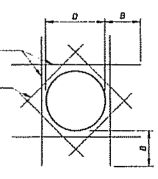
FOR RECTANGULAR OPENINGS 21" < D <= 54"

EXTRA BARS EQUAL IN TOTAL AREA TO REGULAR REINFORCING CUT BY OPENING. PLACE ONE HALF TOTAL AREA TO EACH SIDE OF OPENING AND IN THE SAME TRANSVERSE POSITION AS REGULAR REINFORCING

ONE EXTRA BAR EACH CORNER PER LAYER OF REGULAR REINFORCING (SEE TABLE BELOW). PLACE IN SAME TRANSVERSE POSITION AS REGULAR REINFORCING.

THICKNESS OF CONCRETE	BAR SIZE	BAR LENGTH RECT OPNG	BAR LENGTH CIRC OPNG
<12"	4	3'-0"	D+12"
12" TO 18"	5	3'-0"	D+12"
>18"	6	3'-8"	D+12"

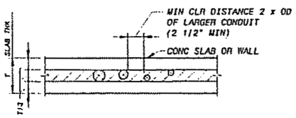
B=THE REQUIRED LENGTH FOR LAPPED SPLICE FOR TOP BARS AS SHOWN ON THIS SHEET



FOR CIRCULAR OPENINGS 21" < D <= 54"

TYPICAL EXTRA REINFORCING AT OPENINGS 12" TO <= 54"

(TYPICAL REQUIRED UNLESS ADDITIONAL REINFORCEMENT SPECIFICALLY INDICATED AT OPENINGS ON DRAWINGS)



NOTES:
1. PLACE CONDUIT ONLY IN SHADED AREA
2. FOR CONDUIT REQUIREMENTS SEE THE ELECTRICAL DRAWINGS FOR SPECIFICATIONS

CONDUIT PLACING DETAIL

NO SCALE

BEAM NOTES:

1. BOTTOM REINF SHALL HAVE LAP SPLICES CENTERED ON THE CENTERLINE OF THE SUPPORT USING 75% OF THE LAP SPLICE LENGTH INDICATED ON THE STANDARD CONCRETE REINFORCING DETAILS SHEET. USE THE LAP SPLICE REQUIREMENT OF THE SMALLER BOTTOM BAR IF BAR SIZES IN ADJACENT SPANS DIFFER. AT THE CONTRACTOR'S OPTION, BOTTOM REINF MAY BE MADE CONTINUOUS, WITHOUT SPLICING, ACROSS THE SUPPORT IF BARS IN THE ADJACENT SPAN ARE EQUAL IN SIZE AND QUANTITY.
2. END AND INTERIOR TOP REINF SHALL BE LAPPED AT MIDSPAN BETWEEN SUPPORTS USING 75% OF THE LAP SPLICE LENGTH INDICATED ON THE STANDARD CONCRETE DETAILS SHEETS. USE THE LAP SPLICE REQUIREMENT OF THE SMALLER TOP BAR, IF THE BAR SIZES EACH SIDE OF MIDSPAN DIFFER. AT THE CONTRACTOR'S OPTION, TOP REINF MAY BE MADE CONTINUOUS, WITHOUT SPLICING, IF THE TOP BARS EACH SIDE OF MIDSPAN ARE EQUAL IN SIZE AND QUANTITY.
3. TOP AND BOTTOM BARS SHALL BE PLACED IN THE BEAM SECTION SUCH THAT ONE OF THE BARS IS LOCATED IN EACH CORNER OF THE BEAM STIRRUPS.
4. ALL TOP AND BOTTOM BARS SHALL BE PLACED IN ONE LAYER UNLESS INDICATED OTHERWISE. WHERE MORE THAN ONE LAYER IS NOTED, PROVIDE GREATER OF 2.5 INCHES OR 3 BAR DIAMETER CLEAR BETWEEN LAYERS.
5. SIDE FACE REINF SHALL BE CONTINUOUS WITH LAP SPLICES CENTERED AT THE CENTERLINE OF THE SUPPORT. SCHEDULED SIDE FACE REINF SHALL BE SPACED EQUALLY ON EACH FACE.
6. PROVIDE MINIMUM #5 STIRRUP SUPPORT BARS IN ALL CORNERS OF STIRRUPS WHEN TOP OR BOTTOM BARS ARE NOT PRESENT. LAP #5 BARS 1'-8" MIN TO SCHEDULED REINF.
7. UNLESS INDICATED OTHERWISE, CONSECUTIVE STIRRUP CROSSTIES SHALL HAVE THEIR 90 DEGREE HOOK PLACED ON OPPOSITE SIDES. IN THE EVENT THAT A SLAB FRAMES INTO ONLY ONE SIDE OF A BEAM, THEN THE 90 DEGREE HOOK SHALL BE PLACED ON THE SLAB SIDE CONSISTENTLY. IN THE EVENT A BEAM IS NOT CONFINED BY A SLAB ON EITHER SIDE, THE STIRRUP CROSSTIE SHALL HAVE TWO 135 DEGREE HOOKS AND NO 90 DEGREE HOOK.
8. ABBREVIATIONS USED:
   DEG = DEGREE
   EF = EACH FACE
   EQ = EQUAL
   INT = INTERIOR
   REINF = REINFORCEMENT
   STD = STANDARD (PER ACI 318)
   TYP = TYPICAL
9. SEE SHEET C24 FOR BEAM DETAILS.

LENGTH OF LAPPED SPLICES FOR REINFORCEMENT (INCHES)

f'c=4000 PSI) (UNLESS NOTED OTHERWISE ON THE DRAWINGS)

BAR SIZE	BEAMS & COLUMNS *TOP BARS	BEAMS & COLUMNS OTHERS	WALLS & SLABS *TOP BARS	WALLS & SLABS OTHERS	BAR SIZE
3	16	16	16	16	3
4	20	16	20	16	4
5	26	20	29	22	5
6	37	29	29	23	6
7	60	47	48	37	7
8	70	54	60	47	8
9	80	62	74	57	9
10	92	70	81	70	10
11	103	79	109	84	11

* TOP BARS ARE HORIZONTAL BARS SO PLACED THAT MORE THAN 12" OF CONCRETE IS CAST IN THE MEMBER BELOW THE AR.
HORIZONTAL BARS IN WALLS ARE TO BE PROVIDED WITH LAP LENGTHS AS REQUIRED FOR TOP BARS. VERTICAL BARS MAY BE CONSIDERED AS OTHER BARS.

CONCRETE COVER FOR REINFORCEMENT

LOCATION	MINIMUM COVER
UNFORMED SURFACES ADJACENT TO EXCAVATION	3"
SURFACES INSIDE OF OZONE CONTACTORS EXPOSED TO OZONE IN WATER OR AIR	3"
FORMED OR TOP SURFACES EXPOSED TO WEATHER OR SATURATED AIR, SUBMERGED OR IN CONTACT WITH EARTH, INCLUDING STIRRUPS, TIES OR SPIRALS	2"
OTHER LOCATIONS:	
BARS IN BEAMS OR GIRDERS, INCLUDING STIRRUPS AND COLUMN SPIRALS OR TIES	1 1/2"
SLABS, WALLS AND JOISTS #6 AND LARGER #5	1 1/2"
AND SMALLER	1"

NOTE:
TOLERANCES FOR CONCRETE COVER AND THE FABRICATION AND PLACING OF REINFORCEMENT SHALL CONFORM TO ACI 117.

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK.	APP.
1	NOV 2008	REVISED SUBSEQUENT TO KDOW REVIEW	DAD	MHA	

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PLOTTED:
USER: DUN38005
DWG VER: 4.3
XREF1: XREF2: XREF3: XREF4: XREF5:

STATE OF KENTUCKY DONNIE H. GINN 20346 PROFESSIONAL ENGINEER 11/21/08

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

CIVIL
STANDARD CONCRETE DETAILS

DESIGNED: MHA
DETAILED: DAD
CHECKED: MLK
APPROVED: [signature]
DATE: 11/21/08

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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

C6
SHEET 11 OF 24

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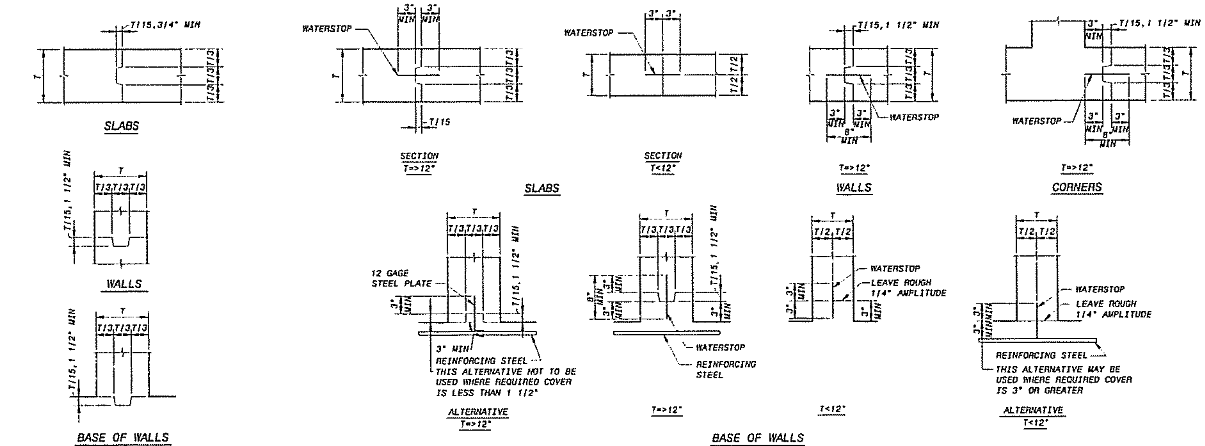
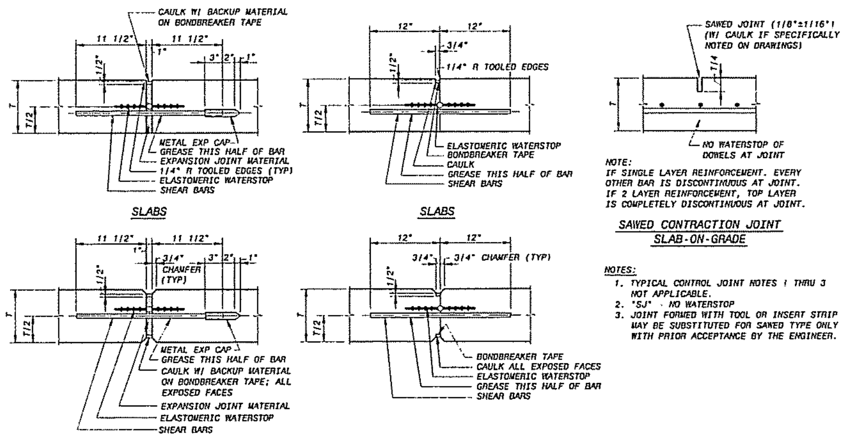


JOINTS WITHOUT WATERSTOPS

JOINTS WITH WATERSTOPS

TYPICAL CONSTRUCTION JOINTS

NOTES:
1. REINFORCING STEEL IS CONTINUOUS THROUGH ALL CONSTRUCTION JOINTS
2. "CSJ W/WS" - WITH WATERSTOP
3. "CSJ" - WITHOUT WATERSTOP



NOTE:
IF SINGLE LAYER REINFORCEMENT, EVERY OTHER BAR IS DISCONTINUOUS AT JOINT. IF 2 LAYER REINFORCEMENT, TOP LAYER IS COMPLETELY DISCONTINUOUS AT JOINT.

SAWED CONTRACTION JOINT
SLAB-ON-GRADE

NOTES:
1. TYPICAL CONTROL JOINT NOTES 1 THRU 3 NOT APPLICABLE.
2. "SJ" - NO WATERSTOP
3. JOINT FORMED WITH TOOL OR INSERT STRIP MAY BE SUBSTITUTED FOR SAWED TYPE ONLY WITH PRIOR ACCEPTANCE BY THE ENGINEER.

EXPANSION JOINTS

NOTE:
"EJ" W/ WS" - WITH ELASTOMERIC WATERSTOP
"EJ" - WITHOUT ELASTOMERIC WATERSTOP

CONTRACTION JOINTS

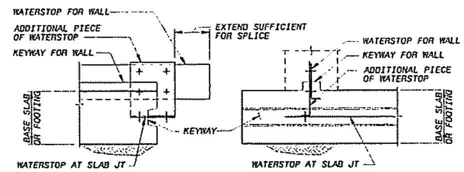
NOTE:
"CJ" W/ WS" - WITH ELASTOMERIC WATERSTOP
"CJ" - WITHOUT ELASTOMERIC WATERSTOP

TYPICAL CONTROL JOINTS

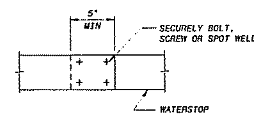
NOTES:
1. PROVIDE 3/4" SHEAR BARS @ 1'-6" CTRS ACROSS JOINT UNLESS NOTED OTHERWISE.
2. REINFORCING STEEL SHALL NOT BE EXTENDED ACROSS JOINT UNLESS NOTED OTHERWISE.
3. SHEAR BARS SHALL BE SMOOTH FREE FROM RUST OR SCALE, AND GREASED TO PREVENT BOND (ONE HALF OF BAR ONLY).

NOTES

1. DETAILS ON THIS DRAWING APPLY TO ALL DRAWINGS UNLESS OTHERWISE NOTED.
2. WORK THIS DRAWING WITH THE STANDARD CONCRETE REINFORCING DETAILS.
3. AT WALL JOINTS AND AT WALL BASE JOINTS, SECURE ALL ELASTOMERIC WATERSTOPS IN THE CORRECT POSITION USING HOG RINGS OR GROMMETS SPACED AT 12 INCHES ALONG THE LENGTH OF THE WATERSTOP AND WIRE TIE TO ADJACENT REINFORCING STEEL.
4. AT SLAB JOINTS AND FOOTING JOINTS, ENSURE SPACE BENEATH AND AROUND WATERSTOP IS COMPLETELY FILLED WITH CONSOLIDATED CONCRETE. DURING OPERATION MAKE VISUAL INSPECTION OF ENTIRE WATERSTOP AREA. LIMIT CONCRETE PLACEMENT TO ELEVATION OF WATERSTOP IN FIRST LIFT. RAISE ELASTOMERIC WATERSTOPS TO CONFIRM FULL CONSOLIDATION WITHOUT VOIDS. PLACE REMAINING CONCRETE TO FULL DEPTH OF SLAB.



STEEL WATERSTOP INTERSECTION AT BASE SLAB CONSTRUCTION JOINT



STEEL WATERSTOP SPLICE

1	NOV 2008	REVISED SUBSEQUENT TO KOON REVIEW	DAD / WHA
NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY / CK

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SAVED: DUN38005, 8/18/2008 2:45:45 PM
USER: DUN38005 | DWG VER: 4.3

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PROJECT NO. 143757

C7
SHEET 12 OF 24

ONE-LINE DIAGRAM LEGEND

- 1500KVA 2.4KVD-480Y/277 3Ø, 60HZ — TRANSFORMER WITH PRIMARY AND SECONDARY VOLTAGE, AND KVA RATING AS NOTED
- 20 — 22: 3#8,#10G,2" — CIRCUIT NO.22 WITH #8 INSULATED CONDUCTORS, 1#10 BARE GROUND WIRE ALL IN 2" CONDUIT TO 20 HP MOTOR
- 15 — AUXILIARY ITEMS MAY NOT BE SHOWN COMPLETELY — ONE-LINE SHOWING POWER AND CONTROL TO A PACKAGE UNIT, AS FOR EXAMPLE A STEAM GENERATOR OR AN AIR HANDLING UNIT, SHALL IMPLY THAT ANY AND ALL ASSOCIATED EQUIPMENT SHALL ALSO BE INSTALLED AND WIRED AS REQUIRED BY THE EQUIPMENT FURNISHED.
- INDICATES THAT ALL OR PART OF CIRCUIT MAY BE ROUTED IN DUCT BANK OR UNDERGROUND. CONDUIT SIZE SHOWN ON ONE-LINE IS ABOVE GROUND AND/OR INSIDE OF STRUCTURE. SEE DUCT BANK SCHEDULE AND SECTIONS FOR CONDUIT SIZE OF UNDERGROUND PORTION OF CIRCUIT.
- HIGH VOLTAGE DRAWOUT AIR OR VACUUM CIRCUIT BREAKER
- 3P-20 — LOW VOLTAGE AIR CIRCUIT BREAKER, 3 POLE, 20 AMPERE
- S4 — SIZE 4 COMBINATION MAGNETIC MOTOR STARTER
- LOW VOLTAGE DRAWOUT AIR CIRCUIT BREAKER
- HIGH VOLTAGE DRAWOUT CONTACTOR
- FUSE AND DISCONNECT SWITCH
- S2 — SIZE 2 COMBINATION MAGNETIC MOTOR STARTER, REVERSING OR 2 SPEED
- S1 — SIZE 1 COMBINATION REDUCED VOLTAGE STARTER
- POTENTIAL TRANSFORMER
- CURRENT TRANSFORMER

CONDUIT & WIRING INSTALLATION LEGEND

- CONDUIT EXPOSED
- CONDUIT CONCEALED
- CONDUIT TURNING UP. CONDUIT TURNING DOWN.
- CONDUIT PLUGGED FLUSH. CONDUIT CAPPED.
- L2-5 — TYPICAL FOR HOME RUN TO BE ROUTED TO LIGHTING PANEL L2 & CONNECTED TO CIRCUIT #5 (MINIMUM NO. 12 AWG CONDUCTORS AND 3/4" CONDUIT)
- A — LIGHTING FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE
- 11 — FLUORESCENT FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE.
- LP1-3 — RECEPTACLE POWERED FROM LIGHTING PANEL LP1, CIRCUIT 3
- A LP2-2 — LIGHTING FIXTURE POWERED FROM LIGHTING PANEL LP2, CIRCUIT 2 (NON-SWITCHED)
- LPA-4 A 11 — LIGHTING FIXTURE POWERED FROM LIGHTING PANEL LPA, CIRCUIT 4, VIA SWITCH A
- E — UNDERGROUND CONCRETE ENCASED ELECTRICAL DUCT BANK
- UNDERGROUND CONCRETE ENCASED ELECTRICAL BANK ROUTED BENEATH SLAB-ON-GRADE
- EE — DIRECT BURIED CONDUIT
- GROUND CONDUCTOR

SCHEMATIC SYMBOLS

- WIRE CONNECTION POINT
- EXTERNAL CONNECTION POINT
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- STARTER, CONTACTOR OR RELAY COIL
- NORMALLY OPEN PUSH BUTTON
- NORMALLY CLOSED PUSH BUTTON
- MAINTAINED PUSH BUTTON
- NORMALLY CLOSED GEARED LIMIT SWITCH
- NORMALLY OPEN GEARED LIMIT SWITCH
- INDICATING LIGHT
- FUSE
- POTENTIOMETER
- CAPACITOR
- DIODE
- RESISTOR
- CONTROL POWER TRANSFORMER
- SWITCH
- MS — MANUAL STARTER
- OL — OVERLOAD
- ELECTRODE
- FLOAT SWITCH (CLOSING ON RISING LEVEL)
- FLOAT SWITCH (OPENING ON RISING LEVEL)
- PRESSURE SWITCH (CLOSING ON RISING PRESSURE)
- PRESSURE SWITCH (OPENING ON RISING PRESSURE)
- VACUUM SWITCH (CLOSING ON INCREASING VACUUM)
- VACUUM SWITCH OPENING ON INCREASING VACUUM)
- TEMPERATURE SWITCH (CLOSING ON RISING TEMPERATURE)
- TEMPERATURE SWITCH (OPENING ON RISING TEMPERATURE)
- FLOW ACTUATED SWITCH (CLOSING ON INCREASE IN FLOW)
- FLOW ACTUATED SWITCH (OPENING ON INCREASE IN FLOW)
- ON TIME DELAY CONTACT (NORMALLY OPEN, WHEN THE COIL IS ENERGIZED THE CONTACT WILL CLOSE AFTER A TIME DELAY)
- ON TIME DELAY CONTACT (NORMALLY CLOSED, WHEN THE COIL IS ENGERGIZED THE CONTACT WILL OPEN AFTER A TIME DELAY)
- OFF TIME DELAY CONTACT (NORMALLY OPEN, WHEN THE COIL IS DE-ENERGIZED THE CONTACT WILL OPEN AFTER A TIME DELAY)
- OFF TIME DELAY CONTACT (NORMALLY CLOSED, WHEN THE COIL IS DE-ENERGIZED THE CONTACT WILL CLOSE AFTER A TIME DELAY)
- TORQUE SWITCH (NORMALLY OPEN)
- TORQUE SWITCH (NORMALLY CLOSED)
- LIMIT SWITCH (NORMALLY OPEN)
- LIMIT SWITCH (NORMALLY OPEN, HELD CLOSED)
- LIMIT SWITCH (NORMALLY CLOSED)
- LIMIT SWITCH (NORMALLY CLOSED, HELD OPEN)
- DIFFERENTIAL PRESSURE SWITCH (NORMALLY OPEN, CLOSING ON INCREASING DIFF.)
- DIFFERENTIAL PRESSURE SWITCH (NORMALLY CLOSED, OPENING ON INCREASING DIFF.)

MISCELLANEOUS SYMBOLS

- BELL
- HORN
- THERMOSTAT
- JUNCTION BOX
- GROUND ROD
- GROUND ROD WITH TEST WELL
- GROUND CONNECTION
- DISCONNECT SWITCH
- COMBINATION STARTER
- POWER PANEL
- LIGHTING PANEL
- MISCELLANEOUS PANEL
- LIGHTING CONTACTOR

COMMUNICATION SYMBOLS

- HORN SPEAKER
- DUAL HORN SPEAKER
- WALL MOUNTED CONE SPEAKER
- SK — CEILING MOUNTED CONE SPEAKER
- WS WP — WALL STATION
- DS — DESK TOP STATION
- RH WP — REMOTE HANDSET
- SA — SPEAKER AMPLIFIER
- LB — LINE BALANCE ASSEMBLY
- TG — TONE GENERATOR
- TI — TELEPHONE INTERFACE
- IA — INTERFACE AMPLIFIER
- IJB — INTERCOM JUNCTION BOX

NOTE: WP=WEATHERPROOF
H=HAZARDOUS AREA

SWITCH & OUTLET SYMBOLS

- S — SINGLE POLE SWITCH
- S_2 — TWO POLE SWITCH
- S_3 — THREE-WAY SWITCH
- S_4 — FOUR-WAY SWITCH
- S_M^{C1} — MOMENTARY SWITCH CONTROLLING CONTACTOR C1
- S_{WP} — WEATHERPROOF SWITCH
- S_{PL} — SWITCH WITH PILOT LIGHT
- S_{KO} — KEY OPERATED SWITCH
- S_{XP} — EXPLOSION PROOF SWITCH
- S_{DM} — DIMMER SWITCH
- S_{3A} — THREE-WAY SWITCH CONTROLLING LIGHTS WITH "A" DESIGNATION
- DUPLEX RECEPTACLE 120 VOLT
- SIMPLEX RECEPTACLE
- RANGE RECEPTACLE
- TWISTLOCK RECEPTACLE
- 30 — 240V, 1Ø RECEPTACLE, TYPICAL AMPERE RATING NOTED
- 60 — 480V, 3Ø WELDING RECEPTACLE, TYPICAL AMPERE RATING NOTED
- 120 VOLT DUPLEX RECEPTACLE (UPS)
- DUPLEX FLOOR OUTLET
- TELEPHONE OUTLET
- TELEPHONE FLOOR OUTLET
- CX — COAXIAL CABLE OUTLET

ABBREVIATIONS

A	AMBER, AMPERE, ALARM
AC	ALTERNATING CURRENT
ACB	AIR CIRCUIT BREAKER
AF	AMPERE FRAME
AFD	ADJUSTABLE FREQUENCY DRIVE
AM	AMMETER
ANN	ANNUNCIATOR
AR	ALARM RELAY
AS	AMMETER SWITCH
ATS	AUTOMATIC TRANSFER SWITCH
AT	AMPERE TRIP
AWG	AMERICAN WIRE GAGE
BC	BATTERY CHARGER
BR	BRAKE
BT	BEARING TEMPERATURE
C	CLOSE, COUNTER OR CONTACTOR
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CB"A"	CIRCUIT BREAKER AUXILIARY CONTACT (OPEN WHEN BREAKER IS OPEN OR TRIPPED CLOSED WHEN BREAKER IS CLOSED)
CB"B"	CIRCUIT BREAKER AUXILIARY CONTACT (CLOSED WHEN BREAKER IS OPEN OR TRIPPED OPEN WHEN BREAKER IS CLOSED)
CD	CONTROL DAMPER
CI	CELL INTERLOCK
CKT	CIRCUIT
CL2	CHLORINE
COS	CABLE OPERATED SWITCH
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CURRENT OR CONTROL RELAY
CS	CONTROL STATION
CT	CYCLE TIMER OR CURRENT TRANSFORMER
CTC	CYCLE TIMER CLUTCH
CTM	CYCLE TIMER MOTOR
2/C	2 CONDUCTOR
4"C	4" CONDUIT
DC	DIRECT CURRENT
DI	DOOR INTERLOCK
DM	DAMPER MOTOR OR DEMAND METER
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DPR	DIFFERENTIAL PRESSURE REGULATOR
DPS	DIFFERENTIAL PRESSURE SWITCH
DS	DISCONNECT SWITCH
DVLS	DISCHARGE VALVE LIMIT SWITCH
E	ELECTRIC OPERATOR FOR CONTROL DAMPER OR VALVE
EC	EMPTY CONDUIT
EL	ELEVATION OR EMERGENCY LIGHT
EMH	ELECTRICAL MANHOLE
ER	ELECTRODE RELAY
ES	END SWITCH
ETM	ELAPSED TIME METER
EX	EXISTING
F	FORWARD
FS	FLOW SWITCH
G	GREEN OR GROUND
GD	GROUND DETECTOR
GEN	GENERATOR
GFI	GROUND FAULT INTERRUPTER
GLS	GEARED LIMIT SWITCH
#8G	#8 GROUND WIRE
H	HIGH OR HUMIDISTAT
HC	HOT CIRCUIT
HH	HANDHOLE
HMT	HIGH MOTOR TEMPERATURE
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HP	HORSEPOWER
HWCO	HIGH WATER CUTOFF
HZ	HERTZ (CYCLE)
I/O	INPUT/OUTPUT
INST	INSTANTANEOUS
J	JUNCTION BOX
JB	JUNCTION BOX
K	KEY INTERLOCK
KCMIL	THOUSAND CIRCULAR MIL
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVAR
KW	KILOWATT
KWH	KILOWATT HOUR
L	LOW, LEVEL
LA	LIGHTNING ARRESTER
LAN	LOCAL AREA NETWORK
LC	LIGHTING CONTACTOR
LOA	LOCAL-OFF-AUTO
LOR	LOCAL-OFF-REMOTE
LP	LIGHTING PANEL
LS	LIMIT OR LEVEL SWITCH
LWCO	LOW WATER CUTOFF
1-1PR#16S	ONE, SINGLE PAIR, TWISTED, SHIELDED #16 CABLE
3-7/C#14	THREE, SINGLE, SEVEN CONDUCTOR #14 MULTICONDUCTOR CONTROL CABLES
M	MAGNETIC MOTOR STARTER
MA	MILLIAMPERE
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCLU	MOTOR CONTROL LINEUP
MD	MOISTURE DETECTOR
MFM	MAGNETIC FLOW METER
MFR	MANUFACTURER
MH	MANHOLE OR MOUNTING HEIGHT
MOV	MOTOR OPERATED VALVE
MPR	MOTOR PROTECTION RELAY
MS	MANUAL MOTOR STARTER
MSH	MOTOR SPACE HEATER
MV	MILLIVOLT
MVA	MEGA VOLT AMPERE
N	NEUTRAL
NC	NORMALLY CLOSED
NO	NORMALLY OPEN, NUMBER
O	OPEN
OCB	OIL CIRCUIT BREAKER
OL	OVERLOAD
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
P	PRIMARY
PCS	PLANT CONTROL SYSTEM
PB	PUSH BUTTON OR PULL BOX
PF	POWER FACTOR METER
PH	PHASE, CHEMICAL TERM
PLC	PROGRAMMABLE LOGIC CONTROLLER
PP	POWER PANEL
PRS	PROXIMITY SWITCH
PS	PRESSURE SWITCH
PT	POTENTIAL TRANSFORMER, PROGRAM TIMER
2P	2 POLE
R	RED, RAISE, RELAY OR REVERSE
RECP	RECEPTACLE
RES	RESISTOR
RT	REPEATING TIMER
RTD	RESISTANCE TYPE TEMP DETECTOR
RTU	REMOTE TERMINAL UNIT
RVSS	REDUCED VOLTAGE SOLID STATE STARTER
S2	SIZE 2 STARTER
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SH	SPACE HEATER
SN	SOLID NEUTRAL
SO	SOLENOID OILER
SP	SINGLE POLE
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SS	SELECTOR SWITCH
SSS	SOLID STATE STARTER
SUPV	SUPERVISORY CONTROL
SV	SOLENOID VALVE
SWB	SWITCHBOARD
SWGR	SWITCHGEAR
T	THERMOSTAT, TIMER, OR TOTALIZER
TACH	TACHOMETER
TB	TERMINAL BLOCK
TC	TIMER CLUTCH
TD	TIME DELAY RELAY
TEMP	TEMPERATURE
TM	TIMER MOTOR
TQ	TORQUE
TS	TEMPERATURE SWITCH
TTB	TELEPHONE TERMINAL BOX
UG	UNDERGROUND
UV	UNDER VOLTAGE
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTS
VA	VOLT AMPERE
VAR	VARMETER
VLS	VALVE LIMIT SWITCH
VM	VOLTMETER
VPI	VALVE POSITION INDICATOR
VS	VOLTMETER SWITCH
W	WHITE OR WATTS
WH	WATTHOUR METER
WM	WATT METER
WP	WEATHERPROOF
WPI	WEATHERPROOF IN-USE
X	AUXILIARY RELAY
XFMR	TRANSFORMER
XP	EXPLOSION PROOF
Y	YELLOW
Z	AUXILIARY RELAY
ZS	POSITION SWITCH
ZSS	ZERO SPEED SWITCH

AREA DESIGNATIONS

THE SPECIAL AREA DESIGNATION BOXES, AS DEFINED BELOW, ARE LOCATED ON THE PLAN DRAWINGS TO DEFINE ELECTRICAL INSTALLATION REQUIREMENTS. DESIGNATION BOXES ARE LOCATED WITHIN ROOM OR BELOW ROOM NUMBER. ALL INDOOR AREAS NOT INDICATED OTHERWISE ARE AREA TYPE 1 AND MINIMUM NEMA TYPE 1 ENCLOSURES.

- AREA TYPE 1A — CORROSIVE CHEMICAL FEED AND STORAGE ROOMS. CONDUIT SYSTEM SHALL BE EXPOSED PVC RIGID NON-METALLIC CONDUIT WITH PVC FITTINGS, BOXES, AND ACCESSORIES.
- AREA TYPE 4 — INDOOR WET LOCATIONS SUCH AS VAULTS, HOSEDOWN AREAS, BASEMENTS, ETC. MINIMUM NEMA TYPE 4 ENCLOSURE FOR EQUIPMENT AND GASKETED FITTINGS IN A CONDUIT SYSTEM.
- AREA TYPE 7A — CLASS I, DIVISION 1 AREA AS DEFINED BY NEC. ALL EQUIPMENT AND CONDUIT SYSTEMS SHALL BE RATED FOR USE IN THIS AREA.
- AREA TYPE 7B — CLASS I, DIVISION 2, GROUP C AND D (METHANE, GASOLINE) AS DEFINED BY NEC. EQUIPMENT AND CONDUITS SYSTEMS SHALL BE RATED FOR USE IN THIS AREA.
- AREA TYPE 12 — INDOOR, DRY, DIRTY AREA. REQUIRES MINIMUM NEMA TYPE 12 GASKETED ENCLOSURES FOR ALL EQUIPMENT AND GASKETED FITTINGS IN CONDUIT SYSTEMS.

GENERAL REQUIREMENTS

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ROUTING ALL CONDUITS NOT SHOWN ON THE PLANS. THIS SHALL INCLUDE ALL CONDUITS SHOWN ON THE ONE-LINES AND HOME-RUNS SHOWN ON THE PLAN DRAWINGS. CONDUITS SHALL BE ROUTED AS DEFINED IN THE SPECIFICATIONS.
2. SPARE WIRES SHALL BE TAPED AND COILED.
3. IF EQUIPMENT SUPPLIED BY MANUFACTURER HAS A LARGER LOAD THAN VALUE SHOWN, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENLARGING THE CABLE, CONDUIT AND ASSOCIATED ELECTRICAL EQUIPMENT, AS REQUIRED, TO ACCOMMODATETHE HIGHER VALUE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING PROPERLY SIZED STARTER OVERLOADS FOR EQUIPMENT FURNISHED.
5. LIGHTING AND RECEPTACLE CIRCUITS DESIGNATED ON THE FLOOR PLANS ARE NOT SHOWN ON THE ONE-LINES. CONDUCTORS FOR LIGHTING, RECEPTACLES, AND MISCELLANEOUS 120VAC CIRCUITS SHALL BE MINIMUM NO. 12 AWG. CONDUIT FOR LIGHTING, RECEPTACLES, AND MISCELLANEOUS 120VAC CIRCUITS SHALL BE MINIMUM 3/4"
6. IN AREAS WHERE THERE ARE OVERHEAD BRIDGE CRANES, HOISTS, ETC., NO CONDUITS SHALL BE RUN OVERHEAD THAT WILL INTERFERE WITH THE OPERATION OF THE EQUIPMENT.

GENERAL NOTES

1. SOLID LINES (————) INDICATE NEW WORK OR EQUIPMENT.
2. SCREENED LINES (·· ····) INDICATE EXISTING WORK OR EQUIPMENT.
3. DASHED LINES (– – – – –) INDICATE FUTURE WORK OR EQUIPMENT.
4. REFER TO THE FOLLOWING DRAWING(S) FOR INSTRUMENTATION LEGEND: P1, P2, & P3
5. THIS IS A GENERAL LEGEND SHEET. SOME SYMBOLS AND ABBREVIATIONS MAY NOT BE UTILIZED ON THIS SPECIFIC PROJECT.
6. INFORMATION RELATED TO CIRCUIT IDENTIFICATION, WIRE & CONDUIT SIZES, AND ROUTING, IS ON THE FOLLOWING DRAWING TYPES.
   A. ONE-LINE DIAGRAMS SHOW CIRCUIT IDENTIFICATION, WIRE QUANTITY AND SIZES, AND CONDUIT SIZE WITHIN STRUCTURES. ONE-LINE DIAGRAMS ALSO INDICATE ORIGIN AND DESTINATION OF CIRCUITS, AND IDENTIFY CIRCUITS ROUTED UNDERGROUND.
   B. FOR CIRCUITS WITHOUT UNDERGROUND PORTIONS, BUILDING FLOOR PLANS SHOW LOCATION OF EQUIPMENT FOR DETERMINING CIRCUIT LENGTH WITHIN THE STRUCTURE. FOR CIRCUITS WITH UNDERGROUND PORTIONS, ANTICIPATED PENETRATION OF UNDERGROUND CONDUITS ARE SHOWN ON STRUCTURE PLANS FOR DETERMINING THE LENGTH OF THE IN-STRUCTURE PORTIONS OF CIRCUITS. BUILDING FLOOR PLANS MAY ALSO SHOW HOME RUNS FOR LIGHTING, RECEPTACLE, AND OTHER MISCELLANEOUS EQUIPMENT CIRCUITS.
   C. SITE PLANS INDICATE THE GENERAL ROUTING OF UNDERGROUND CONDUITS AND DUCT BANKS. CIRCUITS ROUTED IN UNDERGROUND CONDUITS OR DUCT BANKS ARE INDICATED IN DUCT BANK SECTIONS REFERENCED ON THE SITE PLAN.
   D. DUCT BANK SECTIONS AND SCHEDULES IDENTIFY CONDUIT SIZE CONDUIT MATERIAL, ARRANGEMENT OF THE UNDERGROUND CONDUITS, AND CIRCUITS ROUTED IN EACH UNDERGROUND CONDUIT.

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK.
NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	SAY

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NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

ELECTRICAL
LEGENDS, ABBREVIATIONS AND GENERAL NOTES

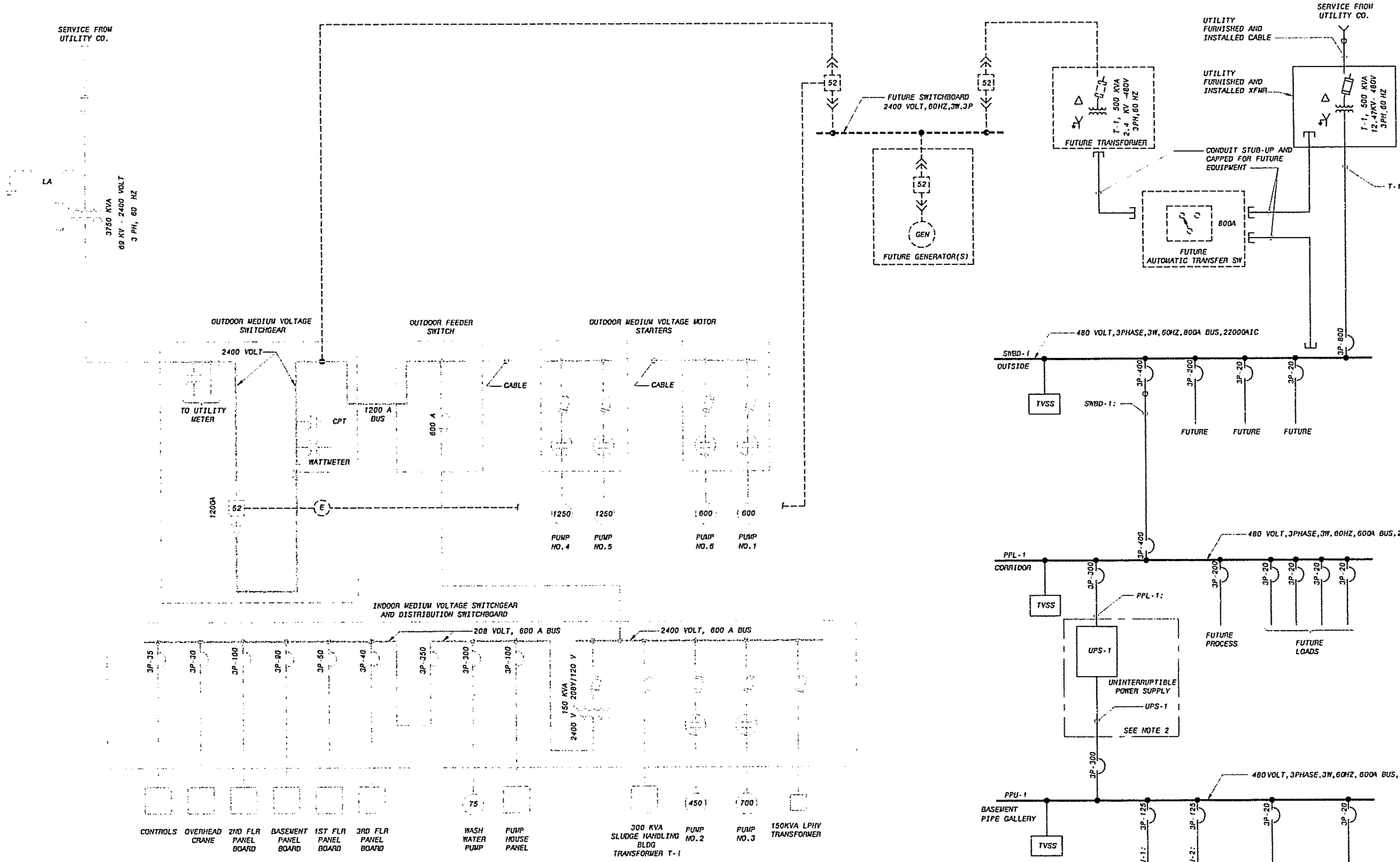
DESIGNED: MEM
DETAILED: DAD
CHECKED: JTF
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

E1
SHEET 13 OF 24

F06000
06009



PLANT POWER DISTRIBUTION FUNCTIONAL DIAGRAM
DERIVED FROM OWNERS CONTRACT 95-1, JULY 1995 CONTACT DRAWINGS

UV DISINFECTION SYSTEM
POWER DISTRIBUTION FUNCTIONAL DIAGRAM

NOTES:
1. SEE DRAWING E1 FOR ELECTRICAL LEGEND & ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. UPS EQUIPMENT AND CIRCUITRY ASSOCIATED WITH BID ALTERNATIVE A. REFER TO SECTIONS 01015 AND 16610.

NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAO	DAY
DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK

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NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

ELECTRICAL
POWER DISTRIBUTION FUNCTIONAL DIAGRAM

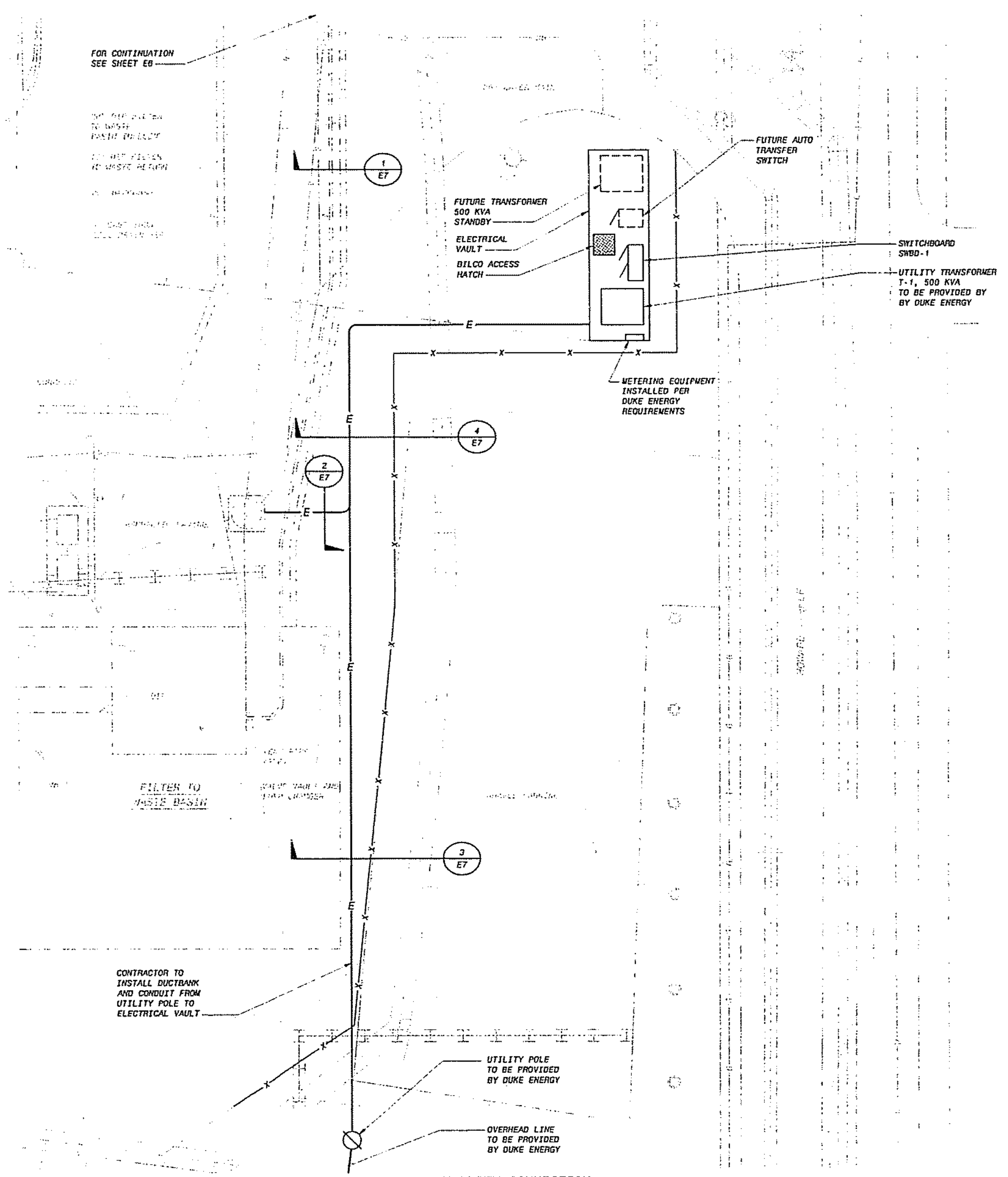
DESIGNED: MEM
DETAILED: MEM, DAO
CHECKED: JTF
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

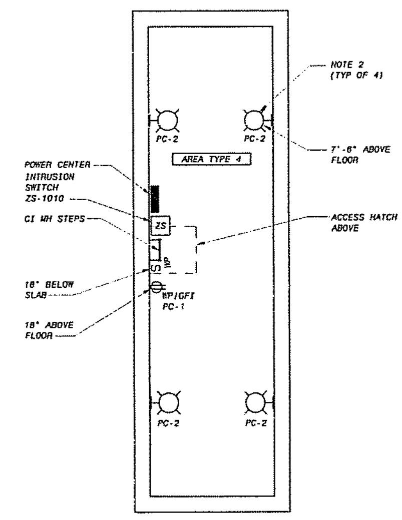
PROJECT NO.
143757

E2
SHEET
14 OF 24

F06000
D6003



TRANSFORMER AND UTILITY CONNECTION SITE PLAN
1" = 10'-0"



ELECTRICAL VAULT POWER/LIGHTING PLAN
1/4" = 1'-0"

NOTES:

1. SEE DRAWING E1 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. 26 WATT COMPACT FLUORESCENT FIXTURE, WALL MOUNTED, ENCLOSED AND GASKETED, GLOBE AND GUARD, SUITABLE FOR WET AND HAZARDOUS LOCATIONS, GREY FINISH, ELECTRONIC BALLAST, 120V, LAMP F26DBX/SPX35/4P-1800 LUMENS, CANLET #6802FWF210G11.
3. ALL DUCTS SHALL BE EQUIPPED WITH PULL STRINGS.

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK	APP
1	NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	DAD	SAY	M

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SAVED: DUH38005, 11/16/2006 11:45:01 AM XREF3:
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USER: DUH38005 DWG VER: 4.6 XREF5:

11/20/06

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TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

ELECTRICAL
TRANSFORMER AND UTILITY CONNECTION SITE PLAN AND ELECTRICAL VAULT POWER/LIGHTING PLAN

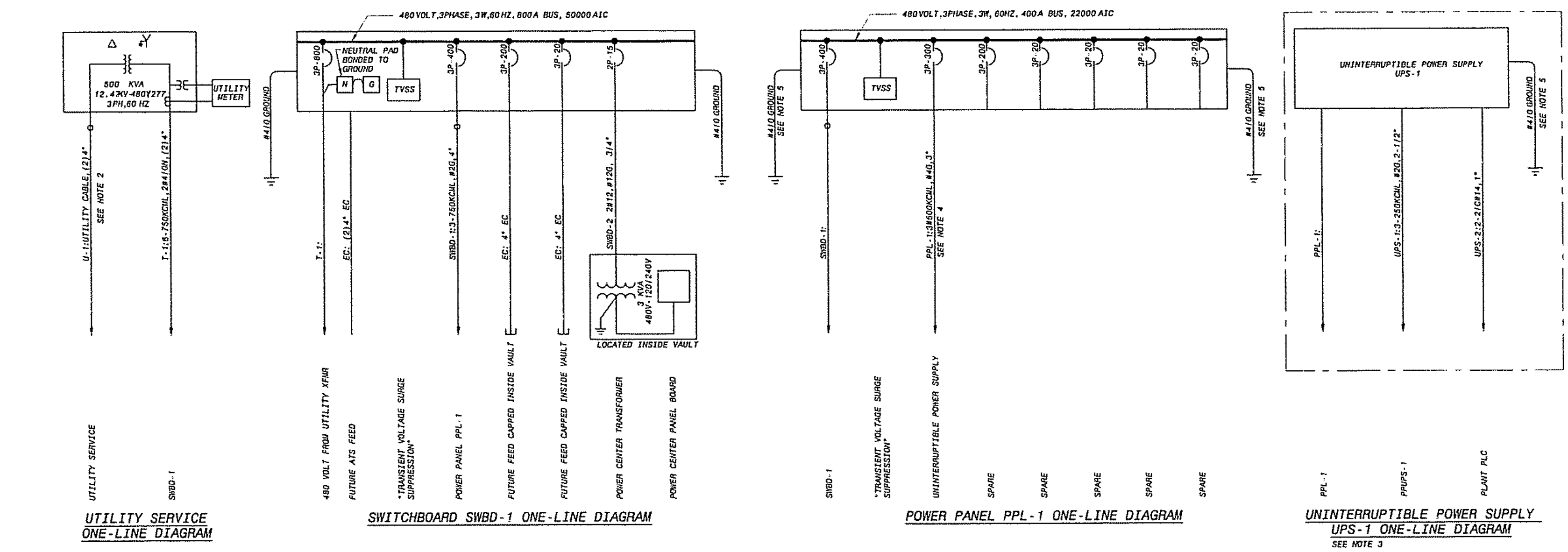
DESIGNED: WEM
DETAILED: DAD
CHECKED: JTF
APPROVED: MAE
DATE: 11/20/06

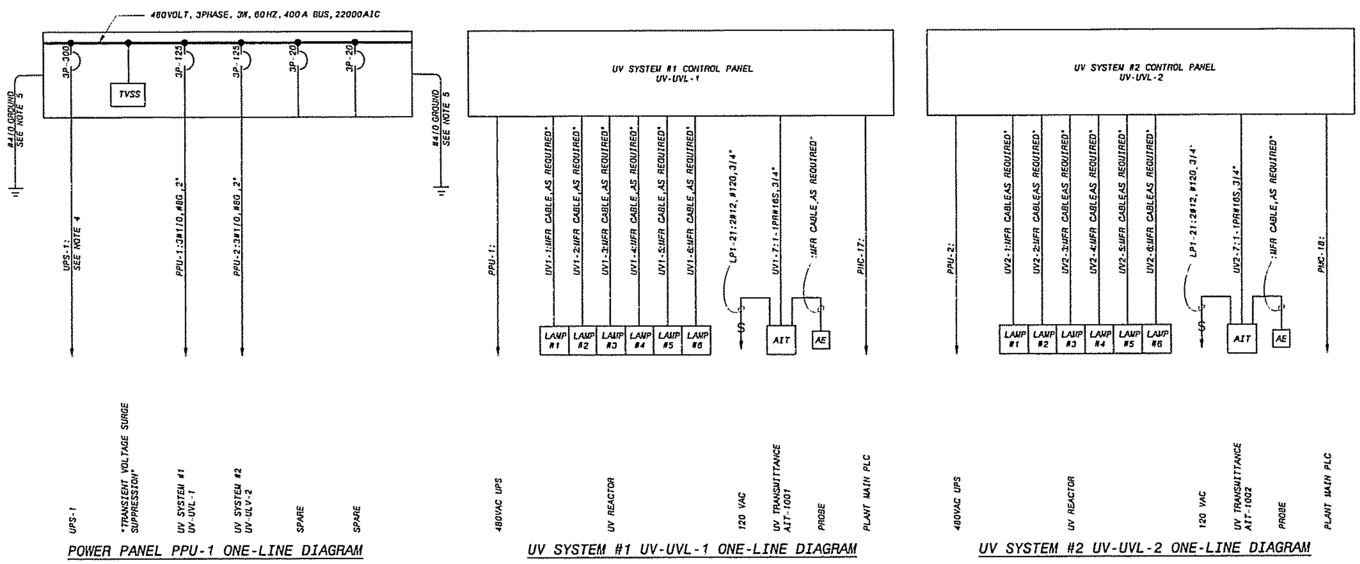
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

E3
SHEET 15 OF 24

F06000 D6009





NOTES:

1. SEE DRAWING E1 FOR ELECTRICAL LEGEND & ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. UNDERGROUND DUCT BANK TO UTILITY OVERHEAD POWER POLE. COORDINATE LOCATION WITH UTILITY. SERVICE CABLES TO BE INSTALLED BY UTILITY.
3. UPS EQUIPMENT AND CIRCUITRY ASSOCIATED WITH BID ALTERNATIVE A. REFER TO SECTION 01015.
4. CIRCUIT PPL-1 ROUTES TO MAIN BREAKER OF PPU-1 IF BID ALTERNATE A IS NOT SELECTED.
5. INSTALL GROUNDING CONDUCTOR TO BUILDING STEEL.

NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW		1	DAD	SAY
DATE	REVISIONS AND RECORD OF ISSUE		NO.	BY	CK

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11/20/06

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TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

ELECTRICAL
POWER ONE-LINE DIAGRAMS

DESIGNED: MEW
DETAILED: MEW, DAD
CHECKED: JTF
APPROVED:
DATE: 11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

E4
SHEET 16 OF 24

F06000
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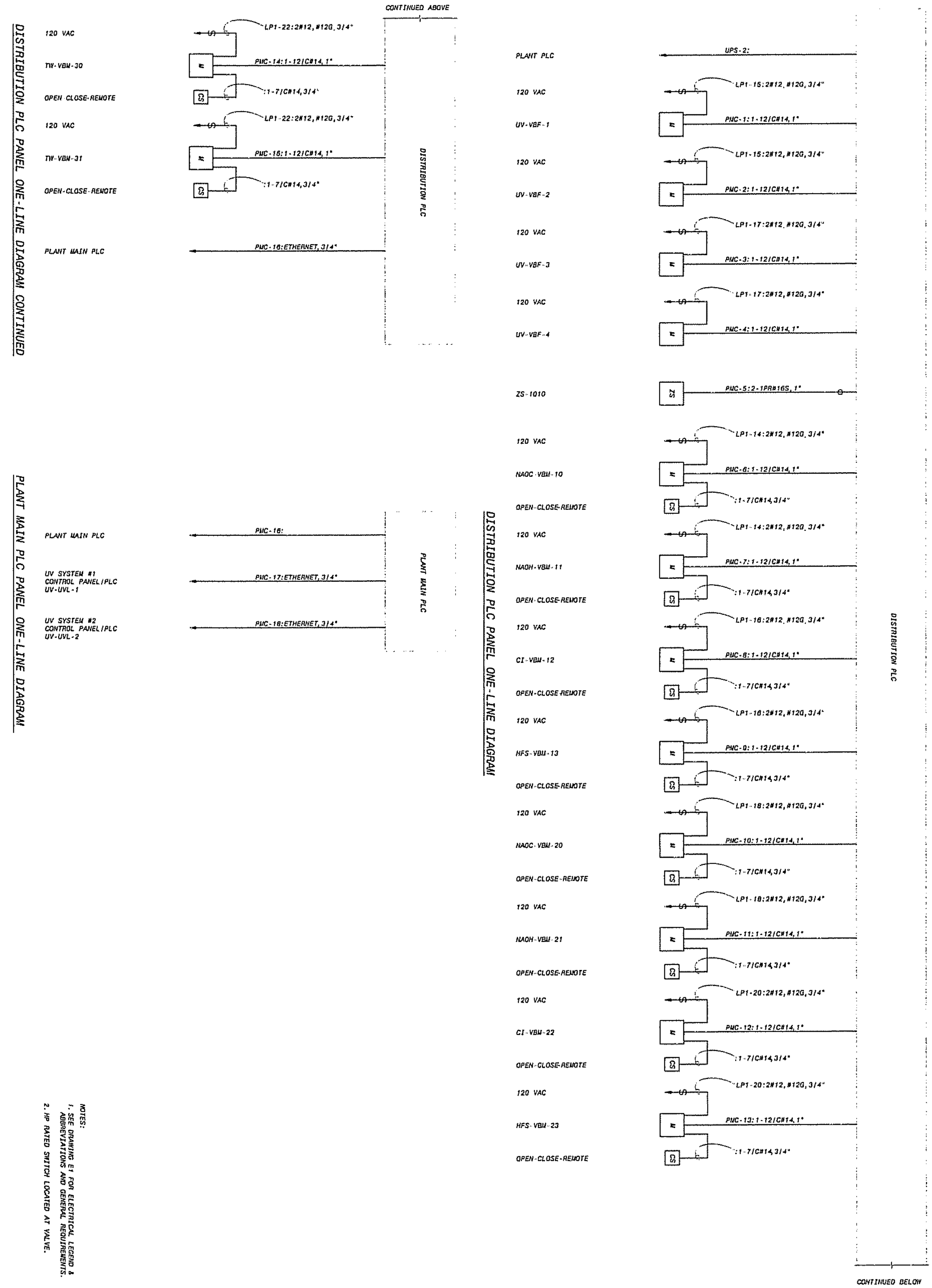

NOTES:
1. SEE DRAWING E1 FOR ELECTRICAL LEGEND & ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. HP RATED SWITCH LOCATED AT VALVE.

NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	SAY	
DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	

CYGNET ID: 143757-3000-E-800000BX6 XREF1:
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STATE OF KENTUCKY — LICENSED PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

ELECTRICAL
CONTROL ONE-LINE DIAGRAMS

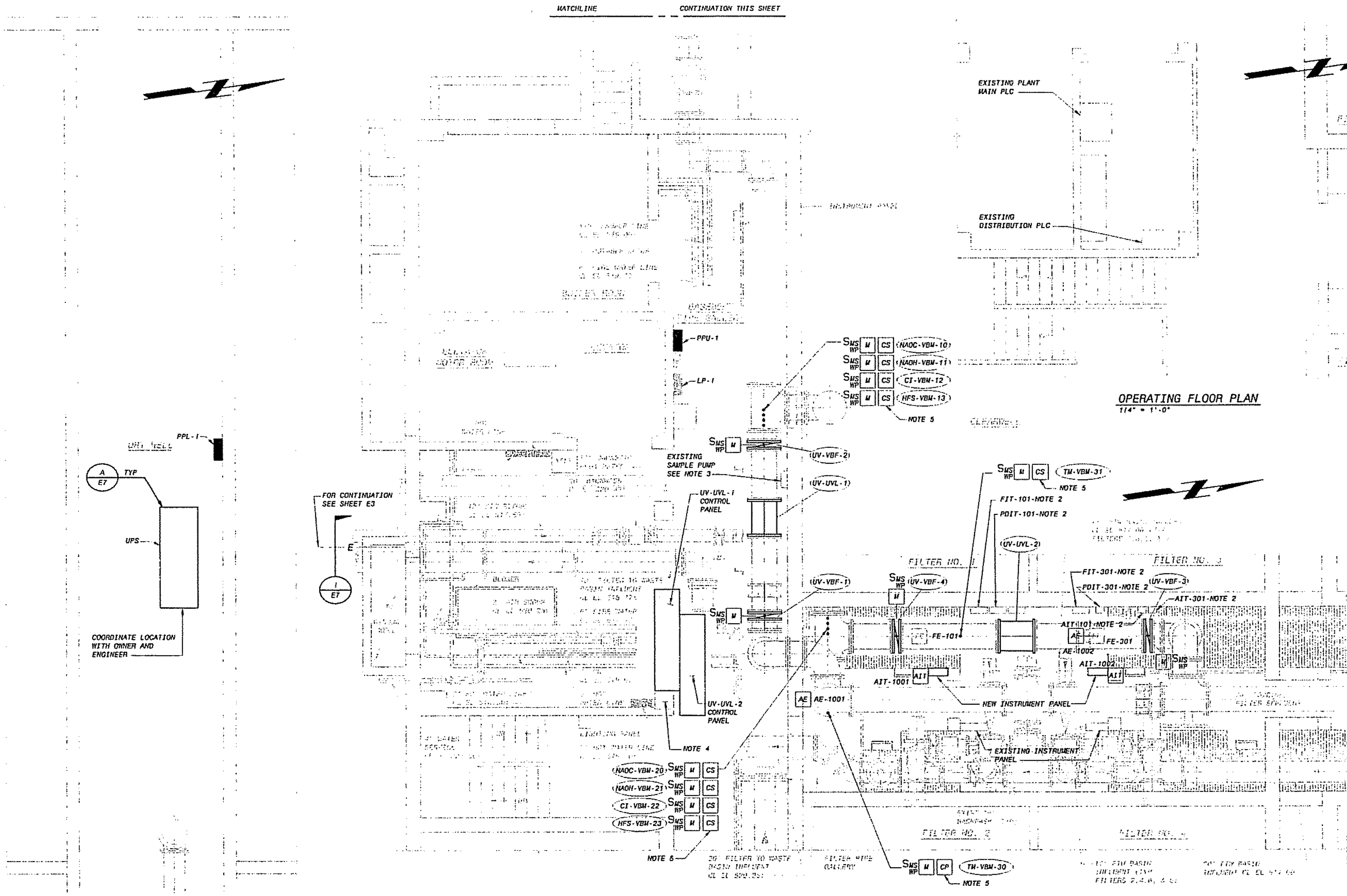
DESIGNED: NEW
DETAILED: NEW, DAD
CHECKED: JTF
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

E5
SHEET 17 OF 24

FD5000
D6000



CORRIDOR PLAN
1/4" = 1'-0"

BASEMENT PIPE GALLERY PLAN
1/4" = 1'-0"

OPERATING FLOOR PLAN
1/4" = 1'-0"

NOTES:

1. SEE DRAWING E1 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. EXISTING INSTRUMENTS SHALL BE RELOCATED TO NEW INSTRUMENT PANELS. SEE SHEET I1 FOR DETAILS.
3. RELOCATE POWER OUTLET AND EXTEND CIRCUIT FOR RELOCATED SAMPLE PUMP. SEE DRAWING C2.
4. REMOVE AND RELOCATE MISCELLANEOUS ELECTRICAL DEVICES MOUNTED TO COLUMN AS ACCEPTABLE TO OWNER AND ENGINEER TO ALLOW PANELS TO BE INSTALLED ADJACENT TO COLUMN.
5. INSTALL CONTROL STATION(S) ON A STAND AT A LOCATION ACCEPTABLE TO THE OWNER AND ENGINEER. REFER TO DRAWING I1 FOR STAND DETAIL.

NO.	BY	CK	DATE	REVISIONS AND RECORD OF ISSUE
1	DAO	CAV	NOV 2008	REVISED SUBSEQUENT TO KDOW REVIEW

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XREF5:

STATE OF KENTUCKY — PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
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NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

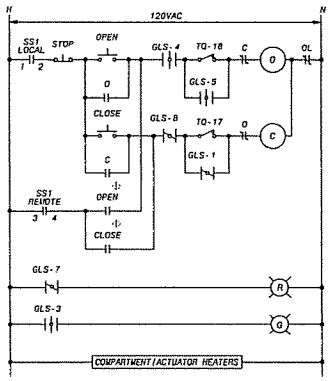
ELECTRICAL
BASEMENT AND FILTER PIPE GALLERY
POWER PLAN

DESIGNED: NEW
DETAILED: DAO
CHECKED: JTF
APPROVED:
DATE: 11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

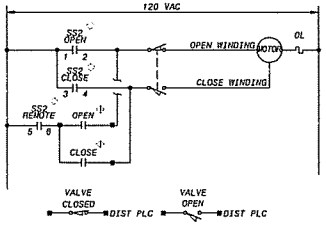
PROJECT NO.
143757

E6
SHEET
18 OF 24



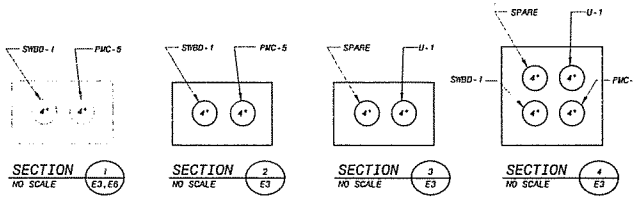
VALVE UV-VBF-1

SIMILAR FOR VALVES UV-VBF-2,3,4 AND 5 SEE NOTE 3

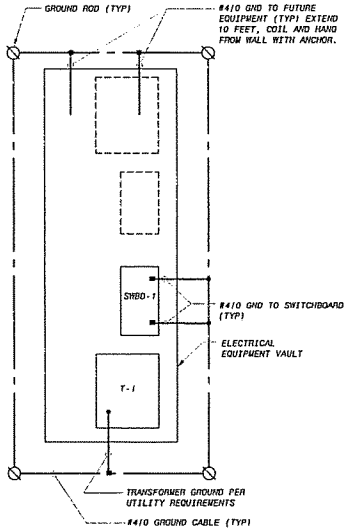


CHEMICAL VALVE NAOC-VBM-10

(SIMILAR FOR NAOH-VBM-11, CI-VBM-12, HFS-VBM-13 NAOC-VBM-20, NAOH-VBM-21, CI-VBM-22, HFS-VBM-23) SEE NOTE 3

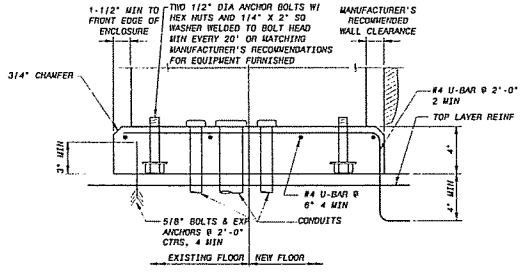


PHASE "A" V.A.	PHASE "B" V.A.	PHASE "C" V.A.	PANELBOARD: LP-1 SERVICE: 120/208V, 3PH, 4W, STN MOUNTING: SURFACE	LOAD	P	BKR	CKT #		BKR	P	LOAD	PHASE "A" V.A.	PHASE "B" V.A.	PHASE "C" V.A.
1630			BUS: COPPER RATING: 225A		1		1	2		1	MAINS: 3P-100A MAIN BREAKER LOCATION: FILTER BUILDING	1630		
	1630				1		3	4		1			1630	
		1630			1		5	6		1				1630
1630					1		7	8		1		1630		
	200				1		9	10		1			200	
		815			1		11	12		1				50
720					1		13	14		1	NAOC-VBM-10, NAOH-VBM-11	1000		
	1630		UV-VBF-1, UV-VBF-2		1		15	16		1	CI-VBM-12, HFS-VBM-13		1000	
		1630	UV-VBF-3, UV-VBF-4		1		17	18		1	NAOC-VBM-20, NAOH-VBM-21			1000
					1		19	20		1	CI-VBM-22, HFS-VBM-23	1000		
	200		AIT-1001, AIT-1002		1		21	22		1	TW-VBM-30, TW-VBM-31		1000	
					1		23	24		1				
					1		25	26		1				
					1		27	28		1				
					1		29	30		1				
					1		31	32		1				
					1		33	34		1				
					1		35	36		1				
					1		37	38		1				
					1		39	40		1				
					1		41	42		1				
3980			TOTAL "A"	9240							TOTAL "A"	5260		
	3660		TOTAL "B"	7490							TOTAL "B"		3830	
		4075	TOTAL "C"	6755							TOTAL "C"			2680
			TOTAL	23580										



SWBD-1/TRANSFORMER T-1 GROUNDING PLAN

NO SCALE



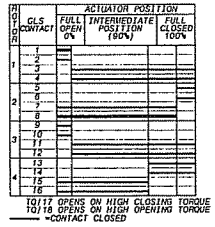
ELECTRICAL EQUIPMENT BASE A

NO SCALE

NOTE:

UNLESS OTHERWISE NOTED, ALL INDOOR AND OUTDOOR FLOOR-MOUNTED ELECTRICAL EQUIPMENT, INCLUDING SWITCHGEAR, SWITCHBOARDS, MOTOR CONTROL CENTERS, ADJUSTABLE FREQUENCY DRIVES, INSTRUMENT CABINETS, ETC., SHALL BE PROVIDED WITH EQUIPMENT BASES.

LIMIT SWITCH DEVELOPMENT:



SWITCH DEVELOPMENT:

SS1

CONTACTS	POSITION LOCAL	POSITION OFF	POSITION REMOTE
1-2	X		
3-4			X
5-6			X

SS2

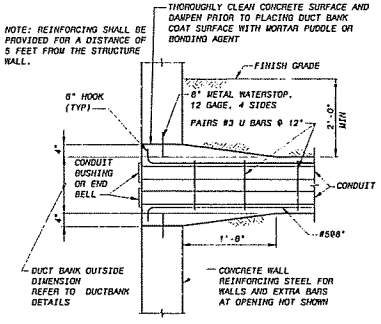
CONTACTS	POSITION OPEN	POSITION CLOSE	POSITION REMOTE
1-2	X		
3-4		X	
5-6			X

LEGEND

- INTERSECTION POINT
- CONNECTION POINT POINT
- LOCATED AT DRIVEN EQUIPMENT
- LOCATED AT PLC
- LOCATED REMOTE FROM STARTER AND DRIVEN EQUIPMENT

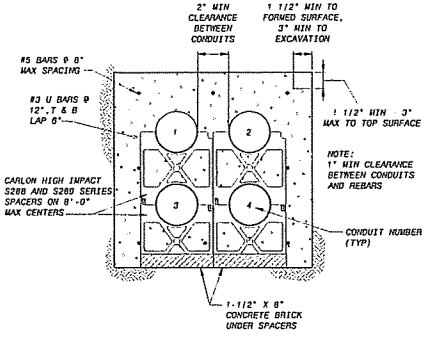
NOTES:

1. SEE DRAWING E1 FOR ELECTRICAL LEGEND & ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. CONTROL SETTINGS, ALARM LIMITS, AND SIMILAR ADJUSTABLE LIMITS ARE INTENDED TO BE FOR INITIAL STARTUP. ADJUSTABLE SETTINGS SHALL BE TESTED AND CHANGED BY THE CONTRACTOR, IF REQUIRED FOR PROPER SEQUENCING AND OPERATION.
3. REFER TO PLC RELAY SCHEMATICS ON DRAWING I1



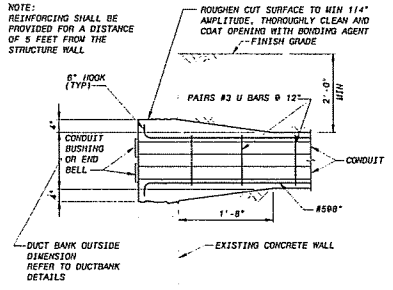
TYPICAL UNDERGROUND DUCT BANK ENTRANCE DETAIL

NO SCALE



TYPICAL DUCT BANK SECTION

NO SCALE



TYPICAL UNDERGROUND DUCT BANK ENTRANCE DETAIL

NO SCALE

NOTE: FOR EXISTING WALL

NO.	BY	CAT	DATE	REVISIONS AND RECORD OF ISSUE
1	DAD	SAY	NOV 2008	REVISED SUBSEQUENT TO 100% REVIEW

CYBERT ID: I:\E757-3000-E-R0000X.DWG SHEET: 1
WF: E7.dwg SHEET: 2
SAVED: 02/26/09, 11:17:12 SHEET: 3
PLOTTED: 03/04/09, 3:35:29 PM SHEET: 4
USER: DAVIDSON ORG VER: 1.2

STATE OF KENTUCKY — MICHAEL W. MEHR — LICENSED PROFESSIONAL ENGINEER — 11/20/08

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

ELECTRICAL
SCHEMATICS, SCHEDULES AND DETAILS

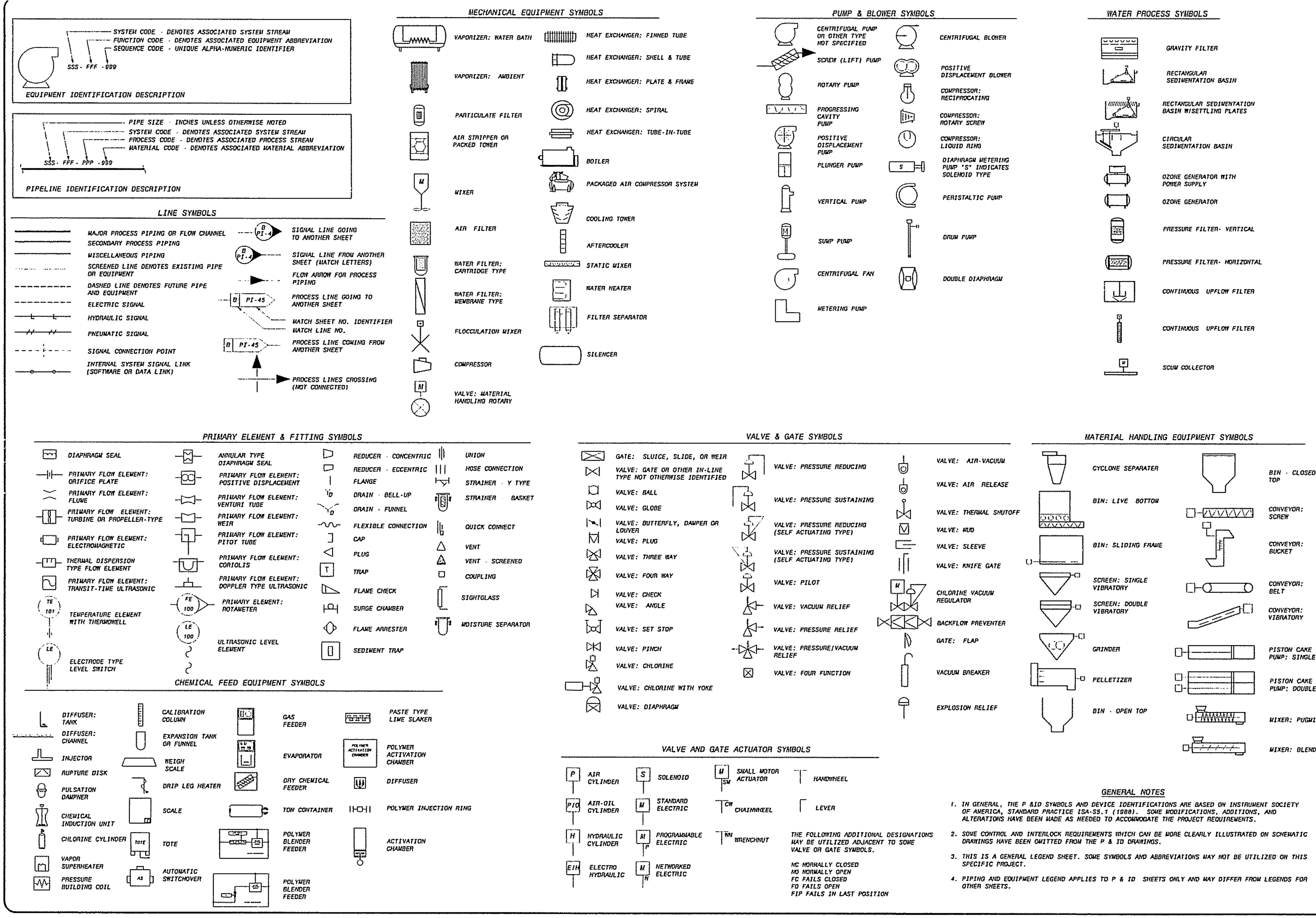
DESIGNED: MEM
DETAILED: MEM, DAD
CHECKED: JTF
APPROVED: [signature]
DATE: 11/20/08

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

E7
SHEET 19 OF 24

FSA000 36009


EQUIPMENT IDENTIFICATION DESCRIPTION
SSS - FFF - 999
SYSTEM CODE - DENOTES ASSOCIATED SYSTEM STREAM
FUNCTION CODE - DENOTES ASSOCIATED EQUIPMENT ABBREVIATION
SEQUENCE CODE - UNIQUE ALPHA-NUMERIC IDENTIFIER
PIPELINE IDENTIFICATION DESCRIPTION
SSS - FFF - PPP - 999
PIPE SIZE - INCHES UNLESS OTHERWISE NOTED
SYSTEM CODE - DENOTES ASSOCIATED SYSTEM STREAM
PROCESS CODE - DENOTES ASSOCIATED PROCESS STREAM
MATERIAL CODE - DENOTES ASSOCIATED MATERIAL ABBREVIATION
LINE SYMBOLS
MAJOR PROCESS PIPING OR FLOW CHANNEL
SECONDARY PROCESS PIPING
MISCELLANEOUS PIPING
SCREENED LINE DENOTES EXISTING PIPE OR EQUIPMENT
DASHED LINE DENOTES FUTURE PIPE AND EQUIPMENT
ELECTRIC SIGNAL
HYDRAULIC SIGNAL
PNEUMATIC SIGNAL
SIGNAL CONNECTION POINT
INTERNAL SYSTEM SIGNAL LINK (SOFTWARE OR DATA LINK)
B PI-4
SIGNAL LINE GOING TO ANOTHER SHEET
SIGNAL LINE FROM ANOTHER SHEET (MATCH LETTERS)
FLOW ARROW FOR PROCESS PIPING
D PI-45
PROCESS LINE GOING TO ANOTHER SHEET
MATCH SHEET NO. IDENTIFIER
MATCH LINE NO.
PROCESS LINE COMING FROM ANOTHER SHEET
PROCESS LINES CROSSING (NOT CONNECTED)
MECHANICAL EQUIPMENT SYMBOLS
VAPORIZER: WATER BATH
VAPORIZER: AMBIENT
PARTICULATE FILTER
AIR STRIPPER OR PACKED TOWER
MIXER
AIR FILTER
WATER FILTER: CARTRIDGE TYPE
WATER FILTER: MEMBRANE TYPE
FLOCCULATION MIXER
COMPRESSOR
VALVE: MATERIAL HANDLING ROTARY
HEAT EXCHANGER: FINNED TUBE
HEAT EXCHANGER: SHELL & TUBE
HEAT EXCHANGER: PLATE & FRAME
HEAT EXCHANGER: SPIRAL
HEAT EXCHANGER: TUBE-IN-TUBE
BOILER
PACKAGED AIR COMPRESSOR SYSTEM
COOLING TOWER
AFTERCOOLER
STATIC MIXER
WATER HEATER
FILTER SEPARATOR
SILENCER
PUMP & BLOWER SYMBOLS
CENTRIFUGAL PUMP OR OTHER TYPE NOT SPECIFIED
SCREW (LIFT) PUMP
ROTARY PUMP
PROGRESSING CAVITY PUMP
POSITIVE DISPLACEMENT PUMP
PLUNGER PUMP
VERTICAL PUMP
SUMP PUMP
CENTRIFUGAL FAN
METERING PUMP
CENTRIFUGAL BLOWER
POSITIVE DISPLACEMENT BLOWER
COMPRESSOR: RECIPROCATING
COMPRESSOR: ROTARY SCREW
COMPRESSOR: LIQUID RING
DIAPHRAGM METERING PUMP "S" INDICATES SOLENOID TYPE
PERISTALTIC PUMP
DRUM PUMP
DOUBLE DIAPHRAGM
WATER PROCESS SYMBOLS
GRAVITY FILTER
RECTANGULAR SEDIMENTATION BASIN
RECTANGULAR SEDIMENTATION BASIN W/SETTLING PLATES
CIRCULAR SEDIMENTATION BASIN
OZONE GENERATOR WITH POWER SUPPLY
OZONE GENERATOR
PRESSURE FILTER - VERTICAL
PRESSURE FILTER - HORIZONTAL
CONTINUOUS UPFLOW FILTER
CONTINUOUS UPFLOW FILTER
SCUM COLLECTOR
PRIMARY ELEMENT & FITTING SYMBOLS
DIAPHRAGM SEAL
PRIMARY FLOW ELEMENT: ORIFICE PLATE
PRIMARY FLOW ELEMENT: FLUME
PRIMARY FLOW ELEMENT: TURBINE OR PROPELLER-TYPE
PRIMARY FLOW ELEMENT: ELECTROMAGNETIC
THERMAL DISPERSION TYPE FLOW ELEMENT
PRIMARY FLOW ELEMENT: TRANSIT-TIME ULTRASONIC
TE 101
TEMPERATURE ELEMENT WITH THERMOWELL
LE
ELECTRODE TYPE LEVEL SWITCH
ANNULAR TYPE DIAPHRAGM SEAL
PRIMARY FLOW ELEMENT: POSITIVE DISPLACEMENT
PRIMARY FLOW ELEMENT: VENTURI TUBE
PRIMARY FLOW ELEMENT: WEIR
PRIMARY FLOW ELEMENT: PITOT TUBE
PRIMARY FLOW ELEMENT: CORIOLIS
PRIMARY FLOW ELEMENT: DOPPLER TYPE ULTRASONIC
FE 100
PRIMARY ELEMENT: ROTAMETER
LE 100
ULTRASONIC LEVEL ELEMENT
REDUCER - CONCENTRIC
REDUCER - ECCENTRIC
FLANGE
DRAIN - BELL-UP
DRAIN - FUNNEL
FLEXIBLE CONNECTION
CAP
PLUG
TRAP
FLAME CHECK
SURGE CHAMBER
FLAME ARRESTER
SEDIMENT TRAP
UNION
HOSE CONNECTION
STRAINER - Y TYPE
STRAINER - BASKET
QUICK CONNECT
VENT
VENT - SCREENED
COUPLING
SIGHTGLASS
MOISTURE SEPARATOR
CHEMICAL FEED EQUIPMENT SYMBOLS
DIFFUSER: TANK
DIFFUSER: CHANNEL
INJECTOR
RUPTURE DISK
PULSATION DAMPNER
CHEMICAL INDUCTION UNIT
CHLORINE CYLINDER
VAPOR SUPERHEATER
PRESSURE BUILDING COIL
CALIBRATION COLUMN
EXPANSION TANK OR FUNNEL
WEIGH SCALE
DRIP LEG HEATER
SCALE
TOTE
TOTE
AUTOMATIC SWITCHOVER
AS
GAS FEEDER
EVAPORATOR
DRY CHEMICAL FEEDER
TON CONTAINER
POLYMER BLENDER FEEDER
POLYMER BLENDER FEEDER
PASTE TYPE LIME SLAKER
POLYMER ACTIVATION CHAMBER
DIFFUSER
POLYMER INJECTION RING
ACTIVATION CHAMBER
VALVE & GATE SYMBOLS
GATE: SLUICE, SLIDE, OR WEIR
VALVE: GATE OR OTHER IN-LINE TYPE NOT OTHERWISE IDENTIFIED
VALVE: BALL
VALVE: GLOBE
VALVE: BUTTERFLY, DAMPER OR LOUVER
VALVE: PLUG
VALVE: THREE WAY
VALVE: FOUR WAY
VALVE: CHECK
VALVE: ANGLE
VALVE: SET STOP
VALVE: PINCH
VALVE: CHLORINE
VALVE: CHLORINE WITH YOKE
VALVE: DIAPHRAGM
VALVE: PRESSURE REDUCING
VALVE: PRESSURE SUSTAINING
VALVE: PRESSURE REDUCING (SELF ACTUATING TYPE)
VALVE: PRESSURE SUSTAINING (SELF ACTUATING TYPE)
VALVE: PILOT
VALVE: VACUUM RELIEF
VALVE: PRESSURE RELIEF
VALVE: PRESSURE/VACUUM RELIEF
VALVE: FOUR FUNCTION
VALVE: AIR-VACUUM
VALVE: AIR RELEASE
VALVE: THERMAL SHUTOFF
VALVE: MUD
VALVE: SLEEVE
VALVE: KNIFE GATE
CHLORINE VACUUM REGULATOR
BACKFLOW PREVENTER
GATE: FLAP
VACUUM BREAKER
EXPLOSION RELIEF
VALVE AND GATE ACTUATOR SYMBOLS
AIR CYLINDER
AIR-OIL CYLINDER
HYDRAULIC CYLINDER
ELECTRO HYDRAULIC
SOLENOID
STANDARD ELECTRIC
PROGRAMMABLE ELECTRIC
NETWORKED ELECTRIC
SMALL MOTOR ACTUATOR
CHAINWHEEL
WRENCHNUT
HANDWHEEL
LEVER
THE FOLLOWING ADDITIONAL DESIGNATIONS MAY BE UTILIZED ADJACENT TO SOME VALVE OR GATE SYMBOLS.
NC NORMALLY CLOSED
NO NORMALLY OPEN
FC FAILS CLOSED
FO FAILS OPEN
FIP FAILS IN LAST POSITION
MATERIAL HANDLING EQUIPMENT SYMBOLS
CYCLONE SEPARATER
BIN: LIVE BOTTOM
BIN: SLIDING FRAME
SCREEN: SINGLE VIBRATORY
SCREEN: DOUBLE VIBRATORY
GRINDER
PELLETIZER
BIN - OPEN TOP
BIN - CLOSED TOP
CONVEYOR: SCREW
CONVEYOR: BUCKET
CONVEYOR: BELT
CONVEYOR: VIBRATORY
PISTON CAKE PUMP: SINGLE
PISTON CAKE PUMP: DOUBLE
MIXER: PUGMILL
MIXER: BLENDER

GENERAL NOTES

1. IN GENERAL, THE P &ID SYMBOLS AND DEVICE IDENTIFICATIONS ARE BASED ON INSTRUMENT SOCIETY OF AMERICA, STANDARD PRACTICE ISA-S5.1 (1980). SOME MODIFICATIONS, ADDITIONS, AND ALTERATIONS HAVE BEEN MADE AS NEEDED TO ACCOMMODATE THE PROJECT REQUIREMENTS.
2. SOME CONTROL AND INTERLOCK REQUIREMENTS WHICH CAN BE MORE CLEARLY ILLUSTRATED ON SCHEMATIC DRAWINGS HAVE BEEN OMITTED FROM THE P & ID DRAWINGS.
3. THIS IS A GENERAL LEGEND SHEET. SOME SYMBOLS AND ABBREVIATIONS MAY NOT BE UTILIZED ON THIS SPECIFIC PROJECT.
4. PIPING AND EQUIPMENT LEGEND APPLIES TO P & ID SHEETS ONLY AND MAY DIFFER FROM LEGENDS FOR OTHER SHEETS.

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK	AP
1	NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	DAD	SAY	MEK

CYGNET ID: 143757-3000-XPE-1-000009NSB
XREF1:
XREF2:
XREF3:
XREF4:
XREF5:
WF: P1.DWG
SAVED: DUN38005, 11/17/2006 2:15:13 PM
PLOTTED:
USER: DUN38005
DWG VER: 4.3

STATE OF KENTUCKY — MARK E. MADDOX — 21981 — PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

P&ID
P&ID LEGEND AND ABBREVIATIONS
SHEET 1 OF 3

DESIGNED: SAY
DETAILED: SAY
CHECKED: JSH
APPROVED:
DATE: 11/20/06

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO. 143757

P1
SHEET 20 OF 24

FD6000
06008

INSTRUMENT TAG NUMBERS

MEANINGS OF IDENTIFICATION LETTERS

LETTER	FIRST LETTER: MEASURED OR INITIATING VARIABLE	FIRST LETTER: MODIFIER	SUCCEEDING LETTERS: READOUT OR PASSIVE FUNCTION	SUCCEEDING LETTERS: OUTPUT FUNCTION	SUCCEEDING LETTERS: MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY (ELECTRICAL)			CONTROL	CLOSED
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE		GLASS		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME-SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY	MOMENTARY			MIDDLE OR INTER-MEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE (RESTRICTION)		OPEN
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE OR TOTALIZE	INTEGRATE OR TOTALIZE		
R	RADIATION		RECORD OR PRINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE, DAMPER, OR LOUVER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED		UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, OR PRESENCE			RELAY OR COMPUTE	
Z	POSITION, DIMENSION			DRIVE, ACTUATOR OR UNCLASSIFIED FINAL CONTROL ELEMENT	

GENERAL INSTRUMENT SYMBOLS

FIELD MOUNTED INSTRUMENT

INSTRUMENT MOUNTED ON FACE OF PANEL

INSTRUMENT MOUNTED BEHIND OR INSIDE OF PANEL

INSTRUMENT MOUNTED ON FACE OF LOCAL PANEL

INSTRUMENT MOUNTED BEHIND OR INSIDE OF LOCAL PANEL

SINGLE INSTRUMENT HOUSING CONTAINING TWO (OR MORE) INSTRUMENTATION FUNCTIONS

CONTROL INTERLOCK FUNCTION, SEE SCHEMATICS AND SYSTEM SPECIFICATIONS FOR SPECIFIC FUNCTION

TAG NUMBERS AND ADDITIONAL DESIGNATIONS

TRC 31-1

- FIRST LETTER
- SUCCEEDING LETTERS
- NUMBER AFTER DASH (-1, -2, ETC) DENOTES MULTIPLE DEVICES USED IN IDENTICAL DUPLICATE SYSTEMS.
- A LETTER AFTER THE LOOP NUMBER (31A, 31B, ETC) IS USED TO DISTINGUISH MULTIPLE SIMILAR DEVICES IN THE SAME INSTRUMENT LOOP.
- LOOP DESIGNATION NUMBER

pH 2

- SEE INSTRUMENT FUNCTIONAL DESIGNATIONS AND ABBREVIATIONS.
- PANEL REFERENCE NUMBER AS FOLLOWS:
  1=
  2=
  3=
  4=

DIGITAL SYSTEMS INTERFACE SYMBOLS

NOTE: REFER TO DETAILED SYSTEM SPECIFICATIONS FOR FUNCTIONAL DESCRIPTION. ALSO SEE I/O SCHEDULES FOR COMPLETE INPUT AND OUTPUT LISTINGS.

COMPUTER, DISTRIBUTED CONTROL SYSTEM, OR DISPLAY FUNCTION BLOCK

LETTERS, TAG NUMBERS, ABBREVIATIONS AND OTHER ANNOTATIONS ARE SIMILAR TO THE GENERAL INSTRUMENT LEGEND

AC 130

PROGRAMMABLE LOGIC CONTROLLER SYSTEM FUNCTION BLOCK

"CB" NUMBER REFERS TO SOFTWARE CONTROL BLOCK DESCRIPTION IN THE SPECIFICATIONS.

DIGITAL SYSTEM I/O INTERFACE DIRECTION OF ARROW DENOTES WHETHER INPUT OR OUTPUT

▽2 DISCRETE I/O

▲2 ANALOG I/O

SYSTEM REFERENCE NUMBER, AS FOLLOWS:
1= EXISTING PLANT DISTRIBUTION SYSTEM PLC
2=
3=
3A=
3B=

FUNCTION DESIGNATIONS AND ABBREVIATIONS

INSTRUMENT DESIGNATIONS

K	GAIN OR ATTENUATE (INPUT:OUTPUT)
-K	GAIN AND REVERSE
Σ	ADD OR SUM (ADD AND SUBTRACT)
Δ	SUBTRACT (DIFFERENCE)
√	EXTRACT SQUARE ROOT
÷	DIVIDE
F(X)	CHARACTERIZE SIGNAL
>	HIGH-SELECT
<	LOW-SELECT
X	MULTIPLY
∫	INTEGRATE (TIME INTEGRAL)
CH_4	METHANE
CL_2	CHLORINE RESIDUAL
CO_2	CARBON DIOXIDE
DO	DISSOLVED OXYGEN
LEL	LOWER EXPLOSIVE LIMIT
MCC	MOTOR CONTROL CENTER
MLSS	MIXED LIQUOR SUSPENDED SOLIDS
O_2	OXYGEN (PURITY)
pH	pH CELL
TURB	TURBIDITY
UV	UV TRANSMITTANCE

HAND SWITCH DESIGNATIONS

HOA	HAND-OFF-AUTO
LR	LOCAL REMOTE
OC	OPEN-CLOSE
OO	ON-OFF
LOR	LOCAL-OFF-REMOTE
OOA	ON-OFF-AUTO
OCR	OPEN-CLOSE-REMOTE
OOR	ON-OFF-REMOTE
FR	FORWARD-REVERSE

TRANSDUCER & CONVERTER DESIGNATION

E	VOLTAGE
FSK	FREQUENCY SHIFT KEYING
H	HYDRAULIC
I	CURRENT
P	PNEUMATIC PULSE
PD	PULSE DURATION
PF	PULSE FREQUENCY
R	RESISTANCE (ELECTRICAL)

EXAMPLE: IIP = CURRENT TO PNEUMATIC TRANSDUCER

POWER SUPPLY ABBREVIATIONS

AS	AIR SUPPLY
ES	ELECTRIC SUPPLY
GS	GAS SUPPLY
HS	HYDRAULIC SUPPLY
NS	NITROGEN SUPPLY
SS	STEAM SUPPLY
WS	WATER SUPPLY

AS >— POWER SUPPLY SOURCE LABEL. USED ONLY WHERE NECESSARY TO HELP CLARIFY AN INSTRUMENT OR SYSTEM FUNCTION.

GENERAL NOTES

1. IN GENERAL, THE P&ID SYMBOLS AND DEVICE IDENTIFICATIONS ARE BASED ON INSTRUMENT SOCIETY OF AMERICA, STANDARD PRACTICE ISA-S5.1 (1986). SOME MODIFICATIONS, ADDITIONS, AND ALTERATIONS HAVE BEEN MADE AS NEEDED TO ACCOMMODATE THE PROJECT REQUIREMENTS.
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4. PIPING AND EQUIPMENT LEGEND APPLIES TO P&ID SHEETS ONLY AND MAY DIFFER FROM LEGENDS FOR OTHER SHEETS.

PIPELINE MATERIAL CODE ABBREVIATIONS

PCCP	SECTION 02612, PRESTRESSED CONCRETE CYLINDER PIPE
CBWS	SECTION 02614, CONCRETE BAR-WRAPPED, STEEL CYLINDER PIPE
LHCPP	SECTION 02616, LOW HEAD CONCRETE PRESSURE PIPE
RCP	SECTION 02618, CONCRETE PIPE
PVC	SECTION 15061, POLYVINYL CHLORIDE PIPE
DIP	SECTION 15061, DUCTILE IRON PIPE
SP	SECTION 15062, STEEL PIPE
LWS-XX	SECTION 15063, LIGHT WALL STEEL PIPE
SS-XX1	SECTION 15064, STAINLESS STEEL PIPE, TUBING, AND ACCESSORIES
CSG-XX	SECTION 15065, MISCELLANEOUS STEEL PIPE, TUBING, AND ACCESSORIES
CS-XX	SECTION 15065, MISCELLANEOUS STEEL PIPE, TUBING, AND ACCESSORIES
FRPE-XX	SECTION 15066, FIBERGLASS REINFORCED PLASTIC PIPE (EXHAUST AIR SERVICE)
FRP-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
PVC-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
CPVC-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
PE-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
PP-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
PVDF-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
RPT-XX	SECTION 15067, MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES
SS	SECTION 15068, AWWA STAINLESS STEEL PIPE
CI-XX	SECTION 15069, CAST IRON SOIL PIPE AND ACCESSORIES
CU-XX	SECTION 15070, COPPER TUBING AND ACCESSORIES
BR-XX	SECTION 15060, MISCELLANEOUS PIPING AND PIPE ASSEMBLY
HS-XX	SECTION 15060, MISCELLANEOUS PIPING AND PIPE ASSEMBLY
TG-XX	SECTION 15060, MISCELLANEOUS PIPING AND PIPE ASSEMBLY
CRP-XX	SECTION 15060, MISCELLANEOUS PIPING AND PIPE ASSEMBLY

1. XX= numbers 01-20

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP
NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	SAY	WEX

CYGNET ID: 143757-3000-WPE-I-B0000WB7 XREF1:
WF: P2.dwg XREF2:
SAVED: YAK31228, 10/12/2006 4:51:47 PM XREF3:
PLOTTED: XREF4:
USER: OUR38005 DWG VER: 4.3 XREF5:

STATE OF KENTUCKY — BURKE E. MAGEL — 21801 — LICENSED PROFESSIONAL ENGINEER — 11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

P&ID
P&ID LEGEND AND ABBREVIATIONS
SHEET 2 OF 3

DESIGNED: SAY
DETAILED: SAY
CHECKED: JSM
APPROVED: [signature]
DATE: 11/20/06

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

P2
SHEET
21 OF 24

FD5000
D6003

SYSTEM CODE ABBREVIATIONS

ACETIC ACID	ACE	FLOCCULATION	FLC	RESIDUALS	RES
ACETYLENE	ACT	GASEOUS OXYGEN	GOX	RETURN ACTIVATED SLUDGE	RAS
ACTIVATED CARBON - GRANULAR	GAC	GASOLINE	GSL	REVERSE OSMOSIS	ROS
AERATION AIR/PROCESS AIR	AIR	GREASE	GRS	SCREENINGS	SCR
AERATION SYSTEM	AER	GRIT	GRT	SECONDARY CLARIFICATION	SCL
AIR WASH	ARW	HELIUM	HEL	SECONDARY SCUM	SSC
ALUMINUM SULFATE	ALS	HYDRAULIC FLUID	HFL	SEPTAGE	SEP
AMMONIUM SULFATE	NSO4	HYDROCHLORIC ACID	HCL	SETTLED WATER	SET
ANHYDROUS AMMONIA	NH3	HYDROFLUOSILIC ACID (FLUORIDE)	[illegible]	SEWAGE	SEW
ANTI-SEALANT	AS	HYDROGEN	HYD	SODA ASH	NAC
AQUA AMMONIA	NHOH	HYDROGEN PEROXIDE	PER	SODIUM ALUMINATE	NAL
ARGON	ARG	INCINERATION	INC	SODIUM ALUMINATE	NAM
ASH	ASH	INFLUENT PUMPING	INFP	SODIUM BICARBONATE	NBC
BACKWASH - MEMBRANE/FILTER	BWH	INTAKE	INT	SODIUM BISULFITE	NHS
BALLASTED FLOCCULATION	BAL	LAGOON STORAGE	LAG	SODIUM CHLORIDE	NCL
BIOSOLIDS	BIO	LAND APPLICATION	LAP	SODIUM CHLORITE	NCL2
BIOTOWER	BIT	LIME - HYDRATED	CAH	SODIUM FLUORIDE	NAF
BLENDED SLUDGE	BLS	LIME - QUICKLIME	CAO	SODIUM HEXAMETAPHOSPHATE	NAX
BNR	BNR	LIME STABILIZATION	LIM	SODIUM HYDROXIDE	NAOH
BRINE	BRN	LIQUID OXYGEN	LOX	SODIUM HYPOCHLORITE	NAOC
CALCIUM HYPOCHLORITE	CACL	LP GAS OR PROPANE GAS	LPG	SODIUM SILICOFLUORIDE	NASF
CALCIUM THIOSULFATE	CATS	MAGNESIUM HYDROXIDE	MGOH	STEAM	STM
CARBON DIOXIDE	CO2	MEMBRANE	MEM	STORM SEWER	STS
CARBON SLURRY	CAS	METHANE GAS	MEG	STORM WATER	STW
CARBONIC ACID	HCO3	METHANOL	MTH	SULFUR DIOXIDE	SO2
CENTRATE	CEN	MIXED LIQUOR	MXL	SULFURIC ACID	HSO4
CHEMICAL ENHANCED BACKWASH - MEMBRANE	CEB	NATURAL GAS	NG	SURFACE WASH	SW
CHLORINE	CL2	NITROGEN	NIT	TERTIARY TREATMENT	TERT
CHLORINE DIOXIDE	CLO2	NITROUS OXIDE	NIO	THICKENED PRIMARY SLUDGE	TPRS
CITRIC ACID	CA	ODOR CONTROL	ODC	THICKENED WASTE ACTIVATED SLUDGE	TWAS
CLEAN IN PLACE	CIP	OIL	OIL	THICKENING	THCK
COAGULATION	COA	OIL - FUEL	FO	TREATED WATER	TW
COMPRESSED AIR - INSTRUMENT	CAI	OZONE	OZN	TRICKLING FILTER	TF
COMPRESSED AIR - SERVICE	CMS	OZONE DESTRUCT	OZD	ULTRAVIOLET	UV
COPPER SULFATE	CUS	PHOSPHATE	PPP	VACUUM	VAC
CORROSION INHIBITOR	CI	PHOSPHORIC ACID	PO4	WASH WATER	WW
DECHLORINATION	DCL	POLYALUMINUM CHLORIDE	PCL	WASTE ACTIVATED SLUDGE	WAS
DETERGENT	DET	POLYMER	POLF	WASTE WASH WATER	WWW
DEWATERING	DWT	POTASSIUM PERMANGANATE	KMN	WATER - CONDENSATE	COW
DIESEL FUEL	FUE	POWDERED ACTIVATE CARBON	PAC	WATER - COOLING	COLW
DIGESTER GAS	DGG	PRE-AERATION	PAR	WATER - DISTILLED WATER	DW
DIGESTER GAS MIXING	DGM	PRESEDIMENTATION	PSD	WATER - FIRE	FW
DIGESTER SLUDGE	DGS	PRIMARY CLARIFICATION	PRC	WATER - IRRIGATION	IRW
DIGESTION - AEROBIC	DGA	PRIMARY SCUM	PSC	WATER - OZONATED	OZW
DIGESTION - ANAEROBIC	DIG	PRIMARY SLUDGE	PRS	WATER - SEAL	SWT
DISINFECTION CONTACT BASIN	DCB	RAW WASTEWATER PUMPING	WWP	WATER - WATER HEATING	HW
DISSOLVED AIR FLOTATION	DAF	RAW WATER PUMPING	RWP	WATER DEIONIZED	DEIW
DRAINAGE	DRN	RAW WATER STORAGE	RWS	WATER NON-POTABLE	NPW
EFFLUENT PUMPING	EFP	RECIRCULATED SLUDGE	RCS	WATER PLANT EFFLUENT	PEW
ENGINE EXHAUST	EXH	RECLAIMED WATER	RCW	WATER POTABLE	PW
EQUALIZATION BASIN	EQB	REFRIGERANT	REF	WATER RAW	RW
FERRIC CHLORIDE	FEC			WET WEATHER TREATMENT	WWT
FERRIC SULFATE	FES			ZINC ORTHOPHOSPHATE	ZOP
FERROUS CHLORIDE	FRC				
FERROUS SULFATE	FRS				
FILTRATION	FLT				

PROCESS CODE ABBREVIATIONS

ACETIC ACID	ACE_X	FLOCCULATION	FLC_X	RESIDUALS	RES_X
ACETYLENE	ACT_X	GASEOUS OXYGEN	GOX_X	RETURN ACTIVATED SLUDGE	RAS_X
ACTIVATED CARBON - GRANULAR	GAC_X	GASOLINE	GSL_X	REVERSE OSMOSIS	ROS_X
AERATION AIR/PROCESS AIR	AIR_X	GREASE	GRS_X	SCREENINGS	SCR_X
AERATION SYSTEM	AER_X	GRIT	GRT_X	SECONDARY CLARIFICATION	SCL_X
AIR WASH	ARW_X	HELIUM	HEL_X	SECONDARY SCUM	SSC_X
ALUMINUM SULFATE	ALS_X	HYDRAULIC FLUID	HFL_X	SEPTAGE	SEP_X
AMMONIUM SULFATE	NSO4_X	HYDROCHLORIC ACID	HCL_X	SETTLED WATER	SET_X
ANHYDROUS AMMONIA	NH3_X	HYDROFLUOSILIC ACID (FLUORIDE)	[illegible]	SEWAGE	SEW_X
ANTI-SEALANT	AS_X	HYDROGEN	HYD_X	SODA ASH	NAC_X
AQUA AMMONIA	NHOH_X	HYDROGEN PEROXIDE	PER_X	SODIUM ALUMINATE	NAL_X
ARGON	ARG_X	INCINERATION	INC_X	SODIUM ALUMINATE	NAM_X
ASH	ASH_X	INFLUENT PUMPING	INFP_X	SODIUM BICARBONATE	NBC_X
BACKWASH - MEMBRANE/FILTER	BWH_X	INTAKE	INT_X	SODIUM BISULFITE	NHS_X
BALLASTED FLOCCULATION	BAL_X	LAGOON STORAGE	LAG_X	SODIUM CHLORIDE	NCL_X
BIOSOLIDS	BNR_X	LAND APPLICATION	LAP_X	SODIUM CHLORITE	NCL2_X
BIOTOWER	BIO_X	LIME - HYDRATED	CAH_X	SODIUM FLUORIDE	NAF_X
BLENDED SLUDGE	BIT_X	LIME - QUICKLIME	CAO_X	SODIUM HEXAMETAPHOSPHATE	NAX_X
BNR	BLS_X	LIME STABILIZATION	LIM_X	SODIUM HYDROXIDE	NAOH_X
BRINE	BRN_X	LIQUID OXYGEN	LOX_X	SODIUM HYPOCHLORITE	NAOC_X
CALCIUM HYPOCHLORITE	CACL_X	LP GAS OR PROPANE GAS	LPG_X	SODIUM SILICOFLUORIDE	NASF_X
CALCIUM THIOSULFATE	CATS_X	MAGNESIUM HYDROXIDE	MGOH_X	STEAM	STM_X
CARBON DIOXIDE	CO2_X	MEMBRANE	MEM_X	STORM SEWER	STS_X
CARBON SLURRY	CAS_X	METHANE GAS	MEG_X	STORM WATER	STW_X
CARBONIC ACID	HCO3_X	METHANOL	MTH_X	SULFUR DIOXIDE	SO2_X
CENTRATE	CEN_X	MIXED LIQUOR	MXL_X	SULFURIC ACID	HSO4_X
CHEMICAL ENHANCED BACKWASH - MEMBRANE	CEB_X	NATURAL GAS	NG_X	SURFACE WASH	SW_X
CHLORINE	CL2_X	NITROGEN	NIT_X	TERTIARY TREATMENT	TERT_X
CHLORINE DIOXIDE	CLO2_X	NITROUS OXIDE	NIO_X	THICKENED PRIMARY SLUDGE	TPRS_X
CITRIC ACID	CA_X	ODOR CONTROL	ODC_X	THICKENED WASTE ACTIVATED SLUDGE	TWAS_X
CLEAN IN PLACE	CIP_X	OIL	FO_X	THICKENING	THCK_X
COAGULATION	COA_X	OIL - FUEL	OIL_X	TREATED WATER	TW_X
COMPRESSED AIR - INSTRUMENT	CAI_X	OZONE	OZN_X	TRICKLING FILTER	TF_X
COMPRESSED AIR - SERVICE	CMS_X	OZONE DESTRUCT	OZD_X	ULTRAVIOLET	UV_X
COPPER SULFATE	CUS_X	PHOSPHATE	PPP_X	VACUUM	VAC_X
CORROSION INHIBITOR	CI_X	PHOSPHORIC ACID	PO4_X	WASH WATER	WW_X
DECHLORINATION	DCL_X	POLYALUMINUM CHLORIDE	PCL_X	WASTE ACTIVATED SLUDGE	WAS_X
DETERGENT	DET_X	POLYMER	POLF_X	WASTE WASH WATER	WWW_X
DEWATERING	DWT_X	POTASSIUM PERMANGANATE	KMN_X	WATER - CONDENSATE	COW_X
DIESEL FUEL	FUE_X	POWDERED ACTIVATE CARBON	PAC_X	WATER - COOLING	COLW_X
DIGESTER GAS	DGG_X	PRE-AERATION	PAR_X	WATER - DISTILLED WATER	DW_X
DIGESTER GAS MIXING	DGM_X	PRESEDIMENTATION	PSD_X	WATER - FIRE	FW_X
DIGESTER SLUDGE	DGS_X	PRIMARY CLARIFICATION	PRC_X	WATER - IRRIGATION	IRW_X
DIGESTION - AEROBIC	DGA_X	PRIMARY SCUM	PSC_X	WATER - OZONATED	OZW_X
DIGESTION - ANAEROBIC	DIG_X	PRIMARY SLUDGE	PRS_X	WATER - SEAL	SWT_X
DISINFECTION CONTACT BASIN	DCB_X	RAW WASTEWATER PUMPING	WWP_X	WATER - WATER HEATING	HW_X
DISSOLVED AIR FLOTATION	DAF_X	RAW WATER PUMPING	RWP_X	WATER DEIONIZED	DEIW_X
DRAINAGE	DRN_X	RAW WATER STORAGE	RWS_X	WATER NON-POTABLE	NPW_X
EFFLUENT PUMPING	EFP_X	RECIRCULATED SLUDGE	RCS_X	WATER PLANT EFFLUENT	PEW_X
ENGINE EXHAUST	EXH_X	RECLAIMED WATER	RCW_X	WATER POTABLE	PW_X
EQUALIZATION BASIN	EQB_X	REFRIGERANT	REF_X	WATER RAW	RW_X
FERRIC CHLORIDE	FEC_X			WET WEATHER TREATMENT	WWT_X
FERRIC SULFATE	FES_X			ZINC ORTHOPHOSPHATE	ZOP_X
FERROUS CHLORIDE	FRC_X				
FERROUS SULFATE	FRS_X				
FILTRATION	FLT_X				

X = PROCESS CODE SUFFIX USED TO FURTHER SPECIFY A PROCESS STREAM (I.E. CL2_G FOR CHLORINE GAS OR CL2_S FOR CHLORINE SOLUTION)

FUNCTION CODE ABBREVIATIONS

ACTIVATION CHAMBER	AC	DIGESTER COVER, GAS HOLDER	DCG	MEMBRANE	MFM	SCUM COLLECTOR	SMC	VALVE, MATERIAL HANDLING ROTARY	VMR
ADJUSTABLE FREQUENCY DRIVE	AFD	DIGESTER COVER, MEMBRANE	DCM	MEMBRANE, MICROFILTRATION	MBNF	SCUM WEIR - ROTATING	SCW	VALVE, MUD	VMD
AERATOR, COARSE BUBBLE DIFFUSED	ACD	DIGESTER, AEROBIC	DGE	MEMBRANE, NANOFILTRATION	MBNF	SEPARATOR	SEP	VALVE, PILOT	PTV
AERATOR, FINE PORE DIFFUSED	AEFD	DIGESTER, ANAEROBIC PRIMARY	DGAP	MEMBRANE, REVERSE OSMOSIS	MBRO	SIGHT GLASS - TALL	SGT	VALVE, PINCH	VPN
AERATOR, FLOATING SURFACE	AFS	DIGESTER, ANAEROBIC SECONDARY	DGAS	MEMBRANE, ULTRAFILTRATION	MBUF	SIGHTGLASS	SG	VALVE, PISTON OPERATED	VPO
AERATOR, SURFACE	AES	DISINFECTION UNIT, UV	DSUV	MIXER, CARBON	MXC	SILENCER	SIL	VALVE, PLUG	VPG
AFTERCOOLER	AFC	DISSOLVED AIR FLOTATION THICKENER	DAF	MIXER, FLLOCCULATION	FLM	SLUDGE COLLECTOR, CIRCULAR	SLC	VALVE, PRESSURE REDUCING	VPR
AIR DRYER	AD	DUST COLLECTOR	DUC	MIXER, IN-LINE	MXI	SLUDGE COLLECTOR, FLOCCULATING-CLARIFYING	SFC	VALVE, PRESSURE REGULATING	VPC
AIR FILTER	AF	ELECTRICAL EQUIPMENT, GENERAL	EQPE	MIXER, PUGMILL	MXPG	SLUDGE COLLECTOR, SECONDARY CLARIFIERS	SCS	VALVE, PRESSURE RELIEF	VSP
AIR RECEIVER	AR	EMERGENCY EYE WASH	EEW	MIXER, RAPID	MXR	SLUDGE COLLECTOR, SOLIDS CONTACT	SSC	VALVE, PRESSURE/VACUUM RELIEF	VSPV
AIR SEPARATOR	AS	EMERGENCY SHOWER	ES	MIXER, STATIC	MXS	SLUDGE COLLECTOR, STRAIGHT LINE	SLCS	VALVE, PROCESS	VP
AIR STRIPPER	AST	EMERGENCY SHOWER & EYEWASH	ESE	MIXER, SUBMERSIBLE PROPELLER	MXP	SLUDGE GRINDER	SLG	VALVE, RESILIENT SEATED GATE	VGR
BACKFLOW PREVENTER	BFP	EQUIPMENT, GENERAL OR UNSPECIFIED	EQPT	OVERFLOW ROOF DRAIN	ORD	SLUDGE SCREEN-INLINE	SCRI	VALVE, SAFETY	VS
BASIN, AERATION	BSNA	EVAPORATOR	EV	OZONE DESTRUCT UNIT	ODU	SOLIDS BLENDER-INLINE	SBL	VALVE, SLEEVE	VSLV
BASIN, ANOXIC	BSNX	EXPANSION CHAMBER	EXC	OZONE GENERATOR	OGEN	STRAINER	STR	VALVE, SOLENOID	VSL
BASIN, BNR	BNR	FAN SUPPLY OR EXHAUST	FAN	PARTICLE COUNTER	PCN	STRAINER ? BASKET TYPE	STRB	VALVE, THERMAL SHUTOFF	VTS
BASIN, CHLORINE CONTACT	BSNC	FILTER SEPARATOR	FTSP	PELLETIZER	PLT	STRAINER ?Y TYPE	STRY	VALVE, THREE WAY	VTW
BASIN, OZONE CONTACT	BSNO	FILTER, CARTRIDGE TYPE	FLC	PIPE	PIPE	SURGE CHAMBER	SRCH	VALVE, VACUUM BREAKER	VVB
BELT FILTER PRESS	BFPS	FILTER, UNDERDRAINS AND MEDIA	FLT	PLATE SETTLER	PSE	TANK, ABOVE GROUND STORAGE	TSA	VALVE, VACUUM RELIEF	VSV
BIN (STORAGE - ALL TYPES)	B	FILTER, SURFACE WASH EQUIPMENT	FSW	POLYMER RING	PIR	TANK, AMMONIA STORAGE	TCN	VALVE, V-PORT BALL	VBP
BIN ACTIVATOR	BA	FITTING, MISCELLANEOUS	FTTNG	POWER SUPPLY UNIT	PSU	TANK, CRYOGENIC STORAGE	TCR	VAPORIZER	VAP
BLOWER, CENTRIFUGAL	BLC	FLAME ARRESTER	FAR	PULSATION DAMPNER	PD	TANK, DOUBLE WALL	DWT	WEIR, CIPOLETTI	WC
BLOWER, POSITIVE DISPLACEMENT	BL	FLAME CHECK	FC	PUMP, AIR DIAPHRAGM	PAD	TANK, ELEVATED STORAGE	TSE	WEIR, RECTANGULAR	WR
BOILER	BLR	FLOCCULATOR, HORIZONTAL	FLCH	PUMP, CENTRIFUGAL	PCL	TANK, EXPANSION	TX	WEIR, V-NOTCH	WV
BUILDING SERVICES EQUIPMENT	EQPB	FLOCCULATOR, VERTICAL	FLCV	PUMP, DIAPHRAGM METERING	PDM	TANK, FRP CHEMICAL STORAGE	TCF	WELL, HORIZONTAL COLLECTOR	WLHC
CALIBRATION COLUMN	CCLM	FLOOR DRAIN	FD	PUMP, HEATING WATER	PHW	TANK, GENERAL OR UNSPECIFIED	TNK	WELL, VERTICAL	WLV
CENTRIFUGE	CFG	FLOW SPLITTER	FS	PUMP, HORIZONTAL END SUCTION	PHE	TANK, PE CHEMICAL STORAGE	TCP		
CHEMICAL FEEDER	CHF	FLUME, PARSHALL	FE	PUMP, HORIZONTAL SPLIT CASE	PSC	TANK, STEEL CHEMICAL STORAGE	TCS		
CHLORINE GAS SCRUBBER	CGS	FOAM SEPARATOR	FMSP	PUMP, PERISTALTIC	PPS	TANK, STEEL WATER STORAGE	TSW		
CLARIFIER, PRIMARY	PCLR	GAS CYLINDER	CYG	PUMP, PLUNGER	PPL	TRAP, DRIP	TRP		
CLARIFIER, SECONDARY	SCLR	GAS FEEDER	GFD	PUMP, PROGRESSING CAVITY	PPC	TRAP, SEDIMENT	TRPS		
CLASSIFIER, GRIT	CGR	GAS FLARE	GF	PUMP, SCREW ENCLOSED	PSEN	TURBIDIMETER	TB		
CLEARWELL	CW	GAS WATER HEATER	GWH	PUMP, SCREW OPEN	PSO	UNINTERRUPTABLE POWER SUPPLY	UPS		
COMPRESSOR	CMP	GATE, FLAP	GFL	PUMP, SUBMERSIBLE	PSM	VACUUM REGULATOR	VRG		
COMPRESSOR, BASE MOUNTED	CMB	GATE, SLIDE	GSD	PUMP, SUBMERSIBLE CHOPPER	PCH	VALVE, AIR RELEASE	VR		
COMPRESSOR, ROTARY SCREW	CMR	GATE, SLUICE	GSC	PUMP, SUBMERSIBLE SUMP	PSS	VALVE, AIR-VACUUM	VRAV		
CONTAINER, PROCESS	CTR	GATE, WEIR	G	PUMP, SUMP	PSP	VALVE, ANGLE	VAG		
CONVEYOR, BELT	COB	GENERATOR, ENGINE (BACKUP POWER)	GEN	PUMP, UNSPECIFIED TYPE	P	VALVE, AWWA BALL	VBL		
CONVEYOR, SCREW	COS	GRAVITY BELT THICKENER	GBT	PUMP, VERTICAL DIFFUSION VANE	PVD	VALVE, AWWA BUTTERFLY	VBF		
COVER, ALUMINUM DOME BASIN	CFA	GRAVITY THICKENER	GVT	PUMP, VERTICAL END SUCTION	PVE	VALVE, BALL MISCELLANEOUS	VBM		
COVER, FIXED DIGESTER	CFD	GRINDER	GRD	PUMP, VERTICAL WET PIT	PVW	VALVE, CHECK	VCK		
COVER, FLOATING DIGESTER	CFL	GRIT BASIN, AERATED OR VORTEX TYPE	GRB	RESERVOIR	RSV	VALVE, CONE	VCN		
CRANE	CR	GRIT EQUIPMENT, FORCED VORTEX	GRV	RESIDUAL COLLECTOR	RCO	VALVE, DIAPHRAGM OPERATED OPEN OR CLOSE	VDG		
CRANE, GANTRY	CRG	HEAT EXCHANGER	HEX	ROTAMETER	RM	VALVE, DOUBLE DISC GATE	VGD		
CRANE, JIB	CRJ	HOIST, CHAIN	HSC	RUPTURE DISK	RD	VALVE, ECCENTRIC PLUG	VPL		
CRANE, PORTABLE GANTRY	CRP	HOIST, WIRE ROPE	HSE	SAMPLER	SAMP	VALVE, EXPLOSION RELIEF	VER		
CRANE, TRAVELLING BRIDGE	CRT	HYDRANT, FIRE	HYDF	SCALE	SC	VALVE, GATE	VG		
CYLINDER, CHLORINE	CYL	HYDRANT, WALL	HYDW	SCREEN, MECHANICALLY CLEANED BAR	SCRA	VALVE, GENERAL OR UNSPECIFIED	V		
DEWATERING SCREW	DWS	HYDROCYCLONE	HYC	SCREEN, STEP	SCRS	VALVE, GLOBE	VGL		
DIAPHRAGM SEAL	DPS	INJECTOR, CHEMICAL	INJ	SCREEN, TRAVELLING WATER	SCT	VALVE, INDUSTRIAL BUTTERFLY	VBI		
DIFFUSER	DIF	LIME SLAKER	LS	SCRUBBER	SCU	VALVE, KNIFE GATE	VKG		
DIFFUSER BANK	DFB								

NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	1	DAD	SAY	MEW
DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

CYGNET ID: 143757-3000-WPE-1-B0000SW08 XREF1:
WF: P3.dwg XREF2:
SAVED: DUN38005, 11/17/2006 2:14:37 PM XREF3:
PLOTTED: XREF4:
USER: DUN38005 DWG VER: 4.3 XREF5:

STATE OF KENTUCKY — MARK E. MACLEOD — 21891 — LICENSED PROFESSIONAL ENGINEER
11/20/06

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati, Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

P&ID
P&ID LEGEND AND ABBREVIATIONS
SHEET 3 OF 3

DESIGNED: SAY
DETAILED: SAY
CHECKED: JSM
APPROVED: [signature]
DATE: 11/20/06

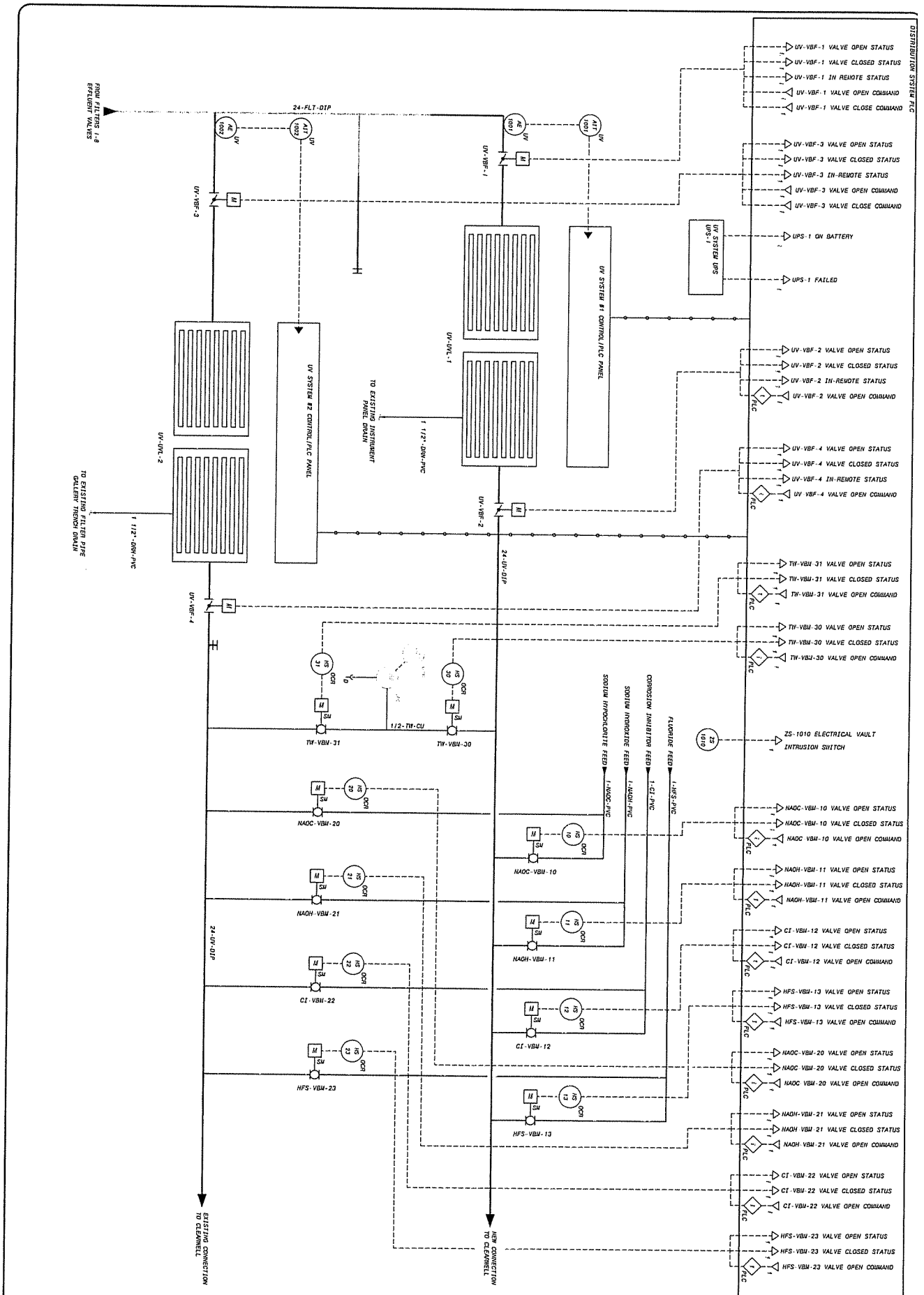
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

P3
SHEET
22 OF 24

F06000
06009

FD5000
06009



NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

P&ID
ULTRAVIOLET DISINFECTION SYSTEM P&ID

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati Ohio

STATE OF KENTUCKY
MARK A. MABELLE
25351
LICENSED PROFESSIONAL ENGINEER
11/20/06

DESIGNED: SAY
DETAILED: SAY
CHECKED: JEM
APPROVED: MAM
DATE: 11/20/06

P4
SHEET 23 OF 24

PROJECT NO. 143757

IF THIS BAR IS NOT 1" THEN DRAWING IS NOT TO FULL SCALE

NO.	DATE	REVISIONS AND RECORD OF ISSUE	BY	CK	APP
1	NOV 2006	REVISED SUBSEQUENT TO KDOW REVIEW	DAD	SAY	MEW

CYCNET ID: 143757-3000-HPE-I-800000VRL
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SAVED: YAM31228, 11/27/2006 5:13:55 PM
PLOTTED: DUN38005, 11/21/2006 8:48:51 AM
USER: DUN38005
DWG VER: 4.11

XREF1:
XREF2:
XREF3:
XREF4:
XREF5:

TURBIDITY METER
NO SCALE

TYPICAL FOR:
AIT-101, AIT-301

MAGNETIC FLOWMETER
NO SCALE

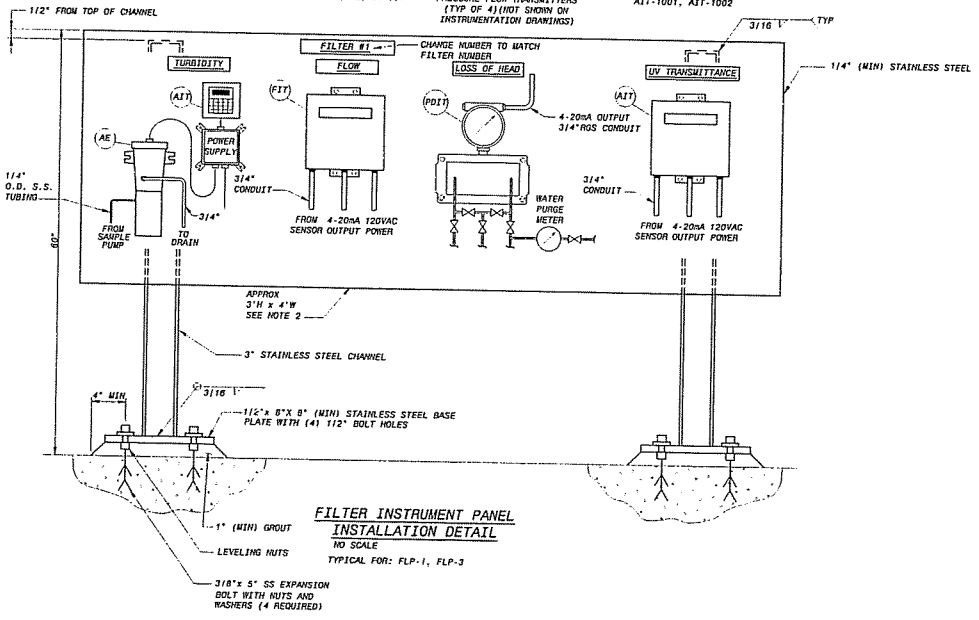
TYPICAL FOR:
FE/FIT-101, FE/FIT-301

LOSS OF HEAD METER
NO SCALE

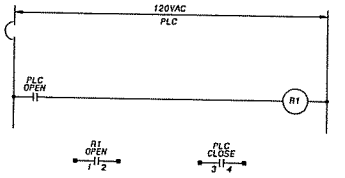
TYPICAL FOR: EXISTING DIFF. PRESSURE FLOW TRANSMITTERS (TYP OF 4)(NOT SHOWN ON INSTRUMENTATION DRAWINGS)

UV TRANSMITTANCE METER
NO SCALE

TYPICAL FOR:
AIT-1001, AIT-1002



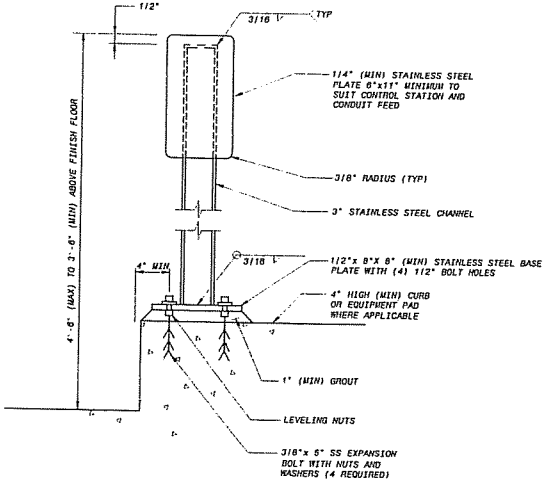
FILTER INSTRUMENT PANEL INSTALLATION DETAIL
NO SCALE
TYPICAL FOR: FLP-1, FLP-3



VALVE UV-VBF-2 PLC CONTROL RELAY SCHEMATIC
(SIMILAR FOR VALVES UV-VBF-4, NAOC-VBW-10, NAOC-VBW-20, NAOH-VBW-11, NAOH-VBW-21, CI-VBW-12, CI-VBW-22, HFS-VBW-13, HFS-VBW-23, TW-VBW-30, TW-VBW-31)

RELAY R1

CONTACTS	POSITION	
	OPEN	CLOSE
1-2		X
3-4	X	



TYPICAL CONTROL STATION MOUNTING DETAIL
NO SCALE

NOTES:

1. SEE SHEETS P1, P2, AND P3 FOR LEGEND AND ABBREVIATIONS.
2. PANEL/ENCLOSURE SIZE SHOWN IS RECOMMENDED. SYSTEM SUPPLIER SHALL PROVIDE A PANEL/ENCLOSURE SIZED ADEQUATELY FOR REQUIRED EQUIPMENT AS SPECIFIED.
3. AIT-101, AIT-301, FE/FIT-101, FE/FIT-301, 2 LOSS OF HEAD METERS AND 2 UV TRANSMITTANCE MONITORS SHALL BE MOUNTED AS LOCATED ON THE ELECTRICAL DRAWINGS.

NO.	BY	CK	APP
1	DAD	SAY	MEW

NOV 2008 REVISED SUBSEQUENT TO HDR REVIEW

REVISIONS AND RECORD OF ISSUE

XREF1:
XREF2:
XREF3:
XREF4:
XREF5:

DRC: 11.0M3
PLOTTED: 03/28/2005, 11:17:12AM
USER: SAMPSON
DWG VER: A.4

OCTOBER '08: 143737-2008-T-BOOOOCBSV

BLACK & VEATCH
Black & Veatch Corporation
Cincinnati Ohio

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT
UV DISINFECTION

INSTRUMENTATION
INSTRUMENT INSTALLATION DETIALS

DESIGNED:	SAY, MEW
DETAILED:	DAD, SAY
CHECKED:	JSM
APPROVED:	
DATE:	11/28/08

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
143757

I1
SHEET
24 OF 24

F30000
D0039

Section 02050

DEMOLITION AND SALVAGE

PART 1 - GENERAL

1-1. SCOPE. This section covers the demolition of existing piping, and the salvage of existing materials and equipment as specified herein.

1-2. GENERAL. Contractor shall be responsible for all work under this section.

All structures and facilities of the existing Taylor Mill Treatment Plant which are not to be removed must remain in continuous operation during the work. Demolition and salvage work shall create minimum interference with Owner's operations and minimum inconvenience to Owner.

Blasting will not be permitted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. DEMOLITION.

3-1.01. Structure Demolition. Not used.

3-1.02. Piping and Equipment Demolition. The following piping and equipment shall be removed as indicated on the drawings and shall become the property of Contractor. All such items shall be promptly removed from the jobsite.

24-inch Combined Filter Effluent piping

Chemical feed piping

3-1.03. Sitework Demolition. Not used.

3-2. SALVAGE.

3-2.01. Items To Be Salvaged by Owner. Not used.

3-2.02. Items To Be Salvaged by Contractor. Removed and salvaged equipment or facilities shall include removal and salvage of all accessories, piping, wiring, supports, associated electrical starters and devices, baseplates and frames, and all other appurtenances, unless otherwise directed.

Existing materials and equipment removed, and not reused as a part of the work, shall become Contractor's property unless otherwise specified, and shall be removed from the jobsite.
The following existing materials and equipment shall be removed by Contractor, shall be reused as a part of the work, and shall remain the property of Owner:

Item	Location	Location of Reuse
Filter 1 Turbidity Analyzer	Filter Pipe Gallery, adjacent to Filter 3	As indicated on the drawings
Filter 1 Loss of Head Piping and Instrumentation	Filter Pipe Gallery, adjacent to Filter 1	As indicated on the drawings
Filter 3 Turbidity Analyzer	Filter Pipe Gallery, adjacent to Filter 3	As indicated on the drawings
Filter 3 Loss of Head Piping and Instrumentation	Filter Pipe Gallery, adjacent to Filter 3	As indicated on the drawings
Hose Reel, Hose and Piping	Filter Pipe Gallery	As acceptable to Owner and Engineer
Sample Pump and Piping	Basement Pipe Gallery	As acceptable to Owner and Engineer
Platform Ladders	Filter Pipe Gallery, adjacent to platforms for piping at Filters 1 and 3	

Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified herein or indicated to be salvaged and to remain the property of Owner. Contractor shall store and protect salvaged items specified or indicated to be reused in the work. 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, at his option, 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.

End of Section

Section 02200

EARTHWORK

PART 1 - GENERAL

1-1. SCOPE. This section covers earthwork and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation; handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of sub-grades; pumping and dewatering as necessary; protection of adjacent property; backfilling; construction of fills and embankments; surfacing and grading; and other appurtenant work.

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a registered professional engineer, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with Section 01300 – Submittals.

At least 30 days before starting construction on the sheeting and shoring, the sheeting and shoring design engineer shall complete and submit to Engineer the Protection System Design Certificate (Figure 1-02200) and the Contractor shall use the sheeting and shoring design. A separate certificate shall be submitted for each unique design. The certificate shall be signed and sealed by the registered professional engineer that designed the protection system. The professional engineer shall be licensed or registered in the state of Kentucky.

1-3.01. Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted in accordance with Section 01300 – Submittals. Data submitted shall include:

A 12 inch square sample of fabric.

Manufacturer's descriptive product data.

Installation instructions.

1-4. BASIS FOR PAYMENT.

1-4.01. Sheeting for Excavation of Structures. No additional payment above the Contract Price will be made for steel sheet piling left in place in excavations for structures.

1-5. INSURANCE. Professional Liability insurance shall be provided as specified in Section 00800 -- Supplementary Conditions.

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01. Filter Fabric. Filter fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01. Filter Fabric Type A. Filter fabric Type A shall be provided for installation at locations indicated on the drawings and as specified herein. Filter fabric Type A shall be a non-woven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

Property	Test Method	Unit	Min Roll Value*
Fabric Weight	ASTM D3776	oz/yd2	5.7
Grab Strength	ASTM D4632	lb	155
Grab Elongation	ASTM D4632	percent	50
Mullen Burst Strength	ASTM D3786	psi	190
Apparent Opening Size	CW-02215	U.S. Standard Sieve Size	70

*Minimum average roll value in weakest principal direction.

2-1.01.02. Filter Fabric Type B. Not used.

2-1.01.03. Filter Fabric Type C. Not used.

2-1.02. Polyethylene Film. Polyethylene film beneath concrete slabs or slab base course material shall be Product Standard PS17, 6 mil minimum thickness.

2-1.03. General Fill and Embankment Materials. To the maximum extent available, excess suitable material obtained from structure and trench excavation shall be used for the construction of general fills and embankments. Additional material shall be provided from Contractor's off-site source. No borrow pits shall be opened on site unless such pits are specifically indicated on the drawings.

All material placed in fills and embankments shall be free from rocks or stones larger than the required size in their greatest dimension, brush, stumps, logs, roots, debris, and other organic or deleterious materials. The maximum size of stone in fills and embankment shall be 4 inches. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so that they do not interfere with proper compaction.

2-1.04. Granular Fill. Granular fill material shall be crushed rock or gravel suitable for use as a free draining sub-base beneath slabs and foundations. Granular fill shall be free from dust, clay, and trash; hard, durable, non-friable; and shall be graded 3/4 inch to No. 4 as defined in ASTM C33 for No. 67 coarse aggregate. Granular fill shall meet the quality requirements for ASTM C33 coarse aggregate. Only crushed rock with angular particles shall be used when the perimeter of the granular fill is not confined or otherwise subject to raveling, such as on a slope.

2-1.05. Structure Backfill. Structure backfill shall be defined as the material placed around and outside of structures. Structure backfill shall be as indicated herein.

2-1.05.01. General Fill Structure Backfill. General fill for structure backfill shall meet the requirements of the previous paragraph entitled "General Fill and Embankment Materials".

2-1.05.02. Crushed Rock Structure Backfill. Not used.

2-1.05.03. Clean Sand Structure Backfill. Not used.

2-1.06. Select Fill. Select fill shall be defined as the material placed beneath the structure foundations and slabs below any granular material layer or lean concrete slab indicated on the drawings. Select fill shall be used to replace any unsuitable material below the structure foundations and slabs and to raise the site grades below and within 5 feet of structural footprints and at locations indicated on the drawings. Select fill shall be as indicated herein.

2-1.06.01. General Fill Select Fill. General fill for use as select fill shall meet the requirements of the previous paragraph entitled "General Fill and Embankment Materials".

2-1.06.02. Crushed Rock Select Fill. Not used.

2-1.06.03. Clean Sand Select Fill. Not used.

2-1.07. Gravel Base Beneath Slabs. Gravel base beneath slabs shall consist of material meeting the quality requirements specified for ASTM C33 concrete coarse aggregate and shall be graded No. 7 coarse aggregate.

2-1.08. Controlled Low Strength Material (CLSM). Not used.

2-2. MATERIAL TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in Section 01400 – Quality Control, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of general fill, designated fill, backfill, or other material, and one additional gradation test shall be made for each additional 500 tons of each material delivered to the jobsite. In addition, one set of initial Atterberg Limits test shall be made for each fill material containing more than 20 percent by weight pass the No. 200 sieve and for materials specified by Atterberg Limits. One additional Atterberg Limits test shall be made for each additional 500 tons of each material delivered to the job site.

All material testing on CLSM shall be made by an independent testing laboratory at the expense of Contractor.

2-2.02. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of Owner. Contractor shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.03. Required Field Tests. For planning purposes the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as indicated in Section 01300 – Submittals.

Two moisture-density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, designated fill, backfill, or other material proposed.

For area fills and embankments, an in-place field density and moisture test for each 1000 cubic yards of material placed.

One in-place field density and moisture test for every 100 to 200 cubic yards of structure backfill or select fill.

One in-place density and moisture test whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.

At least one test for every full shift of compaction operations on mass earthwork.

Additional gradation, proctor, and relative density tests whenever the source or quality of materials changes.

PART 3 - EXECUTION

3-1. SITE PREPARATION. All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments and sites to be occupied by permanent construction shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of Contractor.

3-2. EXCAVATION.

3-2.01. General. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Sub-grade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Except where exterior surfaces are specified to be damp-proofed, monolithic concrete manholes and other concrete structures or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches clearance is provided for outside plastering.

3-2.02. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.03. Preservation of Trees. No trees shall be removed outside excavated or filled areas, unless their removal is authorized by Owner. Trees left standing

shall be adequately protected from permanent damage by construction operations.

3-2.04. Unauthorized Excavation. Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced with concrete or lean concrete at the expense of Contractor. If structural concrete replacement is chosen, it shall be with concrete placed at the same time and monolithic with the concrete foundation.

3-2.05. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.06. Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 12 inches, beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit used for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

3-2.07. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported as necessary to prevent caving or sliding.

Steel sheet piling or other excavation support systems shall be furnished and installed as necessary to limit the extent of excavations for the deeper structures and necessary backfill under adjacent shallower structures, and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and install adequate protection systems for prevention of damage to existing facilities.

Excavation support systems and sheeting and shoring shall be removed unless specifically otherwise permitted by Engineer.

The design of the excavation support system shall be such as to permit complete removal while maintaining safety and stability in the excavation at all times.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state of Kentucky.

3-2.08. Stabilization. Sub-grades for concrete structures shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in such a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the drawings.

3-2.09. Ring-wall Excavation. Not used.

3-2.10. Roadway Excavation. Excavation for the roadways, drives, and parking areas shall conform to the lines, grades, cross sections, and dimensions indicated on the drawings and shall include the excavation of all unsuitable material from the subgrade. After shaping to line, grade, and cross section, the subgrade shall be compacted to a depth of at least 6 inches and shall meet the following:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction and moisture content relative to the optimum.	98 %.
Moisture content relative to the optimum.	-2 % to +3%.

This operation shall include any reshaping and wetting or drying required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

3-3. GENERAL FILLS AND EMBANKMENTS. Fills and embankments not required or indicated to be designated fills shall be constructed as general fills and embankments. All fills and embankments shall be constructed to the lines

and grades indicated on the drawings. Backfill materials shall be deposited in layers not to exceed 8 inches in uncompacted thickness. Unless otherwise specified herein, the following governing standards apply:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction and moisture content relative to the optimum.	95%.
Moisture content relative to the optimum.	-2 % to +3 %.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-3.01. Sub-grade Preparation. After preparation of the fill or embankment site, the sub-grade shall be scarified and moisture conditioned to a minimum depth of 6 inches, leveled and rolled so that surface materials of the sub-grade will be at a moisture content and as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

Unless otherwise directed by Engineer, the sub-grade shall be proof-rolled by a rubber-tired roller, a loaded dump truck, or other suitable rubber-tired equipment acceptable to Engineer. A minimum of four passes of the proof-rolling equipment shall be provided such that the last two passes are made perpendicular to the first two passes.

All soft, yielding, or otherwise unsuitable material shall be removed and replaced with compacted fill.

3-3.02. Placement and Compaction. All fill and embankment materials shall be placed in approximately horizontal layers not to exceed 8 inches in un-compacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material shall have the best practicable moisture content for satisfactory compaction. The material in each layer shall be wetted or dried to achieve the moisture content relative to optimum as specified above, and shall be thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted to the required degree of compaction at the required moisture content. If the material fails to meet the density specified, compaction methods shall be altered. The changes in compaction methods shall include, but not be limited to, changes in compaction

equipment, reduction in uncompacted lift thickness, increase in number of passes, and better moisture control.

Wherever a trench is to pass through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench is excavated.

3-3.03. Borrow Pits. Borrow pits are not permitted.

3-4. DESIGNATED FILLS. Fills required or indicated to be designated fills shall be constructed using the specific materials and placement requirements as specified. In addition to the specific requirements specified herein, all requirements for general fills and embankments shall apply. These requirements include, but are not limited to organic or deleterious materials, subgrade preparation, lift thickness, and moisture conditioning requirements. All designated fills shall be constructed to the lines and grades indicated on the drawings. Backfilling and construction of fills during freezing weather shall not be done except by permission of Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3-4.01. Granular Fill. Granular fills shall be provided where indicated on the drawings. Granular fills shall be placed on suitably prepared sub-grades in uncompacted lift thickness of 6 inches or less and compacted by vibration. Granular fills shall be compacted to not less than 70 percent relative density as determined by ASTM D4253 and D4254.

Where granular fills are to be covered with concrete, the top surface shall be graded to the required sub-grade elevation. The completed fill shall be covered by a vapor barrier.

3-4.02. Structure Backfill. Backfill materials shall be deposited in layers not to exceed 8 inches in uncompacted thickness and shall meet the following requirements:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction.	95%.
Moisture content relative to the optimum.	-2 % to +3%.

Compaction of structure backfill shall be performed in such a manner that damage to the structure is prevented. The compaction equipment used within 8 feet of the walls and for the top 8 feet of backfill shall have no restriction on

type. Limit of equipment weight shall be 1 ton. Compaction of structure backfill by inundation with water will not be permitted.

No backfill shall be deposited or compacted in water.

Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, parking areas, walks, curbs, gutters, or other surface construction or structures. In addition, wherever a trench is to pass through structure backfill, the structure backfill shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

3-4.03 Select Fill. Select fill shall be placed in nearly horizontal layers in uncompacted lift thickness of 8 inches or less and shall meet the following requirements:

Test method to determine maximum density and moisture.	ASTM D698.
Relative compaction.	95%.
Moisture content relative to the optimum.	-2 % to +3%.

3-4.04. Gravel Base Beneath Slabs. The gravel base beneath slabs shall be placed in uncompacted lift thickness of 6 inches or less and compacted with a minimum of four passes (round trips) of a self-propelled or walk-behind type vibrating roller. The roller shall be operated in the vibrating mode and in accordance with the manufacturer's instructions.

3-4.05. Controlled Low Strength Material (CLSM) Fill. Not used.

3-4.06. Ringwall Fill. Not used.

3-5. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual

methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-6. DISPOSAL OF EXCAVATED MATERIALS. Suitable excavated materials may be used in fills and embankments as needed. All excess excavated material shall be disposed of off site at the expense of Contractor.

All debris, stones, logs, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by, and at the expense of, Contractor.

3-7. RESODDING. All established lawn areas cut by the line of trench, by excavation, or damaged during the work shall be resodded, after completion of construction, to the complete satisfaction of the property owner and Owner. All sod used shall be the same type as removed or damaged, shall be best quality, and, when placed, shall be live fresh growing grass with at least 1-1/2 inches of soil adhering to the roots.

All sod shall be procured from areas where soil is fertile and contains a high percentage of loamy topsoil and from areas that have been grazed or mowed sufficiently to form a dense turf.

Sod shall be transplanted within 24 hours from the time it is harvested, unless stacked at its destination in a suitable manner. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing. In no event shall more than 1 week elapse between cutting and planting.

Before placing sod, all shaping and dressing of the areas shall have been completed. After shaping and dressing, commercial fertilizer of a type acceptable to Owner shall be applied uniformly in the manner and amounts recommended by the manufacturer, and harrowed lightly. Sodding shall follow immediately.

All sodding shall be done during the period from March 15 to October 1, unless written permission is given by Owner to extend the planting season.

3-8. SETTLEMENT. Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.

Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from Engineer or Owner.

End of Section

PROTECTIVE SYSTEM
DESIGN CERTIFICATE

I undersigned engineer, hereby certify that the protection system for _____(structure name) has been designed by me and is in compliance with the Contract Documents.

Name: _____ State of Registration: _____

Signature: _____ P.E. Number _____

Date: _____

_____
(Seal)

FIGURE 1-02200

Section 02202

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1-1. SCOPE. This section covers clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching; tunneled (trenchless construction) crossings; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other appurtenant work.

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a registered professional engineer, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with the Submittals section.

At least 30 days before starting construction on the sheeting and shoring, the sheeting and shoring design engineer shall complete and submit to Engineer the Protection System Design Certificate (Figure 2-02202) and the Contractor shall use the sheeting and shoring design. A separate certificate shall be submitted for each unique design. The certificate shall be signed and sealed by the registered professional engineer that designed the protection system. The professional engineer shall be licensed or registered in the state where the protection system is located.

1-3.01. Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted in accordance with the Submittals section. Data submitted shall include:

A 12 inch square sample of fabric.

Manufacturer's descriptive product data.

Installation instructions.

1-4. BASIS FOR PAYMENT.

1-4.01. Trench Sheeting. No additional payment above the Contract Price will be made for trench sheeting left in place.

1-5. INSURANCE. Professional Liability insurance shall be provided as specified in Section 00800 – Supplementary Conditions.

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01. Filter Fabric. The fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01. Filter Fabric Type A. Filter fabric Type A shall be provided for installation at locations indicated on the drawings and as specified herein. Filter Fabric Type A shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

Property	Test Method	Unit	Minimum Average Roll Value *
Fabric Weight	ASTM D3776	oz/yd2	5.7
Grab Strength	ASTM D4632	lb	155
Grab Elongation	ASTM D4632	percent	50
Mullen Burst Strength	ASTM D3786	psi	190
Apparent Opening Size	CW-02215	U.S. Standard Sieve Size	70

* Minimum average roll value in weakest principal direction.

2-1.01.02. Filter Fabric Type B. Not used.

2-1.02. Polyethylene Film. Polyethylene film beneath concrete slabs or slab base course material shall be Product Standard PS17, 6 mil minimum thickness.

2-1.03. Tunnel Liner Plates. Not used.

2-1.04. Smooth Steel Pipe. Not used.

2-1.05. Wood Skids. Not used.

2-1.06. Casing Insulators. Not used.

2-1.07. Stabilized Sand Backfill. Not used.

2-1.08. End Closure. Not used.

2-1.09. Inundated Sand Fill. Sand fill shall be clean, with not more than 25 percent retained on a No. 4 sieve and not more than 7 percent passing a No. 200 sieve, and shall have an effective size between 0.10 and 0.30 mm.

2-1.10. Graded Gravel Fill. Graded gravel for compacted trench backfill shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	85 – 100
3/8 inch	50 – 80
No. 4	35 – 60
No. 40	15 – 30
No. 200	5 – 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2-1.11. Controlled Low Strength Material (CLSM) Fill. Not used.

2-1.12. Granular Fill. Granular fill material shall be crushed rock or gravel. Granular fill shall be free from dust, clay, and trash; hard, durable, non-friable; and shall be graded 3/4 inch to No. 4 as defined in ASTM C33 for No. 67 coarse aggregate. Granular fill shall meet the quality requirements for ASTM C33 coarse aggregate.

2-2. MATERIALS TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in the Quality Control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of embedment, fill, backfill, or other material, and one additional gradation test shall be made for each additional 500 tons of each material delivered to the site. In addition, one set of initial Atterberg Limits test shall be made for each fill materials containing more than 20 percent by weight passing the No. 200 sieve. One additional Atterberg

Limits test shall be made for each additional 500 tons of each material delivered to the site.

All material testing on CLSM shall be made by an independent testing laboratory at the expense of Contractor.

2-2.02. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of Owner. Contractor shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.03. Required Tests. For planning purposes, the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as indicated in Section 01300 – Submittals.

a. Two moisture density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, designated fill, backfill, or other material proposed.
b. In-place field density and moisture tests at intervals of 1000 feet [300 m] maximum along the trench.
c. One in-place field density and moisture test for every 200 cubic yards [153 m^3] of backfill.
d. One in-place density and moisture test whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.
e. At least one test for every full shift of compaction operations on mass earthwork.
f. Additional gradation, Proctor, and relative density tests whenever the source or quality of material changes.

PART 3 - EXECUTION

3-1. CLEARING. All clearing shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

3-2. EXCAVATION. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Except where exterior surfaces are specified to be damp-proofed, monolithic concrete manholes and other concrete structures or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches clearance is provided for outside plastering.

3-2.01. Classification of Excavated Materials. No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition, or condition thereof.

3-2.02. Preservation of Trees. No trees shall be removed outside excavated or filled areas, unless their removal is authorized by Owner. Trees left standing shall be adequately protected from permanent damage by construction operations.

3-2.03. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.04. Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 12 inches [300 mm], beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

Contractor shall obtain from the appropriate agencies and authorities, the dewatering and stormwater discharge permits required to remove and dispose of groundwater, surface water, and any other water used in Contractor's operations. The permits shall be obtained prior to start of construction.

3-2.05. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported with steel sheet piling and shoring as necessary to prevent caving or sliding.

Sheet piling or other excavation support systems shall be installed as necessary to limit the extent of excavations for deeper structures and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and shall install adequate protection systems for prevention of damage to existing facilities.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state where the project is located.

Trench sheeting may be removed if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, it shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Trench sheeting shall be removed unless otherwise permitted by Engineer. Trench sheeting will not be removed, if in the opinion of Engineer, removal of the sheeting will cause damage to the facility it is protecting. If left in place, the sheeting shall cut off 12 inches below finished grade. The design of the support system shall be such as to permit complete removal while maintaining safety and stability at all times.

3-2.06. Stabilization. Sub-grades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed.

The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the drawings.

3-3. TRENCH EXCAVATION. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. One block or 400 feet, whichever is the shorter, shall be the maximum length of open trench on any line under construction.

Except where tunneling is indicated on the drawings, is specified, or is permitted by Engineer, all trench excavation shall be open cut from the surface.

3-3.01. Alignment, Grade, and Minimum Cover. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe.

Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 36 inches over pipes below paved and graded streets and, of 36 inches over pipes in other locations. Greater pipe cover depths may be necessary on vertical curves or to provide adequate clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation, except where future surface elevations are indicated on the drawings.

3-3.02. Maximum Trench Widths. Not used.

3-3.03. Minimum Trench Widths. Except when maximum trench width is required for certain conduits, trenches shall be excavated to the minimum trench widths indicated in the following table. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment.

Nominal Pipe Size	Minimum Trench Width	Clearance
Less than 27 in	Pipe OD plus 24 in	12 in
27 in through 60 in	Pipe OD plus nominal pipe size	ID/2
Greater than 60 in	Pipe OD plus 70 in	30 in

Clearance = Minimum sidewall clearance
OD = Outside diameter (or span) of conduit
ID = Inside diameter (or span) of conduit.

Specified minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required to the trench excavation or the trench protective system.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits.

3-3.04. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, and that trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.

In locations where maximum trench widths are required for designated rigid conduits, mechanical equipment shall be operated so that uniform trench widths and vertical sidewalls are obtained at least from an elevation 12 inches above the top of the installed pipe to the bottom of the trench.

3-3.05. Cutting Concrete Surface Construction. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1-1/2 inches deep along each side of the trench and along the perimeter of cuts for structures.

Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 6 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.

Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the

surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

3-3.06. Excavation Below Pipe Sub-grade. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, as indicated on Figure 1-02202, to provide for the installation of granular embedment.

Bell holes shall provide adequate clearance for tools and methods used for installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

3-3.07. Artificial Foundations in Trenches. Whenever unsuitable or unstable soil conditions are encountered, trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable material. In such cases, adjustments will be made in the Contract Price in accordance with the provisions of the General Conditions.

3-4. PIPE EMBEDMENT. Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the requirements indicated on Figure 1-02202 and to the following supplementary requirements.

Embedment material shall contain no cinders, clay lumps, or other material which may cause pipe corrosion.

3-4.01. Embedment Classes.

a. Class A Arch Encasement. When arch encasement is indicated on the drawings, Class A arch encasement shall be used at all locations so indicated.
When arch encasement is not indicated on the drawings, Class A arch encasement is not required unless improper trenching or unexpected trench conditions require its use as determined by Engineer.
Concrete and reinforcing steel for Class A arch encasement shall conform to the requirements of the Cast-in-Place Concrete section.

b. Class B Bedding. Class B bedding shall be used for all steel, ductile iron, pretensioned concrete, and vitrified clay pipelines, and for all other pipelines not otherwise specified.

c. Class B Special Bedding. Class B special bedding shall be used for HDPE, PVC, ABS, FRP, GRP and when recommended by the pipe manufacturer.

d. Class C Bedding. Class C bedding shall be used for all reinforced concrete and prestressed concrete pipelines.

3-4.02. Embedment for Ductile Iron, Steel, FRP, and PVC Pipelines. Not used.

3-4.03. Placement and Compaction. Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof by shovel slicing or other suitable methods to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

Class C embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified and also around the restrained pipe sections.

Each lift of granular embedment material shall be vibrated with a mechanical probe type vibrator or shovel sliced during placement to ensure that all spaces beneath the pipe are filled. Granular embedment shall be placed in maximum lift thickness of 6 inches and compacted. Each lift of embedment material shall be compacted with three passes (round trip) of a platform type vibrating compactor.

Where indicated on the drawings, migration of soil into the embedment material shall be prevented with filter fabric Type A or by use of inundated sand embedment. Filter fabric shall be placed on the trench surfaces so that it completely surrounds the embedment material. Joints shall be lapped 12 inches.

3-4.04. Groundwater Barrier. Continuity of embedment material shall be interrupted by low permeability groundwater barriers to impede passage of water through the embedment. Groundwater barriers for sewer lines that contain manholes with cast-in-place bases shall be compacted soil around each manhole, extending through any granular material beneath the manhole, and meeting ASTM D2487 soil classification GC, SC, CL, or ML-CL and shall be compacted to 95 percent of maximum density at near the optimum moisture content (ASTM D698). Material may be finely divided, suitable job excavated material, free from stones, organic matter, and debris.

Groundwater barriers for sewer lines that contain manholes with precast (developed) bases and for all other pipelines shall be soil plugs of 3 feet in width, extending the full depth and width of granular material, and spaced not more than 400 feet apart. The soil plugs shall be constructed from soil meeting ASTM

D2487 classification GC, SC, CL, or ML, and compacted to 95 percent of maximum density at near the optimum moisture content (ASTM D698).

3-5. TRENCH BACKFILL. All trench backfill above pipe embedment shall conform to the following requirements.

A layer of backfill material not more than 8 inches deep may be placed over concrete arch encasement or concrete reaction blocking after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement or blocking until the concrete has been in place for at least 3 days.

3-5.01. Compacted Backfill. Compacted backfill will be required for the full depth of the trench above the embedment in the following locations:

Where beneath pavements, surfacings, driveways, curbs, gutters, walks, or other surface construction or structures.

Where in street, road, or highway shoulders.

In established lawn areas.

The top portion of backfill beneath established lawn areas shall be finished with at least 12 inches of topsoil corresponding to, or better than that which is underlying adjoining lawn areas.

Trench backfill material shall be suitable job excavated material and shall be as specified herein.

3-5.01.01. Job Excavated Material. Job excavated material may be used for compacted backfill when the job excavated material is finely divided and free from debris, organic material, cinders, any corrosive material, and stones larger than 3 inches in greatest dimension. Masses of moist, stiff clay shall not be used. Job excavated materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Each layer of material shall have the best possible moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as needed and thoroughly mixed to ensure uniform moisture content and adequate compaction. Increased layer thickness may be permitted for noncohesive material if Contractor demonstrates to the satisfaction of Engineer that the specified compacted density will be obtained. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. Job excavated material shall be compacted to 95 percent of maximum density at a moisture content within 2 percent of the optimum moisture content, as determined by ASTM D698 when that test is appropriate, or to 70 percent relative density as determined by ASTM D4253 and D4254 when those tests are appropriate.

3-5.01.02. Inundated Sand. Not used.

3-5.01.03. Graded Gravel. Not used.

3-5.02. Ordinary Backfill. Compaction of trench backfill above pipe embedment in locations other than those specified will not be required except to the extent necessary to prevent future settlement. Contractor shall be responsible for backfill settlement as specified.

Ordinary earth backfill material to be placed above embedments shall be free of brush, roots more than 2 inches in diameter, debris, cinders, and any corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth.

Backfill material above embedments shall be placed by methods which will not impose excessive concentrated or unbalanced loads, shock, or impact on installed pipe, and which will not result in displacement of the pipe.

Compact masses of stiff clay or other consolidated material more than 1 cubic foot in volume shall not be permitted to fall more than 5 feet into the trench, unless cushioned by at least 2 feet of loose backfill above pipe embedment.

No trench backfill material containing rocks or rock excavation detritus shall be placed in the upper 18 inches of the trench, nor shall any stone larger than 8 inches in its greatest dimension be placed within 3 feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3-5.03. Water-Settled Earth Backfill. Settlement or consolidation of trench backfill using water jetting or ponding shall not be performed.

3-5.04. Structure Backfill. Backfill around manholes and small concrete vaults shall meet the requirements specified for compacted trench backfill orstructure backfill specified in Section 02200 - Earthwork.

3-5.05. Controlled Low Strength Material (CLSM). Not used.

3-6. TUNNEL EXCAVATION. Not used.

3-7. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All

material deposited in roadway ditches or other watercourses crossed by the line of trench shall be removed immediately after backfilling is completed, and the original section, grades, and contours of ditches or watercourses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3-8. PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other watercourses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds 1 percent, or as otherwise required, ditch checks shall be installed. Unless otherwise indicated on the drawings, ditch checks shall be concrete. Ditch checks shall extend at least 2 feet below the original ditch or watercourse bottom for the full bottom width and at least 18 inches into the side slopes, and shall be at least 12 inches thick.

3-9. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.

3-10. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Disposal of excess material from trench excavations on plant and major facility construction sites shall be accomplished as indicated in the Earthwork section of the specifications for the major construction.

Disposal of excess material from other trench excavation sites shall be as follows. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site.

Excess earth from excavations located in unimproved property may be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of 6 inches above the original ground surface elevation at and across the trench and sloping uniformly each way. Material thus wasted shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing, shall be a subsidiary obligation of Contractor and no separate payment will be made therefore.

3-11. RESODDING. All established lawn areas cut by the line of trench or damaged during the work shall be re-sodded, after completion of construction, to the complete satisfaction of the property owner and Owner. All sod used shall be the same type as removed or damaged, shall be best quality, and, when placed, shall be live fresh growing grass with at least 1-1/2 inches of soil adhering to the roots.

All sod shall be procured from areas where soil is fertile and contains a high percentage of loamy topsoil and from areas that have been grazed or mowed sufficiently to form a dense turf.

Sod shall be transplanted within 24 hours from the time it is harvested, unless stacked at its destination in a suitable manner. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing. In no event shall more than 1 week elapse between cutting and planting.

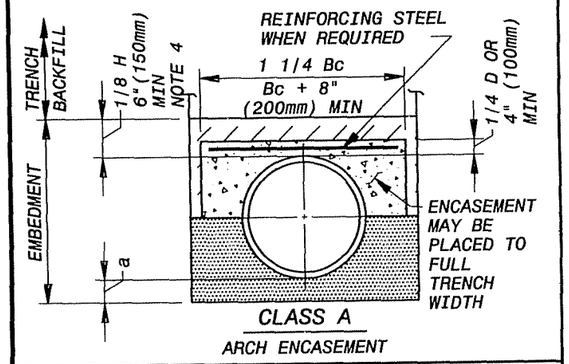
Before placing sod, all shaping and dressing of the areas shall have been completed. After shaping and dressing, commercial fertilizer of a type acceptable to Owner shall be applied uniformly in the manner and amounts recommended by the manufacturer, and harrowed lightly. Sodding shall follow immediately.

All sodding shall be done during the period from March 15 to October 1, unless written permission is given by Owner to extend the planting season.

3-12. SETTLEMENT. Contractor shall be responsible for all settlement of trench backfill which may occur within the correction period stipulated in the General Conditions.

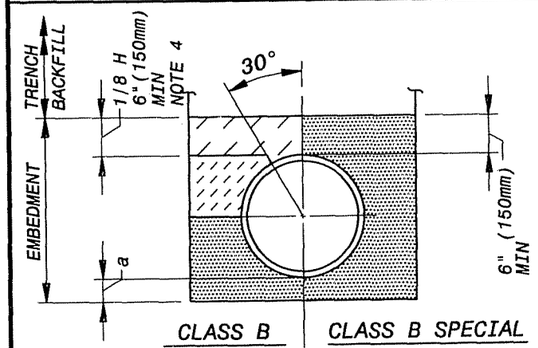
Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from Engineer or Owner.

End of Section

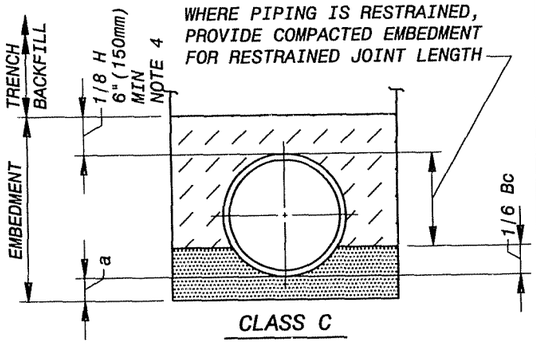


CLASS A

ARCH ENCASEMENT



CLASS B | CLASS B SPECIAL



CLASS C

TABLE OF EMBEDMENT DEPTHS BELOW PIPE

D	a MIN SOIL		a MIN ROCK	
	in	mm	in	mm
27"(675 mm) & SMALLER	3	75	6	150
30"(750 mm) TO 60"(1500 mm)	4	100	9	225
66"(1650 mm) & LARGER	6	150	12	300

NOTES:

1. GRANULAR EMBEDMENT MATERIAL SHALL BE CRUSHED ROCK OR PEA GRAVEL COARSE AGGREGATE SIZE NUMBER 7 (13 TO 4.75) ASTM C33. EMBEDMENT MATERIAL SHALL BE PLACED IN LAYERS NOT MORE THAN 6" (150mm) DEEP AND COMPACTED AS SPECIFIED.
2. HAND PLACED EMBEDMENT SHALL BE FINELY DIVIDED MATERIAL FREE FROM DEBRIS AND STONES.
3. COMPACTED EMBEDMENT SHALL BE FINELY DIVIDED JOB EXCAVATED MATERIAL FREE FROM DEBRIS, ORGANIC MATERIAL, AND STONES, PLACED IN UNIFORM LAYERS NOT MORE THAN 8" THICK, AND COMPACTED TO 95% MAXIMUM DENSITY AS DETERMINED BY ASTM D698; INUNDATED SAND; OR GRADED GRAVEL. GRANULAR EMBEDMENT MAY BE SUBSTITUTED FOR ALL OR PART OF THE COMPACTED EMBEDMENT.
4. EMBEDMENT ABOVE THE TOP OF THE PIPE SHALL BE AN UNCOMPACTED LAYER FOR ALL INSTALLATIONS.
5. REFER TO SPECIFICATIONS FOR GEOTECHNICAL FABRIC OR SPECIAL EMBEDMENT REQUIREMENTS FOR TRENCHES IN FINE SOILS EXTENDING BELOW GROUNDWATER LEVEL.
6. TRENCH OUTLINES DO NOT INDICATE ACTUAL TRENCH EXCAVATION SHAPE, SOIL CONDITIONS, OR PRESENCE OF SHEETING LEFT IN PLACE. EMBEDMENT MATERIAL SHALL EXTEND THE FULL WIDTH OF THE ACTUAL TRENCH EXCAVATION.
7. FOR RESTRAINED JOINT PIPE LENGTH WITH CLASS C EMBEDMENT THE BACKFILL ABOVE THE GRANULAR EMBEDMENT AND BELOW THE TOP OF THE PIPE SHALL BE COMPACTED EMBEDMENT.

LEGEND

Bc	OUTSIDE DIAMETER OF PIPE
H	COVER ABOVE TOP OF PIPE
D	NOMINAL PIPE SIZE
a	EMBEDMENT BELOW PIPE (SEE TABLE)

HAND PLACED EMBEDMENT *

COMPACTED EMBEDMENT *

GRANULAR EMBEDMENT

CONCRETE

* OR GRANULAR EMBEDMENT

EMBEDMENTS FOR CONDUITS

BLACK & VEATCH

FIG 1-02202

REV. 2 - 9/22/06

PROTECTIVE SYSTEM
DESIGN CERTIFICATE

I undersigned engineer, hereby certify that the protection system for _____(trench location) has been designed by me and is in compliance with the Contract Documents.

Name: _____ State of Registration: _____

Signature: _____ P.E. Number _____

Date: _____

_____
(Seal)

FIGURE 2-02202

Section 02675

CLEANING AND DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1-1. SCOPE. This section covers cleaning and disinfection of all potable water lines installed under this contract.

1-2. GENERAL.

1-2.01. Coordination. Contractor shall coordinate flushing and disinfection work with adjacent work as necessary to preclude work interferences or duplication of effort and to expedite the overall progress of the work.

Contractor shall provide all necessary piping, piping connections, temporary valves, backflow preventers, flowmeters, sampling taps, pumps, disinfectant, neutralization agents, chlorine residual test apparatus, and all other items of equipment or facilities necessary to complete the disinfection work.

Water for flushing and disinfection work will be provided as stipulated in the Temporary Facilities section..

In all cases where it is necessary to interrupt service, permission of Owner shall be obtained at least two days before the service will be interrupted.

Unless otherwise specified, final cleaning work shall not be performed until after hydrostatic testing of the lines and any resulting repair work completed.

Contractor shall notify Owner and Engineer prior to the work to allow their representatives to be present during cleaning and/or disinfection of the water lines.

1-2.02. Related Work. Other sections directly related to Work covered in this section are Section 15061 – Ductile Iron Pipe, Section 15065 – Miscellaneous Steel Pipe, Tubing and Accessories, and Section 15067 – Copper Tubing and Accessories.

1-2.03. Governing Standard. All disinfection work shall conform to the requirements of ANSI/AWWA C651, and the requirements of the Kentucky Division of Water, except as modified herein. If any state or local requirements conflict with the provisions of this section, the state and local requirements shall govern.

1-3. SUBMITTALS.

1-3.01. Disinfection Plan. Prior to starting any disinfection work, Contractor shall submit to Engineer a detailed disinfection plan. The plan shall cover the method and procedure proposed, necessary coordination, qualification of personnel performing the disinfection, sequence of operations, equipment to be used, manner of filling and flushing the lines, chlorine injection points, sample points, testing schedule, potable water source, neutralization, and disposal of wasted water. Personnel performing the disinfection shall demonstrate a minimum of 5 years experience in the chlorination and dechlorination of similar pipelines.

1-3.02. Testing. Bacteriological testing shall be performed by an independent testing laboratory furnished by Contractor. Contractor shall submit the qualifications of the proposed independent testing laboratory prior to performing the specified bacteriological tests. Upon completion of each test, three copies of the test results shall be submitted to Engineer.

The chlorine residual test shall be performed by Contractor. The test log shall be made available to Owner or Engineer upon request and shall be provided to Engineer upon completion of all chlorine residual testing.

1-4. QUALITY ASSURANCE.

1-4.01. Chlorine Residual Tests. Contractor shall provide the necessary apparatus for making the chlorine residual tests by the drop dilution method as set forth in Appendix A of ANSI/AWWA C651. Test results shall be recorded in a logbook that includes for each test: the location, date, time, test results, and test kit manufacturer.

1-4.02. Bacteriological Tests. Sampling and testing of water in the lines shall be performed after final flushing in accordance with Section 5 of ANSI/AWWA C651, including a standard heterotrophic plate count for each sample.

1-4.03. Redisinfection. Should the bacteriological tests indicate the presence of coliform organisms at any sampling point, the lines shall be reflushed, resampled and retested. If check samples show the presence of coliform organisms, then the lines shall be rechlorinated until acceptable results are obtained.

PART 2 - PRODUCTS

2-1. MATERIALS. All materials furnished by Contractor shall conform to the requirements of ANSI/AWWA C651 and shall be clean and free of debris which could infer questionable test results.

2-1.01. Liquid Chlorine. Liquid chlorine shall conform to AWWA B301.

2-1.02. Calcium Hypochlorite (Dry). Calcium hypochlorite shall conform to AWWA B300.

2-1.03. Sodium Hypochlorite (Solution). Sodium hypochlorite shall conform to AWWA B300.

2-1.04. Chlorine Residual Test Kit. Chlorine, residual concentration shall be measured using an appropriate range, drop count, titration kit or an orthotolidine indicator comparator with wide range color discs. The color disc range shall be selected to match chlorine concentration limits. Test kits shall be maintained in good working order and available for immediate test of residuals at point of sampling. Test kits manufactured by Hach Chemical or Hellige are acceptable.

PART 3 - EXECUTION

3-1. APPLICATION.

3-1.01. Disinfection Procedure. The new lines shall be disinfected by the tablet method, continuous feed method, or slug method. Potable water shall be used in conjunction with the chlorination agent.

For the continuous feed or slug method, the chlorination agent shall be injected into the line at the supply end of each new line or valved section thereof.

Admission of disinfectant solution into or the flushing thereof through existing mains shall be held to the minimum possible, and then only after adequate measures have been taken to prevent any such solution of wastewater from entering branch service connections to water customers.

During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. Valves shall be operated such that the chlorine solution in the line being chlorinated will not flow back into the supply line. Check valves shall be used if needed.

Existing mains which may become contaminated during work requiring connections to the new water line, involving either tapping or cutting into operations, shall be flushed and disinfected in accordance with Section 4 of ANSI/AWWA C651.

3-1.02. Final Flushing. Upon completion of chlorination, but before sampling and bacteriological testing, all heavily chlorinated water shall be removed from the lines by flushing with potable water until the chlorine residual in the lines is not higher than that generally prevailing in the adjacent existing system.

Small pipelines shall be flushed with water at the maximum velocity which can be developed, but not less than 2.5 feet per second, unless otherwise permitted by Engineer. Flushing shall be accomplished through the installed valves or fittings, or through corporation cocks in accordance with the details indicated on the drawings.

Pipelines may be flushed as specified, cleaned with a hose, or by other methods acceptable to Engineer.

Booster pumps shall be used if needed to obtain the necessary volume or velocity of water. Pumping equipment installed under this contract shall not be used for flushing, nor shall the flushing water be passed through them; temporary bypass piping at each pump shall be provided as needed.

3-1.03. Cleaning. The potable water mains installed under this contract, including all associated valves and fittings, shall be flushed or cleaned to the satisfaction of Owner and Engineer.

All new piping shall be cleaned by flushing with water at the maximum velocity which can be developed until the piping is free of dirt, debris, and other foreign materials. Cleaning shall precede disinfection. Flushing shall be accomplished through the installed valves or fittings, or through corporation cocks furnished and installed for that purpose.

3-1.04. Disposal of Chlorinated Wastewater. All chlorinated wastewater to be discharged shall be neutralized by chemical treatment and disposed in accordance with the requirements of the governing agency specified herein. Schedule and coordinate rates of flow and locations of discharge of disinfection and flushing water with Engineer and cognizant state and local regulatory agencies to ensure compliance with all applicable rules and regulations.

End of Section

Section 02704

PIPELINE PRESSURE AND LEAKAGE TESTING

PART 1 - GENERAL

1-1. SCOPE. This section covers field hydrostatic pressure and leakage testing of piping. The term "piping" shall be used in this section to refer to piping systems, pipelines, or sections thereof.

Testing of other piping is covered in the Sewer Pipe Installation and Testing section and Miscellaneous Piping and Accessories Installation section. Cleaning and disinfection of piping is covered in another section if required.

1-2. GENERAL. Unless otherwise specified, testing of piping shall be completed prior to final cleaning and disinfection.

Contractor shall notify federal, state, and local regulatory agencies to determine if any special procedures or permits are required for disposal of water used for pressure and leakage testing and to identify acceptable locations for disposal of the water. All requirements and costs associated with notifications and obtaining any discharge permit or approvals shall be responsibility of Contractor.

Engineer or Engineer's representative shall be present during testing and shall be notified of the time and place of testing at least 3 days prior to commencement of the work. All work shall be performed to the satisfaction of Engineer.

1-2.01. Testing Schedule and Procedure. A testing schedule and test procedure shall be submitted to Engineer for review and acceptance not less than 21 days prior to commencement of testing. The schedule shall indicate the proposed time and sequence of testing of the piping. The testing procedure shall establish the limits of the piping to be tested, the positions of all valves during testing, the locations of temporary bulkheads, and all procedures to be followed in performing the testing.

1-2.02. Special Testing Requirements. Special testing requirements include the following:

Unless otherwise acceptable to Engineer, the general sequence of work for each pipeline, or valved or bulkheaded section thereof, shall be as follows:

Initial flushing and cleaning of pipeline.
Filling pipeline.

Hydrostatic pressure and leakage testing.
Disinfection.
Final cleaning, flushing, and neutralization of heavily chlorinated water.
Bacteriological tests.

A temporary pressure gauge shall be installed at each end of the limits of the pipeline to be tested.

If testing is permitted against a butterfly valve, the maximum differential test pressure across the valve seat (gate) in the closed position shall be 150 psi on Class 150B butterfly valves and 250 psi on Class 250 butterfly valves.

1-2.03. Water. Water for testing shall be furnished as stipulated in the Temporary Facilities section. Following completion of testing, the water shall be disposed of in a manner acceptable to Engineer. Unless otherwise permitted, the water shall be kept out of the remainder of the piping.

PART 2 - PRODUCTS

2-1. TEST EQUIPMENT. All necessary connections between the piping to be tested and the water source, together with pumping equipment, water meter, pressure gauges, and all other equipment, materials, and facilities required to perform the specified tests, shall be provided. All required flanges, valves, bulkheads, bracing, blocking, and other sectionalizing devices shall also be provided. All temporary sectionalizing devices shall be removed upon completion of testing. Vents shall be provided in test bulkheads where necessary to expel air from the piping to be tested.

Test pressures shall be applied by means of a force pump sized to produce and maintain the required pressure without interruption during the test.

Water meters and pressure gauges shall be accurately calibrated and shall be subject to review and acceptance by Engineer.

Permanent gauge connections shall be installed at each location where test gauges are connected to the piping during the required tests. Drilling and tapping of pipe walls will not be permitted. Upon completion of testing, each gauge connection shall be fitted with a removable plug or cap acceptable to Engineer.

PART 3 - EXECUTION

3-1. FILLING AND VENTING. Before filling the piping with water, care shall be taken to ensure that all air release valves and other venting devices are properly installed and in the open position. Hand-operated vent valves shall not be closed until an uninterrupted stream of water is flowing from each valve. The rate of filling the piping with water must not exceed the venting capacity of the installed air vent valves and devices.

3-2. BLOCKING AND BACKFILLING. Piping shall be adequately blocked, anchored, and supported before the test pressure is applied.

3-3. PRESSURE TESTING. After the piping to be tested has been filled with water, the test pressure shall be applied and maintained without interruption within plus or minus 5 psi of test pressure for 2 hours plus any additional time required for Engineer to examine all piping being tested and for Contractor to locate any defective joints and pipe materials. The test pressure shall be in accordance with the requirements specified for pipeline or plant piping.

3-3.01. Pipeline Test Pressure. Not used.

3-3.02. Plant Piping Test Pressure. Unless otherwise noted, piping shall be subjected to the test pressure as indicated in the Plant Piping Test Pressure Schedule.

3-4. PLANT PIPING LEAKAGE. All plant piping shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

End of Section

Schedule 02704-S02

Plant Piping Test Pressure Schedule

Piping Designation	Test Pressure (psi)
24-inch Combined Filter Effluent	1.5 times working pressure (minimum 50 psi)

Section 02832

CHAIN LINK FENCING

PART 1 - GENERAL

1-1. SCOPE. This section covers chain link fencing and gates. Fencing shall be provided in the alignment indicated on the drawings and for the following locations:

Plant perimeter

1-2. SUBMITTALS. Complete detail drawings and specifications for the fence, gates, and accessories shall be submitted in accordance with Section 01300 – Submittals.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

PART 2 - PRODUCTS

2-1. FENCE TYPES. Fencing shall conform to the details indicated on the drawings and shall be of the following general types.

2-1.01. Plant Perimeter. Fencing around plant perimeters and electric substations shall consist fabric as specified herein, with a top rail, bottom tension wire, and three strands of barbed wire mounted on 45 degree extension arms. The upper strand of barbed wire shall be approximately the 18 inches [0.5 m] out from the fence and the same distance above the top of the fabric. Posts shall be set in concrete or sleeves as indicated on the drawings.

2-1.02. Settling Basins and Clarifiers. Not used.

2-1.03. Aeration Basins and Wetwells. Not used.

2-1.04. Fencing Fabric and Heights. Fencing heights, unless otherwise specified on the drawings, shall be as follows:

Location	Fabric	Height
Plant perimeter	Galvanized steel or aluminum coated steel to match existing.	To match existing

Fence posts shall be supported by concrete structure.

2-2. MATERIALS.

2-2.01. Steel Fencing. All steel or malleable iron parts and accessories shall be as follows hot-dip galvanized or aluminum coated after fabrication.

Fabric	9 gage thick, 2 inch mesh. Galvanized per ASTM A392, Class 2, or aluminum coated per ASTM A491.
Fabric Finish	Knuckled both edges for fabric widths of 60 inches or less. Knuckled one edge and twisted one edge for fabric widths of 72 inches or more.
Posts	Steel pipe, ASTM F1043, Group IC, with ASTM F1043, Type B or D interior and Type B exterior protective coating.
Line Posts	
For 6 foot, 7 foot and 8 foot fencing	2-3/8 inch OD pipe, 3.12 lb/ft.
Terminal Posts (End, corner, and pull posts)	
For 6 foot, 7 foot and 8 foot fencing	2-7/8 inch OD pipe, 4.64 lb/ft.
Top Rails	1-5/8 inch OD pipe, 1.40 lb/ft.
Rail Couplings	Sleeve type, 6 inches long, ASTM F626.
Bracing, required when fence height is greater than 6 feet.	Pipe brace same as top rail, with 3/8 inch diameter steel rod truss and tightener.

Post Tops (with barbed wire)	Pressed steel, malleable iron with pressed steel extension arm, or one-piece aluminum casting, ASTM F626.
Post Tops (without barbed wire)	Pressed steel, malleable iron, or cast aluminum, ASTM F626.
Barbed Wire	Each strand shall consist of two 12.5 gage steel wires with four-point barbs; galvanized per ASTM A121, Class 2, or aluminum coated per ASTM A585, Type I.
Stretcher Bars	Steel, ASTM F626, 3/16 by 3/4 inch, or equivalent area.
Fabric Ties	Aluminum bands or wire, ASTM F626.
Tension Wire	ASTM A824, galvanized or aluminum coated coil spring wire, 7 gage
Handrail-Setting Cement	Minwax "Super Por-Rok Cement" or Master Builders "Set 45".

2-2.02. Aluminum Alloy Fencing.

Fabric	Aluminum 6061-T94 wire, 6 gage, 2 inch mesh.
Fabric Finish	Knuckled both edges for fabric widths of 60 inches or less. Knuckled one edge and twisted one edge for fabric widths of 72 inches or more.
Posts	ASTM B429, aluminum 6063-T6, Schedule 40 pipe.
Line Posts	2-3/8 inch OD, 1.26 lb/ft.
Terminal Posts (End Corner, and Pull)	2-7/8 inch OD, 2 lb/ft.
Top Rails	ASTM B429, aluminum 6063-T6, Schedule 40 pipe, 1-5/8 inch OD, 0.79 lb/ft.
Rail Couplings	Outside type, 6 inches long, ASTM F626.
Bracing, required when fence height is greater than 6 feet.	Pipe brace same as top rail, with 3/8 inch diameter aluminum 6061-T6 truss rod and tightener.

Post Tops	Cast aluminum alloy, with hole for top rail, ASTM F626
Barbed Wire	Each strand shall consist of two 0.110 inch diameter wires with barbs at 5 inch centers, aluminum 5052-H38 or 606-1T94.
Stretcher Bars	Aluminum 6063-T6 or 6061-T6, 1/4 by 3/4 inch, or equivalent area.
Fabric Ties	Aluminum bands or wires, ASTM F626.
Handrail-Setting Cement	Minwax "Super Por-Rok Cement" or Master Builders "Set 45".

2-2.03. Padlocks. Not used.

2-3. GATES. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION. The installed fence shall conform to the alignment and finished grade indicated. All posts shall be plumb. Unless otherwise indicated on the drawings, posts shall be spaced approximately 10 feet apart for plant perimeter and substation fencing and 6 feet apart for wetwell, settling basin, and aeration basin fencing. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Ground surface irregularities shall be graded to maintain not more than 2 inch clearance below the bottom of the fence fabric.

Where the fencing is supported by a concrete structure, posts shall be set in sleeves that provide at least 1/4 inch clearance all around. Sleeves shall be fabricated from Schedule 40 black steel pipe and shall be hot-dip galvanized after fabrication. Sleeves shall be 5 inches long unless otherwise indicated on the drawings. Sleeves shall be rigidly supported in accurate alignment in the forms and shall be positioned vertically so that the top of the sleeve is approximately 1/2 inch below the finished concrete surface. Posts shall be wedged in accurate alignment, and the annular space between posts and sleeves shall be filled with handrail-setting cement to the top of the steel sleeve. Filling of the remaining space with sealant, as indicated on the drawings, is covered in Section 07900 – Caulking.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least 18 foot lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately 6 inches above grade and shall be attached to each post and securely anchored at

terminal and gate posts. Straight runs between braced posts shall not exceed 1,500 feet. A terminal post shall be provided at each change in slope.

Fabric shall be attached to the top rail and bottom tension wire at 24 inch centers, and to the line posts at 15 inch centers. Barbed wire, when necessary, shall be fastened to each extension arm by internal clips or external fabric ties. Stretcher bars shall be provided at each gate post and terminal post. Each stretcher bar shall be threaded through the fabric and anchored to the post at 15 inch centers by positive mechanical means.

When necessary, each gate post and terminal post shall be braced by a horizontal pipe brace and an adjustable truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabric shall be stretched taut and anchored so that a pull of 150 lbs at the middle of a panel will not lift the bottom of the fabric more than 6 inches.

Interior and exterior surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a heavy coat of coal tar paint. The end of each aluminum post to be set in concrete shall be dipped in a container of coal tar paint before installation.

End of Section

Section 03301

CONCRETE

PART 1 - GENERAL

1-1. SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and appurtenant work. All concrete shall be air-entrained.

1-2. GENERAL. All cast-in-place concrete shall be accurately formed and properly placed and finished as indicated on the drawings and as specified herein.

1-3. SUBMITTALS. All submittals of drawings and data shall be in accordance with Section 01300 - Submittals.

1-4. STORAGE AND HANDLING. Cement shall be stored in suitable moistureproof enclosures. Cement which has become caked or lumpy shall not be used.

Aggregates shall be stored so that segregation and the inclusion of foreign materials are prevented. The bottom 6 inches of aggregate piles in contact with the ground shall not be used.

Reinforcing steel shall be carefully handled and shall be stored on supports that will prevent the steel from touching the ground.

PART 2 - PRODUCTS

2-1. LIMITING REQUIREMENTS. Unless otherwise specified, concrete shall be controlled within the following limiting requirements.

2-1.01. Cement Content. The quantity of Portland cement in the concrete shall be not less than that indicated in the following table:

Quantity of Cement (lb/yd^3)			
Coarse Aggregate Size from No. 4 Sieve to			
3/8 in.	1/2 in.	3/4 in.	1 in.
600	580	560	535

2-1.02. Maximum Water-Cement Ratio. The maximum water-cement ratio shall be 0.45 on a weight basis, or, if fly ash is used, the combined mass of cement plus fly ash shall be used to determine the water-cementitious materials ratio.

2-1.03. Fly Ash Content. At the option of the Contractor, fly ash may be substituted for up to 25 percent of the portland cement, but not less than 15 percent, on the basis of 1.0 lbs of fly ash added for each lb [kilogram] of cement reduction.

2-1.04. Coarse Aggregate. The maximum nominal coarse aggregate size shall be not larger than 1 inch.

2-1.05. Slump. Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction. Unless otherwise authorized by the Engineer, slump of concrete without a superplasticizer shall not exceed 4 inches. Slump of concrete with a superplasticizer, or a midrange water reducer, shall not exceed 8 inches.

2-1.06. Total Air Content. The total volumetric air content of concrete after placement shall be 6 percent ±1 percent.

2-1.07. Admixtures. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations. A water-reducing admixture and an air-entraining admixture shall be included in all concrete. A midrange water reducer or a superplasticizer may be used at the Contractor's option. No calcium chloride or admixture containing chloride from sources other than impurities in admixture ingredients will be acceptable.

2-1.08. Strength. The minimum acceptable compressive strengths, as determined by ASTM C39 with 6 inch diameter by 12 inch cylinders, shall be:

Age	Minimum Compressive Strength
7 days	3,000 psi
28 days	4,000 psi

2-1.09. Concrete Mixes. Unless otherwise specified, all concrete shall be structural concrete that conforms to all specified limiting requirements and this specification.

Concrete for ductbank, buried blocking, and encasement of pipe shall conform to the limiting requirements specified herein, except that the cement factor and total water content may be adjusted to provide a minimum compressive strength of

3,000 psi at 28 days. Concrete shall have a slump of not less than 2 inches nor more than 5 inches when placed.

2-2. MATERIALS.

Cement	ASTM C150, Type I or II.
Fly Ash	ASTM C618, Class F, except loss on ignition shall not exceed 4 percent.
Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand will not be acceptable.
Coarse Aggregate	Non-reactive crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, class 4S, except that clay and shale particles shall not exceed 1 percent.
Water	Clean and free from deleterious substances.
Admixtures	
Water-Reducing	ASTM C494, Type A or D.
Air-Entraining	ASTM C260.
Superplasticizing	ASTM C494, Type F or G.
Reinforcing Steel	
Bars	ASTM A615, Grade 60, deformed.
Welded Wire Fabric	ASTM A185 or A497.
Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected.
Mechanical Connector (Couplers or Form Savers)	Classified Type 2 per ACI 318-02 or per UBC-97. Use only where indicated on the drawings.

Water stops

Metal, at construction joints	Uncoated carbon steel, 12 gage, size as indicated on the drawings.
PVC, at construction joints	Extruded, virgin, elastomeric, polyvinyl chloride (PVC), white (no pigment), flat, ribbed, 3/8 inch thick. Reclaimed material will not be acceptable. Provide hog rings or grommets spaced at 12 inches on center entire length.
For concrete sections less than 12 inches [300 mm] in thickness	6 inches wide, 3/8 inch thick; Greenstreak "679" or Vinylex "R6-38"
For concrete sections 12 inches [300 mm] or more in thickness	9 inches wide, 3/8 inch thick; Greenstreak "646" or Vinylex "R9-38"

Forms

Plywood Product	Standard PS1, waterproof, resin-bonded, exterior type, Douglas fir.
Lumber	Straight, uniform width and thickness, and free from knots, offsets, holes, dents, and other surface defects.
Form Coating	Nonstaining and nontoxic after 30 days, VOC-compliant; Burke "Form Release (WB)", L&M Chemical "E Z Strip", Nox-Crete "Form Coating", or Symons "Thrift Kote E".
Pre-Cure Finishing Aid	Burke "Finishing Aid Concentrate", Euclid "Eucbar", L&M Chemical "E-Con", Master Builders "Confilm", or Sika "Sikafilm".
Polyethylene Film	Product Standard PS17 or ASTM D 4397, 6 mils or thicker.
Vapor barrier and seam tape	Polyolefin geomembrane, Stego Wrap, 15 mils Vapor Barrier. Stego Wrap Red polyethelene tape.

Membrane Curing Compound and Floor Sealer	
VOC – EPA	ASTM C1315, Type I, Class A, maximum VOC 5.8 lb/gal, minimum 25 percent solids, acrylic, nonyellowing, unit moisture loss 0.40 kg/m^2 maximum in 72 hours.

2-3. PRELIMINARY REVIEW. The source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to the Engineer for review before concrete is placed.

2-3.01. Aggregates Reports. Reports on aggregates shall include the following information:

a. Fine Aggregate.

(1) Source and type.

(2) Gradation.

(3) Deleterious substances.

b. Coarse Aggregate (each nominal size).

(1) Source and type.

(2) Gradation and abrasion loss.

(3) Deleterious substances.

(4) Results of sodium or magnesium sulfate soundness test.

2-3.02.02. Mix Design. Design quantities and test results on each mix shall be submitted for review and shall be accepted before concrete work is started. Concrete proportions shall be established based on historical data which complies with ACI-301 that meets the following requirements. The report on each proposed concrete mix which shall contain the following information and shall be submitted to the Engineer:

The combination of materials proposed for use in the work.

Slump on which design is based.

Total gallons of water per cubic yard.

Water-cementitious materials ratio.

Brand, type, composition, and quantity of cement.

Source, class, composition, and quantity of fly ash.

Specific gravity and gradation of each aggregate.

Ratio of fine to total aggregates.

Mass (surface dry) of each aggregate per cubic yard.

Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.

Air content.

Compressive strength based on 7 day and 28 day compression tests.

2-3.02.03. Mix Design Reports. All materials shall be tested in accordance with the specified test methods and reports shall be prepared specifically for this project. If the source of any concrete materials is changed during the Work, the materials and the new mix design shall be tested in accordance with the specified preliminary review requirements and reports shall be submitted for review.

Aggregates shall be sampled and tested in accordance with ASTM C33. In addition, the bulk specific gravity of each aggregate shall be determined in accordance with ASTM C127 and ASTM C128.

Concrete test specimens shall be made, cured, and stored in accordance with ASTM C192 and tested in accordance with ASTM C39.

Slump shall be determined in accordance with ASTM C143. Total air content shall be determined in accordance with ASTM C231 and verified in accordance with ASTM C138. Unit weight (mass) shall be determined in accordance with ASTM C138, and concrete temperature shall be determined in accordance with ASTM C1064.

2-4. FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment.

Forms for pavement, curbs, or gutters shall be made of steel and shall be supported on thoroughly compacted earth. The top face of pavement forms shall not vary from a true plane more than 1/4 inch in 10 feet.

Forms shall be thoroughly cleaned and oiled before concrete is placed.

Where concrete is placed against gravel or crushed rock which does not contain at least 25 percent material passing a No. 4 sieve, such surfaces shall be covered with polyethylene film to protect the concrete from loss of water. Joints in the film shall be lapped at least 4 inches.

2-4.01. Form Ties. Form ties shall be of the removable end, permanently embedded body type, and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.

2-4.02. Edges and Corners. Chamfer strips shall be placed in forms to bevel all salient edges and corners, except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Unless otherwise noted, bevels shall be 3/4 inch wide.

2-4.03. Form Removal. Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead, live, and construction loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete.

2-5. REINFORCEMENT. Reinforcement shall be accurately formed and positioned and shall be maintained in proper position while the concrete is being placed and compacted. Unless otherwise indicated on the drawings, the details of fabrication shall conform to ACI 315 and 318. In case of conflict, ACI 318 shall govern. Reinforcement shall be free from dirt, loose rust, scale, and contaminants. Mechanical connections shall be used only as indicated on the drawings.

2-6. BATCHING AND MIXING. Concrete shall conform to ASTM C94 and shall be furnished by an acceptable ready-mixed concrete supplier.

2-6.01. Consistency. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass, and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

2-6.02. Delivery Tickets. A delivery ticket shall be prepared for each load of ready-mixed concrete and a copy of the ticket shall be handed to the Engineer by the truck operator at the time of delivery. Tickets shall indicate the name and location of the concrete supplier, the project name, the mix identification, the

quantity of concrete delivered, the quantity of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added, and the numerical sequence of the delivery.

PART 3 - EXECUTION

3-1. PLACEMENT. The Contractor shall inform the Engineer at least 24 hours in advance of the times and places at which he intends to place concrete.

Methods of conveying concrete to the point of final deposit and of placing shall prevent segregation or loss of ingredients. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcement and embedments and into the corners of the forms. Concrete shall be compacted by immersion-type vibrators, vibrating screeds, or other suitable mechanical compaction equipment. The use of "jitterbug" tampers to compact concrete flatwork will not be permitted.

3-2. WATER STOPS. Each water stop shall be continuous throughout the length of the joint in which it is installed. Water stops shall be clean, free from coatings, and shall be maintained in proper position until surrounding concrete has been deposited and compacted.

Junctions between adjacent sections of metal water stops shall be lapped 5 inches and securely bolted, screwed, or spot welded together.

Junctions between adjacent sections of elastomeric (PVC) water stops shall be spliced in strict conformity with the recommendations of the manufacturer. Directional changes and intersections shall be factory fabricated by the water stop manufacturer prior to delivery to the site of the work. Field splices will be acceptable only in straight sections.

3-3. FINISHING. Recesses from form ties shall be filled flush with mortar. Fins and other surface projections shall be removed from all formed surfaces, except exterior surfaces that will be in contact with earth backfill.

Unless otherwise specified, unformed surfaces shall be screeded and given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface.

Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a finish of uniform texture and color and the completed finish for unformed surfaces unless indicated otherwise.

3-3.01. Troweling. Interior floor surfaces which will be exposed after construction is completed; exposed top surfaces of equipment bases and interior curbs; and other surfaces designated on the drawings shall be steel trowel finished. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks.

3-3.02. Application of Pre-Cure Finishing Aid. Concrete flatwork subject to rapid evaporation due to hot weather, drying winds, and sunlight shall be protected with a pre-cure finishing aid. The finishing aid shall form a monomolecular film on the surface of fresh, plastic concrete to retard evaporation.

Immediately following screeding, pre-cure finishing aid shall be sprayed over the entire surface of fresh, plastic concrete flatwork at a rate of not less than 200 square feet per gallon, in accordance with the manufacturer's recommendations. The spray equipment shall have sufficient capacity to continuously spray finishing aid at approximately 40 psi with a suitable nozzle as recommended by the manufacturer.

The sprayable solution shall be prepared as recommended by the manufacturer.

Under severe drying conditions, additional applications of finishing aid may be required following each floating or troweling, except the last finishing operation.

3-3.03. Pavement. Following placement and consolidation, and the disappearance of bleed water, the concrete surface shall be drag finished, using a seamless strip of damp burlap over the full width of the surface. The burlap drag shall consist of sufficient layers of burlap and shall have sufficient length in contact with the concrete to slightly groove the surface. The drag shall be moved forward with a minimum bow of the lead edge. The drag shall be kept damp, clean, and free of particles of hardened concrete. When acceptable to the Engineer, carpet, artificial turf, or cotton fabric may also be used.

The surface of pavements shall not vary more than 1/8 inch [3 mm] under a 10 foot [3 m] straightedge placed parallel to the center line.

3-3.04. Curb and Gutter. Curb and gutter shall be finished to the shape indicated on the drawings. After the forms have been removed, all exposed edges shall be rounded, using an edging tool with a 1/8 inch corner radius. Exposed surfaces shall be float finished and given a light broom finish applied at right angles to the curb at the time of initial set, using a horsehair broom.

3-3.05. Sidewalks. Concrete surfaces shall be screeded to the proper elevation and contour. All aggregates shall be completely embedded in mortar. Screeded

surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance, with no unnecessary working of the surface. Initial floating shall be followed by a second floating at the time of initial set.

Floated surfaces shall be given a light broom finish, using a horsehair broom, to provide a nonslip surface. Brooming shall be done at right angles to the length of the walk.

Sidewalks shall be edged using a 3 or 4 inch wide edging tool with a 1/8 inch corner radius. Edger lap marks at corners of each slab shall be carefully removed. False joints shall be provided at right angles to the length of the walk, using a grooving tool with 1/8 inch radius. The finished edge on each side of the joint shall be the same width as the edging tool used. False joints shall divide each sidewalk into square sections.

The finished surface of all sidewalks shall be neat in appearance, shall be sloped to drain, and shall not pond water.

3-4. CURING. Concrete shall be protected from loss of moisture by water saturation or by membrane curing for at least 7 days after placement; however, when concrete is also being protected from low temperatures, the period of curing by saturation shall be 1 day less than the duration of the low temperature protection.

Water saturation shall be used on concrete which will be covered later with mortar or additional concrete. Water saturation or membrane curing compound may be used on all other concrete surfaces.

Water saturation of concrete surfaces shall begin as soon as possible after initial set. Unformed surfaces shall be covered with polyethylene film, tarpaulins, or sand to retain the water. Water shall be applied as often as necessary to keep the concrete saturated for the entire curing period. Acceptable methods of water curing are described in ACI 308.

Membrane curing compound shall be sprayed at a coverage rate of not more than 300 square feet per gallon. Unformed surfaces shall be covered with curing compound within 30 minutes after final finishing. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces. Curing compound shall be suitably protected against abrasion during the curing period.

Concrete shall be protected against freezing for at least 8 days after placement.

3-5. REPAIRING DEFECTIVE CONCRETE. Defects in concrete surfaces shall be repaired to the satisfaction of the Engineer. All concrete which is honeycombed or otherwise defective shall be cut out and removed to sound concrete, with edges cut square to avoid feathering.

Concrete repair work shall conform to Article 5.3.7 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

3-6. FIELD CONTROL TESTING.

3-6.01. Air Content. An air content test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. The Contractor shall provide all equipment and supplies necessary for the testing. Air content shall be determined in accordance with ASTM C231.

3-6.02. Slump. A slump test shall be made on concrete from each batch of concrete from which concrete compression test cylinders are made. Slump shall be determined in accordance with ASTM C143.

3-6.03. Test Cylinders. Compression test specimens shall be made, cured, stored, and delivered to the laboratory in accordance with ASTM C31 and C39. Compressive strength tests will be evaluated in accordance with ACI 318 and as specified herein.

One set of 6 inch diameter by 12 inch concrete test cylinders shall be cast for each concrete pour. A set of test cylinders shall consist of four cylinders, two to be broken and to have compressive strengths averaged at 7 days, and two to be broken and to have compressive strengths averaged at 28 days. All concrete required for testing shall be furnished by, and at the expense of, the Contractor.

The cured cylinders shall be tested by an independent testing laboratory at the expense of the Owner.

End of Section

Section 03600

GROUT

PART 1 - GENERAL

1-1. SCOPE. This section covers procurement and installation of grout. Unless otherwise specified, only nonshrinking grout shall be furnished.

Epoxy grouting of anchor bolts, threaded rod anchors, and reinforcing bars is covered in Section 05550 - Anchorage in Concrete and Masonry.

1-2. SUBMITTALS. A letter of certification indicating the types of grout to be supplied and the intended use of each type shall be submitted in accordance with Section 01300 - Submittals.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage of any kind. Materials shall be protected from moisture.

PART 2 - PRODUCTS

2-1. MATERIALS.

Nonshrinking Grout	Cementitious grout with demonstrated non-shrinking properties; L&M "Crystex", Master Builders "Masterflow 713" or "Set Grout", Sauereisen "F-100 Level Fill Grout", Sonneborn "Sonogrout 10K", Hilti "CG 200 PC", or Five Star Products "Five Star Grout".
Water	Clean and free from deleterious substances.

2-2. NONSHRINKING GROUT. Nonshrinking grout shall be furnished factory premixed so that only water is added at the jobsite.

PART 3 - EXECUTION

3-1. PREPARATION. The concrete foundation to receive nonshrinking grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer.

3-2. INSTALLATION.

3-2.01. Mixing. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

3-2.02. Placement. Unless otherwise specified or indicated on the drawings, grout under baseplates shall be 1-1/2 inches thick. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the baseplates are completely filled without voids. Forms shall be provided where structural components of baseplates will not confine the grout.

3-2.03. Edge Finishing. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate.

3-2.04. Curing. Nonshrinking grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least 3 days and then an acceptable membrane curing compound shall be applied.

End of Section

Section 05520

HANDRAILING, GUARDRAILING, AND LADDERS

Data Sheet

Para-graph	Description	Data	Unit
	Performance and Design Requirements		
	Drawings and submittals to be sealed by a professional engineer.	☑ Yes ☐ No	
	Code requirements.	☐ UBC and OSHA ☐ BOCA and OSHA ☐ SBC and OSHA ☐ OSHA only ☑ Other	
	When "Other" is selected, indicate additional alternatives.	OSHA and IBC2003	
	Products and Accessories		
	Systems required.	☑ Aluminum ☐ Stainless steel ☐ Galvanized steel ☐ Primed and painted steel ☐ Fiberglass	
	Acceptable rail manufacturers (metal).	☑ Moultrie "Wesrail" ☑ Universal "Uni-Rail" ☑ Thompson "TUF Rail System" ☑ Julius Blum & Co "Connectorail" ☐ Other	
	When "Other" is selected, indicate additional manufacturers.		
	As specified without exception.	☐ Yes ☑ Alternatives may be proposed	
	Acceptable rail and ladder manufacturers (fiberglass).	☐ Fibergrate Composite Structures "Dynarail" ☐ Strongwell "Safrail" ☐ Other	

	When "Other" is selected, indicate additional manufacturers.		
	As specified without exception.	☐ Yes ☒ Alternatives may be proposed	
	Acceptable ladder system manufacturers (metal).	☑ Alaco "Series 500" ☑ Thompson "TUF Ladder" ☐ Other	
	When "Other" is selected, indicate additional manufacturers.		
	As specified without exception.	☐ Yes ☒ Alternatives may be proposed	
	Ladder extending safety posts required beneath hatches.	☒ Yes ☐ No ☐ As indicated on drawings	
	Lighting standards integral with posts.	☒ Required per drawings ☐ Not required	
	Finishes		
	Painted steel railing required to be shop prime coated.	☒ Yes ☐ No	
	Note:	The shop primer for ladders, guardrails, and handrails shall be compatible with the coating system used in the field.	
	Painted steel railing required to be shop finish coated.	☐ Yes ☒ No	
	When"Yes" is selected, indicate color of painted steel railing.		
	Finish for aluminum railing.	☒ Clear anodic as specified ☐ Other	
	When "Other" is selected, indicate additional alternatives.		
	Fiberglass railing color.	☒ Yellow ☐ Gray ☐ Other	
	When "Other" is selected, indicate additional alternatives..		

Section 05520

HANDRAILING, GUARDRAILING, AND LADDERS

PART 1 - GENERAL

1-1. SCOPE. This section covers the fabrication and installation of handrailing, guardrailing, and ladders fabricated from metal or fiberglass shapes. Ornamental railing systems, metal stairs, concrete and masonry anchorage systems, and structural and miscellaneous metal are covered in other sections.

1-1.01. Terminology. When the phrase "as required" is stated in this section, it shall mean "as required in the attached Data Sheet".

1-2. GENERAL. Fabricated items which are indicated on the drawings but not mentioned specifically herein shall be fabricated in accordance with the applicable requirements of this section.

1-3. SUBMITTALS. Complete data, detailed drawings, and setting or erection drawings covering all materials shall be submitted in accordance with Section 01300 - Submittals. Each separate piece shall be marked. Drawings and submittals shall be sealed by a professional engineer registered in the state of Kentucky.

Data shall be submitted to certify that all railings and ladders meet all applicable requirements of the codes as required and the project specifications and drawings. Engineer may request copies of all supporting calculations.

1-3.01. Samples. Samples shall be submitted to indicate finishes. Samples of each type of fitting required to complete the installation shall also be submitted.

1-3.02. Colors. Where color selections are required, color charts shall be submitted showing the full range of available colors. Procedures for selecting colors shall be as indicated in the Submittals section.

1-4. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, coating damage, or corrosion. Damaged materials shall be promptly replaced. Materials shall be stored on blocking so that no material touches the ground and water cannot collect thereon. The material shall be protected against bending under its own weight or superimposed loads.

PART 2 - PRODUCTS

2-1. GENERAL. Railing systems and ladders shall be designed and fabricated by companies normally engaged in the manufacture of such systems and as required. Railing products of like materials shall be from a single supplier and the installed systems shall have a uniform appearance throughout the project. Ladders may be from another supplier. Unless indicated otherwise on the drawings, ladders in proximity with guardrailing shall be of the same material, style, and finish as the guardrailing.

For metal railing systems, at Contractor's option, handrailing and guardrailing shall be either shop fabricated welded systems or prefabricated nonwelded systems designed for field assembly. Welded railing systems shall be fabricated from pipe and accessories by metal fabricators experienced in designing and fabricating welded railing.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS.

2-2.01. Railing System Design Criteria. All railing systems shall be designed and fabricated in compliance with the most stringent requirements of the applicable local building code, OSHA 29 CFR Part 1926 Subpart R, and all other pertinent OSHA regulations and local safety regulations. Handrails for handicapped accessible areas, if required, shall comply with the requirements of the local building code, ANSI 117.1 Uniform Federal Accessibility Standards, and the accessibility standards of the Americans with Disabilities Act. In case of conflicting requirements the more stringent requirements shall be applicable.

At a minimum, guardrailings shall be designed to withstand a uniform horizontal load of 50 lbs per foot with a simultaneous vertical load of 100 lbs per foot applied to the top rail. Handrailing and stair railing shall be designed to withstand a uniform horizontal load of 50 lbs per foot applied to the top rail. In addition, guardrailing, handrailing, and stair railing shall be designed to withstand a concentrated load of 200 lbs applied in any direction, at any point on the railing system. The 200 lb concentrated load need not be applied simultaneously with the 50 lbs per foot uniform horizontal load.

Maximum spacing for railing posts shall be 6 feet.

2-2.02. Handrails. Steel and aluminum handrailings shall be fabricated from 1-1/2 inch ID pipe. Fiberglass handrailing shall be fabricated from 1 -1/2 inch minimum fiberglass reinforced pultruded square tube.

2-2.03. Guardrails. Steel and aluminum guardrailings shall be fabricated from 1-1/2 inch ID pipe. Fiberglass guardrailing shall be fabricated from 1-3/4 inch minimum fiberglass reinforced pultruded square tube.

2-2.04. Pickets. Steel and aluminum pickets shall be fabricated from 3/4 inch ID pipe. Fiberglass pickets shall be fabricated from 3/4 inch fiberglass reinforced round tube.

2-2.05. Kickplate. Kickplates shall be 4 inches high and shall be fabricated from similar materials as the railing. Kickplates shall clear the walking surface by 1/4 inch .

2-2.06. Fasteners. Unless noted otherwise, all fasteners shall be stainless steel. Where galvanized bolts are indicated on the drawings or specified, the use of zinc-plated bolts will not be acceptable. Metal railings shall be fastened to fittings with through bolts or flush set screws; glued or pop riveted connections are not permitted. Fiberglass railings shall be connected with epoxy bonded connections in accordance with the manufacturer's standard details. Fastener details shall be indicated on the submittal drawings.

2-2.07. Guarding of Openings. Openings in railing shall be guarded by self-closing gates in accordance with OSHA 1910.23. Safety chains shall not be used unless required or specifically indicated on the drawings.

2-2.08. Removable Guardrail. Removable guardrail sections shall be so designed that each section has at least two, but not more than three posts.

2-2.09 Expansion Control. Guardrailing in outdoor locations shall have slip joints at least every 60 feet and at all concrete expansion joints to permit expansion and contraction. The gap at each slip joint shall be not less than 1/4 inch.

2-2.10. Mounting to Structure. Handrailing and guardrailing shall be mounted to structures as indicated on the drawings. If mounting details are not indicated, railing posts shall be surface mounted with base flanges or side mount brackets secured to concrete by stainless steel anchor bolts set in epoxy grout. Bolt sizes and pattern shall be as needed for the mounting device.

2-2.11. Ladders. Ladders shall be designed to meet the requirements of OSHA and ANSI-A14.3. Ladders with climbing heights greater than 20 feet shall be provided with cages or fall prevention devices as indicated on the drawings. Rest platforms shall be provided to limit straight climbs to maximum 30 feet.

Ladders shall be mounted to structures as indicated on the drawings. If mounting details are not indicated, bracket connection bolts shall be stainless steel bolted to structural steel or set in concrete or masonry with epoxy grout.

Ladders exiting through hatchways shall be furnished with extending ladder safety posts.

2-3. MATERIALS.

Aluminum Systems

Pipe	Aluminum ASTM B429, Alloy 6061-T6, Schedule 40.
Shapes and Plates	Aluminum ASTM B308, Alloy 6061-T6 for Shapes. ASTM B209, Alloy 6061-T6 for Plates.
Fittings, Welded	Angles, offsets, tees, ells, crosses, caps for aluminum, ASTM B429, Alloy 6063-T6, Schedule 40.
Fittings, Non-welded	Manufacturer's standard component fittings, extruded sections, ASTM B221, Alloy 6063-T5 or T6.
Assembly Bolts, Nuts, Washers, and Fasteners	Stainless steel.

Stainless Steel Systems

Pipe	ASTM A312, Grade TP316L, Schedule 40.
Plates	ASTM A240, Type 316L.
Fittings, Welded	Angles, offsets, tees, ells, crosses caps for stainless pipes shall be made with formed, stainless steel welding ells and welding connectors.
Non-welded	Manufacturer standard component fittings, stainless steel.
Assembly Bolts, Nuts, Washers, and Fasteners	Stainless steel.

Galvanized Steel Systems

Pipe	ASTM A 500 Grade B, Schedule 40, galvanized after fabrication.
Plates	ASTM A36. Galvanized.
Fittings, Welded	Angles, offsets, tees, ells, crosses, and caps shall be made with formed, welding ells and welding connectors. Material to match railings. Galvanized.
Fittings, Non-Welded	Manufacturer standard component fittings, material to match railings. Galvanized.
Assembly Bolts, Nuts, Washers, and Fasteners	Stainless steel.

Painted Steel Systems

Pipe	ASTM A 500 Grade B, Schedule 40, Prime painted.
Plates	ASTM A36. Prime Painted.
Fittings, Welded	Angles, offsets, tees, ells, crosses, caps shall be made with formed, welding ells and welding connectors, material to matching railings. Prime painted.
Fittings, Non-welded	Manufacturer standard component fittings, materials to match railings. Prime painted.
Assembly Bolts, Nuts, Washers, and Fasteners	Manufacturer's standard.

Fiberglass Systems

Tube	Fiberglass reinforced pultruded square tube with surfacing veil and UV inhibitors in vinyl ester resin, ASTM E-84 flame spread of 25 or less.
Kickplate	Fiberglass reinforced pultruded corrugated plate with surfacing veil and

	UV inhibitors in vinyl ester resin, ASTM E-84 flame spread of 25 or less.
Hardware	Manufacturer's standard, AISI Type 316 stainless steel.
UV Protective Coating	Manufacturer's standard, polyurethane.
Steel Pipe Sleeves	
Outer Sleeves	Black steel pipe, Schedule 40. Hot-dip galvanized after fabrication.
Removable Post Inner Sleeves	PVC tube, Schedule 40.
Plastic Pipe Sleeves	PVC tube, Schedule 40.
Post Setting Cement	Minwax "Super Por-Rok Cement" or Master Builders Set Products Division "Set 45".
Ladder Fall Prevention Devices	OHSA approved fall prevention device with harness.
Anchor Bolts to Prime Painted Steel	ASTM High Strength bolts, nuts, and washers in accordance with the structural and Miscellaneous Metals section.
Anchor Bolts to Masonry	Stainless steel adhesive anchors in accordance with the Anchorage in Concrete and Masonry section.
Shop Coatings	
Universal Primer	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 888 Primer", or Tnemec "Series N27 S.T. Typoxy."
Red Oxide Primer	SSPC 15, Type 1, or Fed Spec TT-P-636.
Epoxy Enamel	Gray; Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carbogaurd 891", or Tnemec "Series N140 Pota-Pox Plus".
Asphalt Varnish	Fed Spec TT-C-494.

Anodic Finish	AA-M10C22A41, clear unless otherwise required.
Galvanizing	ASTM A123, A153, A385.

2-4. FABRICATION. Unless otherwise indicated on the drawings, all railings provided under this section shall be of the same type and design.

2-4.01. Welded Metal Railings. All angles, offsets, or other changes in alignment in welded pipe railings shall be made with railing ells and welded connectors. Welded joints shall be flush type. Railings shall be smooth, with all projecting joints and sharp corners ground smooth. Members shall be neatly coped and continuously welded or mechanically connected at all junctions. Top rails shall run continuously over posts. All rails and posts shall be in the same plane and shall not be offset. All welding shall be done neatly and substantially by a process (e.g., TIG or MIG) producing a smooth weld. All weld spatter and burrs shall be removed, and all welds shall be thoroughly brushed with a stainless steel power wire brush.

Field joints shall be made with a splice-lock connector which shall provide a firm, permanent connection. The connector shall mechanically draw the railing sections together to form tight, hairline joint.

Handrail posts 10 feet high made from 3 inch pipe shall be provided as standards for lighting fixtures at the locations indicated on the electrical drawings. Each lighting standard shall have a reducer and 6 inches of unthreaded, reamed 2-1/2 inch pipe at the top. Lighting standards shall be constructed of the same material and shall have the same exterior finish as adjacent handrail posts.

2-4.02. Fiberglass Railings. Fiberglass handrails and guardrails shall be fabricated into finished sections of the configurations indicated on the drawings by fabricating and joining fiberglass tube shapes using molded connectors and pultruded components epoxy bonded and connected as recommended by the railing manufacturer. Where kickplates are indicated, the kickplates shall be attached to the railing posts with stainless steel or nylon fasteners. Top rails shall run continuously over posts. All rails and posts shall be in the same plane and shall not be offset.

2-4.03. Guarding of Openings. Openings in railing shall be guarded by self closing gates unless safety chain is specifically required or indicated on the drawings. Self closing gates shall be fabricated of the same materials with the same finish as the guardrailing. The closure device shall be Manufacturer's standard.

At locations specifically indicated on the drawings, a safety chain fabricated of 1/4 inch stainless steel shall be provided across openings in the railing. The chain shall be fastened to one railing post by a stainless steel eyebolt, and shall engage a similar eyebolt on the opposite post by means of a 2-1/2 inch heavy-duty, stainless steel harness snap. The chain length shall be as needed by the width of the opening.

2-4.04. Sleeves. When indicated on the drawings, sleeves for fixed handrail posts shall be fabricated from Schedule 40 PVC pipe or from Schedule 40 black steel pipe hot-dip galvanized after fabrication. Sleeves shall provide at least 1/4 inch clearance all around each post and shall be 5 inches long unless otherwise indicated on the drawings.

When indicated on the drawings, sleeves for removable posts shall have an outer and inner sleeve. The outer sleeve shall be fabricated from Schedule 40 black steel pipe and shall be hot-dip galvanized after fabrication. The inner sleeve shall be Schedule 40 PVC pipe.

2-4.05. Ladders. Ladders, safety cages or climbing devices, and rest platforms shall be provided as indicated on the drawings. Ladder rails intersecting guardrailing shall be configured to provide an aesthetically pleasing transition, although ladder rails need not be physically attached to the guardrailing. There shall be no gaps between ladder rails and adjacent guardrailing that would allow passage of a sphere greater than 4 inches in diameter. Railing gaps at ladders shall be protected by self-closing gates, unless safety chains are required or specifically indicated on the drawings.

All necessary brackets, bolts, and anchors shall be provided for installing the ladders.

2-5. COATING.

2-5.01. Ungalvanized Steel. Unless otherwise required, all ungalvanized steel shall be given a coat of universal primer in the shop after fabrication. Steel surfaces shall be prime-coated as soon as practicable after cleaning. Steel railing shall also be finish coated with one coat of epoxy enamel. The dry film thickness of the shop coatings shall be at least 2 mils for universal primer and at least 5 mils for epoxy enamel. All painting shall be done in a heated structure if the outside air temperature is below 50°F. Steel shall not be moved or handled until the shop coat is dry and hard.

2-5.02. Aluminum. All surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a coat of epoxy enamel.

All aluminum railings shall be provided with a clear anodic finish.

2-5.03. Stainless Steel. Unless otherwise specified or permitted, all items fabricated from stainless steel shall be thoroughly cleaned and degreased after fabrication. Pickling or light blast cleaning shall be used to produce a modest etch and shall remove all embedded iron and heat tint. Surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron and shall be repickled as needed to remove all traces of iron contamination. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

2-5.04. Fiberglass. All fiberglass materials in outdoor locations shall be coated for UV protection. Railing color shall be as required.

2-5.05. Other Surfaces. Shop coating of galvanized steel or stainless steel surfaces will not be required.

PART 3 - EXECUTION

3-1. INSTALLATION. When railings and ladders are assembled, all posts shall be plumb and longitudinal members shall be parallel with each other and with the floor surface or slope of stairs. In any section or run of railing, the center lines of all members shall be in true alignment, positioned in the same vertical plane. All posts in fixed handrail sections and all ladders shall be rigidly attached to the supporting structure. After installation, railings and ladders shall be checked for final alignment, using a tightly drawn wire for reference. The maximum misalignment tolerance for railings shall be 1/8 inch in 12 feet. Bent, deformed, or otherwise damaged installations shall be replaced.

Cut or drilled fiberglass pieces shall be sealed with catalyzed resin in accordance with the fiberglass manufacture's recommendations.

3-1.01. Attachment to Concrete. Posts shall be attached to concrete structures as indicated on the drawings. Base flanges and side-mount brackets shall be installed with minimal disturbance to the reinforcing steel. Bolts shall be stainless steel set in epoxy grout as indicated in the Anchorage in Concrete and Masonry section.

If sleeves are indicated, they shall be rigidly supported in accurate alignment in the forms and shall be positioned vertically so that the top of each sleeve is approximately 1/2 inch below the finished concrete surface. The position of all sleeves shall be carefully measured before railings are fabricated. When the railing is set, the posts shall be wedged in accurate alignment, and the annular space between the posts and sleeves shall be filled with handrail-setting cement

to the top of the steel sleeve. Filling of the remaining space with sealant, as indicated on the drawings, is covered in the Caulking section.

3-1.02. Attachment to Steel or Aluminum. Where attached to steel or aluminum shapes, attachments shall be made with flanges or with other special attachments or anchorages as detailed on the drawings.

3-1.03. Removable Attachments. For removable guardrail sections in embedded sleeves, inner sleeves shall be set in outer sleeves in the same manner as specified herein for the setting of fixed posts. Particular care shall be taken to ensure that the inner sleeves are accurately spaced and plumbed, so that the handrail sections, when set in position, will stand in proper alignment and will be removable without binding.

Removable guardrail sections with base flanges or side mount brackets shall be secured in the bases with removable screws.

3-1.04. Wall Mounted Handrailing. Suitable wall brackets shall be provided where shown or required. Wall brackets shall be securely anchored to walls with stainless steel bolts set in epoxy grout as indicated in Section 05550 - Anchorage in Concrete and Masonry. Expansion anchors shall not be used unless specifically indicated on the drawings.

3-1.05. Connections. Welding connectors and splice locks shall be installed in accordance with the manufacturer's recommendations. Other methods of making connections and changes in alignment will be considered, provided complete information covering the proposed method is submitted to Engineer for review.

End of Section

Section 05530

GRATING

PART 1 - GENERAL

1-1. SCOPE. This section covers the fabrication and installation of metal grating.

Both inch-pound (English) and SI (metric) units of measurement are specified herein; values expressed in inch-pound units shall govern.

1-2. GENERAL.

1-3. SUBMITTALS. Detailed fabrication and erection drawings covering the grating shall be submitted in accordance with Section 01300 - Submittals. Drawings shall indicate locations of grating supports, profiles, thicknesses, lengths, markings of panels, and fastening methods.

1-4. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, scratches, or damage of any kind. Damaged materials shall be promptly replaced. Materials shall be stored off the ground. Shipping shall be in accordance with Section 01612 - Shipping. Handling and storage shall be in accordance with Section 01614 - Handling and Storage.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. Design Criteria. Except as modified herein, the manufacture and fabrication of metal grating shall comply with recommendations in the "Metal Bar Grating Manual" of the National Association of Architectural Metal Manufacturers (NAAMM). Grating depth shall be as indicated on the drawings.

Fiberglass grating shall be designed and fabricated to support 100 psf live load with a maximum deflection not greater than L/150 or 1/4 inch, unless indicated otherwise on the drawings.

2-1.02. Carbon Steel Grating. Not used.

2-1.03. Stainless Steel Grating. Not used.

2-1.04. Aluminum Grating. Aluminum grating shall be the pressure locked type, with cross bars deformed or swaged to prevent turning. Bearing bars shall be at least 3/16 inch thick flat stock or equivalent I-bars, with center-to-center spacing of 1-3/16 inches. Cross bar center-to-center spacing shall be 4 inches maximum. Grating shall be a mill finish.

2-1.05. Fiberglass Grating. Not used.

2-2. MATERIALS.

Aluminum Grating	NAAMM MBG 531, ASTM B221, 6063-T6 or 6061-T6 alloy, pressure or swage locked, mill finish
Grating Stair Treads	Grating stair treads shall match the material and finish of grating in adjacent platforms and floors. Treads shall have a permanently attached or integral non-skid nosing.
Grating Fasteners	Manufacturer's standard, AISI Type 316 stainless steel.
Clips, Bolts, Nuts, Washers	Manufacturer's standard, AISI Type 316 stainless steel.
Welded Threaded Steel Studs	ASTM A108 fully threaded studs automatically welded with compatible nuts and washers; TRW Nelson Type CFL or acceptable equal.
Stepped Locking Fasteners	Non-penetrating, non-welded mechanical fasteners, with stainless steel clips and bolts, galvanized cast iron body; Lindapter "Grate-Fast" or Grating Specialty Co. "G-Clip".
Fiberglass Grating Support Legs	Adjustable fiberglass legs specifically designed to support elevated molded fiberglass grating; Fibergrate Corporation "Grating Legs" or Strongwall Corporation "Elevated Floor System".
Fiberglass Curb Angle	Vinyl ester resin, fiberglass trim angle with integral concrete anchorage; Fibergrate Composite Structures "EZ angle" or Strongwell Corporation "Fiberglass Curb Angle".

2-3. FABRICATION. Grating shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 150 lbs. Panels shall be within ±1/4 inch of authorized length and ±1/4 inch of authorized width, and shall have a maximum difference in length of opposite diagonals of 1/4 inch. The spacing of bearing bars shall be within 1/32 inch of authorized spacing. Cross bars and edge bars of adjacent panels shall align. After installation, there shall be not more than 1/4 inch clearance between panels. All bearing bars shall be parallel. Bands and toeplates shall align within 1/8 inch tolerance, vertical and horizontal.

Angular, circular, and re-entrant cuts in steel grating may be made by flame cutting. All other cuts in steel grating shall be sawed or sheared. Cuts shall be clean and smooth, without fins, beads, or other projections. Any damaged protective coating shall be fully restored.

All cuts in aluminum grating shall be sawed or sheared. All cuts in fiberglass grating shall be cut. All fiberglass grating which requires cutting shall have the affected surfaces sealed with catalyzed resin sealant of equal or superior corrosion resistance to the grating.

Grating panels shall be arranged so that openings are centered on a joint between panels. Toeplates extending the full depth of the grating and 4 inches above the top shall be provided around openings. Toeplates shall be welded to each bearing bar. The ends of bearing bars need not be banded unless required by the drawings. Bands shall be welded to the first, the last, and every fourth intermediate bar. Bands and toeplates shall be 3/16 inch thick. Crossbars shall be cut off flush with the outside face of side bars.

Steel frames anchored to or cast in concrete to support grating shall be stainless steel or hot-dip galvanized after fabrication. The anchorage of fiberglass curb angles shall consist of intermittent embedded shapes or interlocking deformations on the back side of the angle.

2-4. SHOP COATING. Finish painting of grating, if required, is covered in the protective coatings section.

2-4.01. Galvanizing. All galvanizing shall be done by the hot-dip process after fabrication, in conformity with the requirements of ASTM A123, A153, and A385.

2-4.02. Aluminum. All surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a coat of epoxy enamel on the contact surfaces.

2-4.03. Fiberglass. All cut edges of fiberglass grating shall be sealed with catalyzed resin sealant of equal or superior corrosion resistance to the grating or as specified by the manufacturer. Sufficient quantities of edge repair coating shall be supplied with the grating.

PART 3 - EXECUTION

3-1. GENERAL. All grating shall lie flat, with no tendency to rock when installed. Poorly fitting or damaged grating shall be rejected. Grating openings may be field cut with the approval of Engineer, provided that no more than four adjacent bearing bars are cut. If the grating is cut or modified in the field, affected surfaces shall be repaired or sealed to assure restoration of the corrosion resistance of the grating. Field cut openings must be spaced so that there are at least as many continuous bars between each opening as there are cut bars at the opening.

3-2. ATTACHMENTS TO SUPPORTING STRUCTURE. All grating supported on steel, aluminum, or fiberglass structures shall be attached. Grating shall be attached to the supporting structure in accordance with the grating manufacturer's recommendations and submittals. Single span grating over flumes, manholes, pits, or other openings in concrete floors may rest unattached in recesses constructed for that purpose. To preclude excessive accumulation of tolerances, an extra-long panel shall be provided for each unanchored grating cover that exceeds 20 feet in length. The panel shall be cut to the required dimension after the remainder of the grating panels have been installed.

3-2.01. Prime Painted Steel Supports. Unless otherwise required or indicated on the drawings, clip or flange block fasteners or stepped locking fasteners shall be used to attach grating to prime painted steel supports. Clip fasteners shall be secured to the supporting steel with through bolts in drilled holes. Through bolts shall be stainless steel. Fusion welded threaded studs may be utilized if the primer is removed before welding or if a suitable weldable primer is used. Welded studs shall be cleaned and prime painted to match the support steel prior to finish painting.

3-2.02. Galvanized Steel Supports. Unless otherwise indicated on the drawings, stepped locking fasteners shall be used to attach grating to galvanized steel supports. The galvanized coating shall not be damaged.

3-2.03. Stainless Steel, Aluminum, and Fiberglass Supports. Unless indicated otherwise on the drawings, clip or flange block fasteners or stepped locking fasteners shall be used to attach grating to stainless steel, aluminum, or fiberglass supports. Fasteners shall be secured to the supporting structure with stainless steel through bolts in drilled holes. Welded fasteners shall not be used.

3-3. FINISH TOUCHUP. After erection, all grating shall be cleaned. Damaged coatings shall be touched up in accordance with the grating manufacturer's recommendations to fully restore the corrosion resistance of the grating. Cut ends of fiberglass grating pieces shall be sealed with catalyzed resin sealant of equal or superior corrosion resistance to the grating itself or repaired in accordance with the manufacturer's recommendations to assure full undamaged performance.

End of Section

Section 05550

ANCHORAGE IN CONCRETE AND MASONRY

PART 1 - GENERAL

1-1. SCOPE. This section covers the procurement and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts, adhesive anchors, expansion anchors, undercut anchors, and epoxy grouted anchor bolts and reinforcing bars to be installed in concrete and masonry.

1-2. GENERAL. Unless otherwise specified or indicated on the drawings all anchors and anchor bolts shall be cast-in-place anchor bolts with forged heads or embedded nuts and washers. Unless otherwise indicated bolts in concrete shall have a diameter of at least 3/4 inch, and bolts in grouted masonry shall have a diameter of at least 1/2 inch.

Unless otherwise indicated on the drawings, anchors and anchor bolts used in the following locations and applications shall be of the indicated materials. Other anchors and anchor bolts shall be as indicated on the drawings.

Cast-In-Place and Epoxy Grouted Anchor Bolts.

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Galvanized steel.
Other exterior locations	Galvanized steel.
Other interior locations	Carbon steel.

Adhesive, Expansion, and Undercut Anchors.

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.

Anchorage of structural steel columns	Stainless steel.
Other exterior locations	Stainless steel.
Other interior locations	Carbon steel.

Adhesive, expansion, and undercut anchors may be used instead of cast-in-place anchors where specifically indicated or permitted on the drawings or with the specific acceptance by Engineer.

1-3. SUBMITTALS. Data and catalog cuts indicating the manufacturer and types of adhesive anchors, expansion anchors, undercut anchors, and epoxy grouts to be supplied shall be submitted in accordance with Section 01300 - Submittals.

1-4. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage or corrosion. Damaged materials shall be promptly replaced. Materials shall be shipped and stored in original manufacturer's packaging. Shipping shall be in accordance with Section 01612 – Shipping.. Handling and storage shall be in accordance with Section 01614 - Handling and Storage.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be as indicated below.

Anchor Bolts.

Carbon steel	ASTM F1554, Grade 36 with compatible nuts.
Galvanized steel	ASTM F1554, Grade 36 with compatible nuts; hot-dip galvanized, ASTM A153.
Stainless steel	Bolts, ASTM F593, Alloy Group 1 or 2; nuts, ASTM F594, Alloy Group 1 or 2.
Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.
Reinforcing Bars	ASTM A615, Grade 60, deformed.

Reinforcing Bars, weldable	ASTM A706, Grade 60, deformed.
Epoxy Grout for Anchor Bolts and Reinforcing Bars.	
Adhesive	
For Floors and Horizontal Surfaces	Sika "Sikadur 35, Hi-Mod LV"; ChemRex "Concresive Liquid LPL"; Sika "Sikadur 32 Hi-Mod".
For Vertical Surfaces and Overhead Applications	Sika "Sikadur 31 Hi-Mod Gel".
Aggregate	As recommended by the epoxy grout manufacturer.
Water	Clean and free from deleterious substances.
Expansion Anchors	Hilti "Kwik-Bolt 3"; ITW Ramset/Red Head "Trubolt Wedge Anchor"; Powers Fasteners "Power-Stud Anchor"; Simpson "Wedge-All".
Undercut Anchors	Hilti "HDA Self Setting Undercut Anchor"; Drillco "Maxi-Bolt".
Adhesive Anchors for Concrete and Grout Filled Masonry.	
Threaded Rods and Nuts	As specified for Anchor Bolts and as recommended by the adhesive manufacturer.
Adhesive	Hilti "HIT HY 150", "HIT-ICE", "HIT RE 500", or "HVA" Systems; ITW Ramset/Redhead "Epcon Ceramic 6" System; Powers Fasteners "Power Fast Epoxy Injection Gel" System; Simpson "SET Epoxy" or "Acrylic-Tie" Systems.
Adhesive Anchors for Hollow Masonry System.	

Threaded Rods and Nuts	As specified for Anchor Bolts and as recommended by the adhesive manufacturer.
Adhesive	Hilti "HIT HY 20" System; ITW Ramset/Redhead "Epcon Ceramic 6" System; Powers Fasteners "Power Fast Epoxy Injection Gel" System; Simpson "SET Epoxy" or "Acrylic-Tie" Systems.
Screen Tubes	As recommended by the manufacturer.

2-2. ANCHORS.

2-2.01. Cast-in-Place Anchor Bolts. Cast-in-place anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Unless installed in pipe sleeves, anchor bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts indicated on the drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts without locknuts.

2-2.02. Epoxy Grouted Anchor Bolts and Reinforcing. Epoxy grout for installing reinforcing bars and anchor bolts not indicated to be adhesive anchors shall consist of a two-component liquid epoxy adhesive of viscosity appropriate to the location and application, and an inert aggregate filler component, if recommended by the adhesive manufacturer.

Anchor bolts and reinforcing bars shall be free of coatings that would weaken the bond with the epoxy.

2-2.03. Adhesive, Expansion, and Undercut Anchors. When adhesive, expansion, or undercut anchors are indicated on the drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy grouted anchor bolts are specified or indicated.

Unless otherwise required, single nut and washer shall be furnished for adhesive anchors, expansion anchors, and undercut anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.

Adhesive anchors in hollow masonry shall utilize screen tubes as recommended by the manufacturer.

PART 3 - EXECUTION

3-1. GENERAL. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before tightening of the nuts.

3-2. CAST-IN-PLACE ANCHOR BOLTS. Cast-in-place anchor bolts shall be carefully positioned with templates and secured in the forms prior to placing concrete. Contractor shall verify that anchorage devices are positioned in accordance with the design drawings and with applicable equipment submittal drawings. Bolts shall be positioned sufficiently in advance of the concrete placement so that an on-site representative of Engineer or Owner will have sufficient time to inspect the bolts prior to placing concrete. If Special Inspection of the anchor bolts is required by the local building code, anchorage shall be placed in sufficient time and with sufficient notification so that such inspection can take place without delaying progress of the work.

Threads, bolts, and nuts spattered with concrete during placement shall be cleaned prior to final installation of the bolts and nuts.

3-3. EPOXY GROUT. Epoxy grout components shall be packaged separately at the factory and shall be mixed immediately before use. Proportioning and mixing of the components shall be done in accordance with the manufacturer's recommendations.

3-3.01. Preparation. Where indicated on the drawings, anchor bolts and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

Item	Diameter of Hole
Anchor Bolts and Reinforcing Bars	1/8 inch larger than the outside diameter of the bolt or bar.

The embedment depth for epoxy grouted anchor bolts and reinforcing bars shall be at least 15 bolt or bar diameters, unless otherwise indicated on the drawings.

Holes shall be prepared for grouting as recommended by the epoxy grout manufacturer.

3-3.02. Installation. Anchor bolts and reinforcing bars shall be clean, dry, and free of grease and other foreign matter when installed. The bolts and bars shall be set and the epoxy grout shall be placed in accordance with the recommendations of the grout manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids.

3-4. ADHESIVE ANCHORS. The embedment depth for adhesive anchors shall be at least 15 rod diameters unless otherwise indicated on the drawings.

Adhesive for adhesive anchors shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

Anchors shall be installed in holes drilled into hardened concrete or grout filled masonry. Diameter of holes shall be 1/16 inch larger than the outside diameter of the rod unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared for insertion of the anchors by removing all dust and debris using procedures recommended by the adhesive manufacturer.

Adhesive anchors and holes shall be clean, dry, and free of grease and other foreign matter at the time of installation. The adhesive shall be placed and the rods shall be set in accordance with the recommendations of the material manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids.

3-5. EXPANSION AND UNDERCUT ANCHORS. Expansion and undercut anchors shall be installed in accordance with the drawings, but in no case shall the embedment depth be less than six bolt diameters. The minimum distance between the center of any anchor and an edge or exterior corner of concrete shall be at least six times the diameter of the bolt. Unless otherwise indicated on the drawings, the minimum distance between the centers of anchors shall be at least 12 times the diameter of the bolt.

End of Section

Section 05990

STRUCTURAL AND MISCELLANEOUS METALS

PART 1 - GENERAL

1-1. SCOPE. This section covers the fabrication and erection of structural and miscellaneous metal items not covered in other sections.

Except as otherwise specified or indicated on the drawings, all work shall conform to the applicable provisions of the AISC "Manual of Steel Construction - Allowable Stress Design", Parts 1, 2, 3, and 4, the AISC "Specification for Structural Steel Buildings" and the Aluminum Association "Specifications for Aluminum Structures".

Special inspection during the fabrication and erection of structural steel, if required by the local building code, is addressed in the quality control section.

Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

1-2. SUBMITTALS. Complete data, fabrication drawings, and setting or erection drawings covering all structural and miscellaneous metal items shall be submitted in accordance with Section 01300 - Submittals.

All bolted connections and welds shall be properly identified on the shop drawings. Welding procedures, welding procedure qualification records and welder qualifications shall be submitted.

Submittals for high strength bolts, tension control bolts and load indicator washers shall include statements from the bolt and washer manufacturers certifying satisfactory compliance with the governing standards and the specified tests.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, significant coating damage, or corrosion. Damaged materials shall be promptly replaced. Structural and miscellaneous metal work shall be stored on blocking so that no metal touches the ground and water cannot collect thereon. The material shall be protected against bending under its own weight or superimposed loads.

Bolting materials shall be stored indoors. Weld rod shall be stored in accordance with the supplier's instructions and AWS D1.1.

1-4. PLANT CERTIFICATION. All fabricating plants providing structural steel shall be category Sbd certified in accordance with the AISC Quality Certification Program.

PART 2 - PRODUCTS

2-1. GENERAL. All structural steel shall be detailed and fabricated to facilitate compliance with OSHA 29 CFR Part 1926 subpart R and all other pertinent OSHA and local safety regulations.

All field connection materials shall be furnished.

2-2. MATERIALS.

Steel

Shapes (W, WT)	ASTM A992
Shapes (S, M, HP, C)	ASTM A36 or ASTM A572 Grade 50.
Other Shapes (angles)	ASTM A36
Plates and Bars	ASTM A36.
Sheets	ASTM A1008 CS Type B or A1011 CS Type B.
Pipe	ASTM A53, Type E or S, Grade B; ASTM A500, Grade B or C; or ASTM A501.
Square and Rectangular Structural Tubing	ASTM A500, Grade B or C.
Checkered Plate	ASTM A786, carbon steel, skid resistant pattern as standard with the manufacturer; Inland "4-way Floor Plate" or U.S. Steel "Multigrip Floor Plate".
Bolts and Nuts	
Bolts, High Strength	ASTM A325, Type 1; tested in

	accordance with Article 9.2 thereof.
Bolts, Tension Control Type (Twist off)	ASTM F1852. Equivalent to ASTM A325
Bolts, unfinished	ASTM A307.
Nuts, Heavy-Hex	ASTM A563, grade and finish compatible with bolts.
Nuts; Self-Locking	Prevailing torque type; IFI-100, Grade A.
Washers	
Flat, Hardened	ASTM F436, Type 1.
Lock	ANSI/ASME B18.21.1, helical spring type.
Beveled	ASTM F436.
Load Indicator	ASTM F959, compressible-washer-type direct tension indicator; type compatible with bolts tested in accordance with Article 10.2 of ASTM F959.
Anchor Bolts	ASTM F1554, Grade 36
Threaded Rods	ASTM A36
Forged Steel Clevises and Turnbuckles	AISI C-1035
Forged Steel Eyebolts and Eyenuts	AISI C-1030, ANSI B 18.15 Type 2 shoulder pattern unless otherwise required
Forged Steel Sleeve Nuts	AISI C-1018, Grade 2
Stainless Steel	
Shapes	ASTM A276, Type 316L.
Plates	ASTM A240, Type 316L.

Pipe	ASTM A312, Grade TP316L
Tube	ASTM A269, Grade TP316L
Checkered Plate	ASTM A793, stainless steel, raised pattern A
Bolts	ASTM F593, Alloy Group 1 or 2
Nuts	ASTM F594, Alloy Group 1 or 2
Washers	
Flat	ANSI/ASME B18.22.1, Type 316.
Lock	ANSI/ASME B18.21.1, helical spring type, Type 316.
Cast Iron	ASTM A48, Class 35B or better.
Aluminum	
Sheet and Plate	ASTM B209, Alloy 6061-T6.
Rolled Sections	ASTM B308, Alloy 6061-T6. All members shall be Aluminum Association standard shapes.
Rod and Bar (Rolled or Drawn)	ASTM B211, Alloy 6061-T6 or 2017-T4.
Extrusions	ASTM B221, Alloy 6063-T5 or T6.
Pipe	ASTM B429, Alloy 6061-T6.
Rivets	ASTM B316, Alloy 6061-T6.
Bolts, Aluminum	ASTM F468, Alloy 2024-T4.
Nuts, Aluminum	ASTM F467, Alloy 6061-T6.
Washers, Aluminum	
Flat	ANSI/ASME B18.22.1, Type 6061 T-6.

Lock	ANSI/ASME B18.21.1, helical spring type, Type 6061-T6.
Castings	ASTM B26 or B85.
Checkered Plate	ASTM B632, Type 6061-T6.
Brass or Bronze	
Plate and Strip	ASTM B36.
Casting	ASTM B61 or B584
Bolts and Nuts	IFI-104, Grade 462 or 464.
Washers	
Flat	ANSI/ASME B18.22.1
Lock	ANSI/ASME B18.21.1, helical spring type.
Silicon Bronze	
Sheet and Plate	ASTM B96, American Brass "Everdur 1010".
Castings	ASTM B584, American Brass "Everdur 1000".
Bolts and Nuts	IFI-104, Grade 655.
Washers	
Flat	ANSI B18.22.1.
Lock	ANSI/ASME B18.21.1, helical spring type.
Weld Metal (Steel Connections)	ANSI/AWS D1.1, Table 3.1, filler metal with minimum 70 ksi tensile strength unless otherwise required.
Welded Headed Studs, Concrete Anchors, and Shear Connectors	ASTM A108 with a minimum 50,000 psi yield strength and minimum 60,000 psi tensile strength.

	TRW/Nelson or equal.
Deformed Bar Anchors (DBA)	ASTM A496 with a minimum 70,000 psi yield strength and minimum 80,000 psi tensile strength. TRW/Nelson division or equal.
Rails	
Crane	ASTM A1.
Railroad	ASTM A1.
Bird Screen	2 mesh brass or copper wire cloth, min wire dia 0.063 inch.
Body Solder	Flux-core wire, ASTM B32, Alloy Grade 20B.
Shop Coatings	
Universal Primer	As indicated in protective coatings section.
Epoxy Enamel	As indicated in protective coatings section.
Galvanizing	ASTM A123, A153, A385.

2-3. FABRICATIONS. The following fabrications shall be constructed as indicated on the drawings and as specified herein.

2-4. SHOP COATING. All structural and miscellaneous metal items shall be shop coated as specified herein. The requirements for field painting are covered in the Protective Coatings section.

2-4.01. Cleaning. Surfaces shall be dry and of proper temperature when coated, and shall be free of grease, oil, dirt, dust, grit, rust, loose mill scale, weld flux, slag, weld spatter, and other objectionable substances. Articles to be galvanized shall be pickled before galvanizing. All other ferrous metal surfaces shall be cleaned by solvent, high-speed power wire brushing or by blasting to the extent recommended by the paint manufacturer and as required in the Protective Coatings section.

2-4.02. Edge Grinding. Sharp projections of cut or sheared edges of ferrous metals which will be submerged in operation, except for items specified to be hot-

dip galvanized, shall be ground to a radius as needed to ensure satisfactory paint adherence and as required in the Protective Coatings section.

2-4.03. Prime Painted Steel. Unless otherwise specified or indicated on the drawings, all ungalvanized structural and miscellaneous steel shall be given a universal prime coat in the shop after fabrication. The dry film thickness of the universal primer shall be at least 5 mils. Steel surfaces shall be prime-coated as soon as practicable after cleaning. Steel shall not be moved or handled until the shop coat is dry and hard.

2-4.04. Galvanizing. Steel materials required to be galvanized are indicated on the drawings. All galvanizing shall be done by the hot-dip process after fabrication. An approved zinc-rich paint shall be used to touch up minor coating damage. Materials with significant coating damage shall be regalvanized or replaced.

Where galvanized bolts are indicated on the drawings or specified, the use of zinc-plated bolts will not be acceptable.

2-4.05. Stainless Steel. Unless otherwise specified, all items fabricated from stainless steel shall be thoroughly cleaned and degreased after fabrication. Pickling or a light blast cleaning shall produce a modest etch and remove all embedded iron and heat tint. Surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron and shall be retreated as needed to remove all traces of iron contamination. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

2-4.06. Aluminum. All surfaces of aluminum which will be in contact with concrete, mortar, or dissimilar metals shall be given a coat of epoxy enamel.

2-4.07. Castings. Shop coating of miscellaneous iron castings will not be required.

2-4.08. Other Surfaces. Painting of zinc coated steel or bronze surfaces will not be required.

PART 3 - EXECUTION

3-1. STRUCTURAL STEEL ERECTION. Structural steel shall be erected so that individual pieces are plumb, level, and aligned within a tolerance of 1:500. The elevations of the top of floor and roof members shall be within 1/16 inch of the elevations indicated on the drawings. The faces of girts and other supporting members for rigid wall panels shall be in vertical planes within a maximum variation of 1/8 inch.

All members and parts, as erected, shall be free of warps, local deformations, and unauthorized bends. All parts shall be assembled accurately as indicated on the drawings. Light drifting will be permitted to draw parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills and only with the approval of ENGINEER. Enlarging holes by burning will not be permitted.

Baseplates shall be set level in exact position and grouted in place.

All materials shall be erected in compliance with OSHA 29 CFR, Part 1926, Subpart R, and with all other applicable OSHA and local safety regulations.

3-1.01. Inspection and Testing. When the Quality Control section indicates that special inspections are required, such inspections shall be performed for field fabrication and erection of structural and miscellaneous metals, and for all structural steel field connections. The erector shall provide access as needed to facilitate all inspections and shall provide timely notification during erection when inspection milestones are approaching.

3-2. STRUCTURAL STEEL CONNECTIONS. Unless otherwise indicated on the drawings, bolted connections for structural steel, as defined in the AISC manual, shall be made with ASTM A325 high strength bolts conforming to the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Structural Connections. The method of installation, pretensioning procedures, bolting equipment and tools shall likewise conform to the above referenced standard.

Except as otherwise indicated on the drawings or specified herein, bolted connections shall be bearing type with threads excluded from the shear plane. Slip critical connections shall be used in diagonal bracing connections, where slip critical connections are indicated on the drawings, and where oversize holes or slotted holes parallel to the direction of the load are used.

Bolts in all structural steel connections, both bearing and slip critical, shall be fully pretensioned in accordance with the AISC standards unless specifically noted otherwise on the drawings. The turn-of-the-nut method or load-indicator washers shall be used to verify pretensioning of bolts in bearing type connections. When using turn-of-the-nut method the bolt, nut, and material shall be match marked. A wax lumber marker or paint shall be used to clearly mark the assembly. The calibrated wrench method of pretensioning bolts will not be permitted.

Load indicator washers shall be used to verify pretensioning of bolts in slip critical connections. Load indicator washers shall be installed in accordance with the manufacturer's recommendations, as supplemented herein. To facilitate proper tightening of fastener assemblies with load indicator washers, a hardened flat washer shall be installed under the turned element (bolt head or nut) and between the turned element and the load indicator washer protrusions, in all cases. Whenever possible, the load indicator washer shall be installed on the head end of the bolt. If the bolt head will not be visible for inspection of the indicator washer after installation, or if the bolt head must be turned to tighten the assembly, the load indicator washer may be installed on the nut end of the bolt.

Tightening of each connection assembly shall progress systematically from the most rigid part of the joint toward the free edges until all have been sufficiently rotated or the load indicator washers on all bolts have been closed to the average gap stipulated by the load indicator washer manufacturer.

If approved by the Engineer, patented tension control type (twist-off) bolts may be used in bolted connections. Bolts shall be of equivalent size and strength to the indicated high strength bolts, and shall be installed in strict accordance with the manufacturer's instructions.

Bolt holes shall have a diameter nominally 1/16 inch larger than the nominal bolt diameter. Bolt holes for one ply of vertical diagonal bracing connections may be oversized to a diameter nominally 3/16 inch larger than the nominal bolt diameter. If oversized holes are provided in an outer ply, a hardened flat washer shall be installed over each hole during bolting. Load indicator washers shall not be substituted for hardened flat washers required for oversized holes.

Contact surfaces of slip critical connections shall not be shop coated. Contact surfaces of bearing type connections may be shop coated. When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts, or washers, shall be free of loose mill scale, dirt, burrs, oil, and other foreign material that would prevent solid seating of the parts.

Beveled washers shall be used when the bearing faces of bolted parts have a slope of 1:20 or greater with respect to a plane perpendicular to the bolt axis. Bolt length shall be increased as needed to accommodate the beveled washers.

Bolts, nuts, and washers shall be galvanized when connected materials are galvanized or where indicated on the drawings.

3-3. MISCELLANEOUS STEEL CONNECTIONS. Connections for miscellaneous steel fabrications not included in the AISC definition of structural steel may be made with unfinished bolts unless indicated otherwise on the

drawings. Unless otherwise indicated on the drawings all unfinished bolts shall be snug tight.

3-4. STRUCTURAL AND MISCELLANEOUS STEEL WELDING. Welding and related operations shall conform to applicable provisions of the Structural Welding Code - Steel, AWS D1.1, of the American Welding Society. All welding shall be performed in accordance with written procedures, using only those joint details which have prequalified status when performed in accordance with AWS D1.1. All welding shall be performed by welders qualified in accordance with the American Welding Society for steel welding and American Society for Mechanical Engineers Section IX for stainless steel welding.

All welds shall be visually inspected in accordance with AWS procedures.

Welds not dimensioned on the drawings shall be sized to develop the full strength of the least strength component of the connection.

Where structural or miscellaneous steel connections are welded, all butt and miter welds shall be continuous and, where exposed to view, shall be ground smooth. Intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.

Surfaces to be welded and surfaces within 2 inches of a weld shall be free from loose or thick scale, slag, rust, moisture, grease, paint and other foreign materials that would prevent proper welding or release objectionable fumes.

Only shielded metal arc, gas metal arc, flux cored arc, submerged arc, and gas tungsten arc welding are permitted. For flux cored arc welding, only E70xx one (1) or five (5) wire electrodes with supplemental gas shielding shall be permitted. Use of electroslag or electrogas welding processes or the short-circuiting transfer mode of the gas metal arc process will not be acceptable.

Field welded connections shall not be substituted for field bolted connections indicated on the drawings.

Deformed bar anchors, headed studs, concrete anchors and shear connectors shall be welded with an automatic stud welding gun per the manufacturer's recommendation. Hand welding will not be acceptable.

3-5. STRUCTURAL AND MISCELLANEOUS ALUMINUM. Unless otherwise noted, all work shall conform to applicable provisions of the Aluminum Association "Standard for Aluminum Structures".

3-5.01. Connections. Connections not specifically detailed on the drawings shall develop the full strength of the least strength member of the connections. Bolted

connections shall be all-bolted bearing type, equipped with a helical spring lock washer under the stationary element (bolt head or nut) and a flat washer under the turned element. All bolts shall be fully tightened. Bolts and nuts for structural aluminum connections shall be stainless steel. Bolts and nuts for nonstructural miscellaneous aluminum assemblies shall be stainless steel or aluminum. A sufficient number of bolts shall be provided in each connection to develop the shear strength of the member.

Welded connections shall be made in accordance with the American Welding Society D1.2, Structural Welding Code – Aluminum. All welding shall be performed by welders qualified in accordance with American Welding Society. Welds shall be free of porosity, cracks, holes, and flux. Welded connections shall not be substituted for bolted connections without prior approval of ENGINEER.

3-5.02. Erection. Structural aluminum shall be erected so that individual pieces are plumb, level, and aligned within a tolerance of 1:500. The elevation of horizontal members shall be within 1/16 inch of the elevation indicated on the drawings.

Baseplates shall be set level in exact position and grouted in place.

End of Section

Section 07160

DAMPPROOFING

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing and installation of dampproofing for concrete.

Dampproofing of concrete surfaces exposed to water in potable water treatment, distribution, or pumping facilities, shall be with NSF certified epoxy enamel, and shall be in accordance with the Protective Coatings section. Waterproofing is covered in Section 09886 – Elastomeric High-Solids Urethane Lining Systems.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials to be used shall be as follows:

Medium Consistency Coal Tar	Carboline "Bitumastic 50", Polyguard "CA-14 Coating", or Tnemec "46-465 H. B. Tnemecol".
Coal Tar Epoxy	Ameron "Amercoat 78HB Coal Tar Epoxy, Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy"
Epoxy Enamel	As specified in Section 09940 – Protective Coatings

2-2. SURFACES TO BE DAMPPROOFED. Exterior wall surfaces which are poured against sheeting or undisturbed earth need not be dampproofed. The following concrete surfaces that are not in contact with treated or potable water shall be dampproofed:

a. All exterior concrete wall surfaces forming a part of an interior room or dry pit which will be in contact with earth backfill below finished grade and above the top of the footings or bottom slabs.

b. All exterior wall surfaces of cast-in-place and precast concrete electrical manholes and handholes below finished grade and above the top of the footings or bottom slabs.

c. All walls in contact with liquid where the opposite face is above grade or exposed in an interior room, except when waterproofing is specified.

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. When dampproofing is applied, concrete surfaces shall be clean and dry. All dirt, dust, sand, grit, mud, oil, grease, and other foreign matter shall be removed in accordance with ASTM D4258 and the surface abraded when recommended by the manufacturer of the dampproofing material. Abrading shall be done in accordance with ASTM D4259. Prior to application of the coating, the surfaces shall be thoroughly washed, or cleaned by air blasting, to remove all dust and residue.

3-2. APPLICATION. Dampproofing materials shall not be thinned unless recommended by the manufacturer. Dampproofing using medium consistency coal tar or coal tar epoxy shall be applied in at least two coats, with a total dry film thickness of at least 20 mils.

Surfaces not intended to be dampproofed shall be protected from contamination, discoloration, or other damage. Such surfaces shall be masked as necessary to protect uncoated areas and to confine the dampproofing to the intended limits.

Surfaces shall be dry and at recommended temperature when dampproofing is applied. Unless properly protected, coatings shall not be applied in wet, damp, or foggy weather or when windblown dust, dirt, or debris, or insects would collect on the coating. Dampproofing shall not be applied when the temperature of the air or the surface is below 40°F.

Dampproofing shall be applied by brush, high pile rollers, or spray equipment complying with the manufacturer's recommendations. If blistering occurs, all blisters larger than 1/4 inch in diameter shall be broken before the subsequent coat is applied.

End of Section

Section 07900

CAULKING

PART 1 - GENERAL

1-1. SCOPE. This section covers caulking and sealing. Fire rated caulking is covered in the fireproofing section.

1-2. GENERAL. The terms "caulking" and "sealing", as used on the drawings and in these specifications, are synonymous. Both terms indicate the materials specified herein. Oil-base caulking shall not be used on this project.

1-3. APPROVALS. All caulking shall meet the requirements of the standards specified herein. All caulking and sealing to be used in contact with potable water shall meet the requirements of ANSI/NSF Standard 61.

1-4. SUBMITTALS. Specifications and data covering the materials proposed for use, together with samples or color cards showing the manufacturer's full line of sealant colors, shall be submitted in accordance with Section 01300 – Submittals.

PART 2 - PRODUCTS

2-1. MATERIALS.

Thiokol Sealants (polysulfides)	Fed Spec TT-S-00227E, Class A or ASTM 920 Type M; polysulfide rubber, two component.
Nonsag	
Submerged Service, Non potable water	Pecora "Synthacalk GC-2+" Sonneborn "Sonolastic Polysulfide Sealant"
Nonsubmerged Service	Pecora " Synthacalk GC-2+" Sonneborn "Sonolastic Polysulfide Sealant" Polymeric Systems "PSI-350"

Self-Leveling, Nonsubmerged	A.C. Horn "Hornflex Traffic Grade" Polymeric Systems "PSI-350"
Urethane Sealants (Polyurethanes)	Fed Spec TT-S-00227E, Class A, Type 2 and ASTM C920, Type M, Grade NS; two component.
Nonsag	
Submerged Service Potable Water	Polymeric Systems "RC-270", Sika "Sikaflex-2cNS
Nonpotable Water	Pecora "Dynatred" Polymeric Systems "RC-270".
Nonsubmerged Service	Bostik "Chem-Calk 500" Tremco "Vulkem 227" Pecora "Dynatrol II" Tremco "DYmeric 240" Sika "Sikaflex-2cNS"
Self-Leveling, Nonsubmerged	Bostik "Chem-Calk 550" Tremco "Vulkem 245" Pecora "Urexpan NR-200" Polymeric Systems " RC-2SL" Tremco "THC-900"
Acrylic Sealant	Fed Spec TT-S-230; ASTM C834 Bostik "Chem-Calk 600" Pecora " AC20" Tremco "Mono 555"
Silicone Sealant	Silicone rubber, neutral color; Dow Corning "Mildew-Resistant silicone 786", General Electric "Silicone Sanitary 1702 Sealant".
Primer	As recommended by the sealant manufacturer.

Backup Material	Polyethylene or polyurethane foam as recommended by the sealant manufacturer; Dow "Ethafoam SB" or Plateau "Denver Foam".
Bondbreaker Tape	Adhesive-backed polyethylene tape as recommended by the sealant manufacturer.

2-2. COLORS. Colors of sealants shall be as selected by Engineer from the manufacturer's standard line of colors. Different colors may be required for different locations.

2-3. LOCATIONS TO BE CAULKED.

2-3.01. With Thiokol or Urethane Sealant (Nonsag) - Submerged Service.

All joints requiring caulking in submerged locations.

2-3.02. With Thiokol or Urethane Sealant (Nonsag) - Nonsubmerged Service.

Control joints in masonry walls.

Joints between masonry and cast-in-place concrete, where indicated on the drawings.

Other locations where caulking is indicated on the drawings, specified in other sections, or required for weatherproofing.

2-3.03. With Thiokol or Urethane Sealant (Self-Leveling).

Horizontal joints in walks or drives.

Horizontal joints in traffic-bearing decks and slabs.

Annular space around handrail posts set in sleeves.

2-3.04. With Acrylic Sealant.

Watertight joints in sheet metal work.

PART 3 - EXECUTION

3-1. JOINT PREPARATION. All surfaces to receive sealant shall be clean, dry, and free from dust, grease, oil, or wax. Concrete surfaces which have been contaminated by form oil, paint, or other foreign matter which would impair the bond of the sealant to the substrate shall be cleaned by sandblasting. All surfaces shall be wiped with a clean cloth saturated with xylol or other suitable solvent, and shall be primed before the sealant is applied.

Unless otherwise recommended by the sealant manufacturer and permitted by the Engineer, the depth of sealant in a joint shall be equal to the width of the joint, but not more than 1/2 inch. Backup material shall be provided as necessary to control the depth of sealant and shall be of suitable size so that, when compressed 25 to 50 percent, the space will be filled. Backup material shall be rolled or pressed into place in accordance with the manufacturer's installation instructions, avoiding puncturing and lengthwise stretching. If depth of the joint does not permit use of backup material, bondbreaker tape shall be placed at the bottom of the joint to prevent three-sided adhesion.

3-2. SEALING. Sealing work shall be done before any field painting work is started. The air temperature and the temperature of the sealed surfaces shall be above 50°F when sealing work is performed.

Upon completion of the sealing work, each sealed joint shall have a smooth, even, tooled finish, flush with the edges of the sealing recess, and all adjacent surfaces shall be clean. Sealant shall not lap onto adjacent surfaces. Any sealant so applied as to prevent the painting of adjacent surfaces to a clean line, or with an excess of material outside the joint and feathered onto surfaces, shall be removed and the joint resealed.

End of Section

Section 09940

PROTECTIVE COATINGS

PART 1 - GENERAL

1-1. SCOPE. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy-duty maintenance coatings. Regardless of the number of coats previously applied, at least two field coats in addition to any shop coats or field prime coats shall be applied to all surfaces unless otherwise specified.

1-2. GENERAL. Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the manufacturer's minimum recommendations. When equivalent products are acceptable to Engineer, Contractor shall comply with this specification and the coating manufacturer's recommendations.

1-2.01. Governing Standards. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of the following AWWA, ANSI, NACE, SSPC, NSF, and ASTM.

1-2.02. Delivery and Storage. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

1-2.03. Coatings, Painting, and Linings Covered in Other Sections.

Dampproofing of concrete when NSF compliance is not required.

1-3. SUBMITTALS. Contractor shall submit color cards for all coatings proposed for use, together with complete descriptive specifications and the completed Coating System Data Sheets, to Engineer for review and color selection. Requests for review submitted directly to Engineer by coating suppliers will not be considered.

When the proposed products will be in contact with treated or raw water in potable water treatment facilities, Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.

Contractor shall submit a Coating System Data Sheet for each separately identified surface in the Coating Schedule that will be used in the project, using the appropriate Coating System Data Sheet forms (Figures 1-09940 and 2-09940) at the end of this section. Each field coating system shall be acceptable to the coating material manufacturer. Each Coating System Data Sheet shall include application temperature limits including recoat time requirements for the ambient conditions at the site, including temperatures up to 130°F. Temperature requirements shall be specified by the coating manufacturer.

Each proposed coating system shall be assigned a unique number with a prefix letter based on the following:

Prefix	Surfaces	Figure
A	Iron and steel	2
C	Concrete and concrete block	1
E	Equipment - submerged nonsubmerged	1 2
F	Nonferrous metal	1
G	Galvanized	1
H	High temperature	1
P	PVC and FRP	1

Each coating system that will be applied entirely in the field shall be assigned only a prefix letter and no suffix letter. When appropriate under the indicated conditions, the following suffix shall be added to the coating system numbers:

-F Each shop-applied coating system that includes a finish coat applied in the field.

A separate Coating System Data Sheet shall be developed and submitted for each variation or change in a coating system or surface to be coated.

For the epoxy enamel and for aliphatic polyurethane, a total of not more than 15 custom colors (excluding deeptone or high-level colors) may be required. The manufacturer's standard colors will be acceptable for all other coatings.The manufacturer's standard colors will be acceptable for all coatings.

1-4. QUALITY ASSURANCE.

1-4.01. Coating System Data Sheet Certifications. The coating applicator and coating manufacturer shall review and approve in writing the coating manufacturer's written recommendations for the coating system and the intended service. Any variations from the specifications or the coating manufacturers published recommendations shall be submitted in writing and approved by the coating manufacturer. The coating manufacturer shall observe the surface preparation, mixing, and application of the coating systems and submit a written report of his observations and any additional recommendations.

1-4.02. Special Interior Coating Systems. Not used.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS.

2-1.01. Alternative Manufacturers. In addition to the coatings listed herein, equivalent products of the following manufacturers will also be acceptable:

PPG
Sigma
Rust-Oleum

2-1.02. Equivalent Coatings. Whenever a coating is specified by the name of a proprietary product or of a particular manufacturer or vendor, it shall be understood as establishing the desired type and quality of coating. Other manufacturers' coatings will be accepted, provided that sufficient information is submitted to enable Engineer to determine that the proposed coatings are equivalent to those named. Information on proposed coatings shall be submitted for review in accordance with the Submittals section. Requests for review of equivalency will be accepted only from Contractor, and will be considered only after the contract has been awarded.

2-2. MATERIALS. All coatings shall be delivered to the job in original, unopened containers, with labels intact. Coatings shall be stored indoors and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating for any purpose.

All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

The coatings specified have been selected on the basis of the manufacturer's statement that the VOC content of the product is 2.8 lbs per gallon or less; however, it shall be the Contractor's responsibility to use only coating materials that are in compliance with the requirements of all regulatory agencies. Local regulations may require some coatings to have a lower VOC content than specified herein. The coatings specified may meet the VOC limits in the unthinned (as shipped) condition, but may exceed the limits if thinned according to the manufacturer's recommendations. In such case, the coatings shall not be thinned beyond the 2.8 lbs per gallon limit, and if the product cannot be thinned to suit the application method or temperature limits, another manufacturer's coating shall be used, subject to acceptance by Engineer.

Contractor shall be responsible for ensuring the compatibility of field coatings with each other or with any previously applied coatings. Coatings used in successive field coats shall be produced by the same manufacturer. The first field coat over shop coated or previously coated surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

All coatings used on surfaces that will be in contact with potable or treated water shall be certified as being in compliance with ANSI/NSF 61. Coatings that cannot be so certified, whether or not specified by manufacturer and by product designation, shall not be used.

2-2.01 Primers.

Universal Primer	Ameron "Amercoat 385 Epoxy", Carboline "Rustbond", ICI Devoe "Devran 224HS" Tnemec "Series 27 F.C. Typoxy", or Sherwin-Williams "Macropoxy 646".
Epoxy Concrete Block Filler	Ameron "Amerlock 400BF Epoxy Block Filler", Carboline "Sanitile 600", ICI Devoe "Blox Filler 4000", Tnemec "Series 54-660", or Sherwin-Williams "Kem Cati-Coat HS".
Epoxy Concrete Filler and Surfacer	Tnemec "Series 63-1500", Ameron NuKlad 114A, or Carboline "Carboguard 510".

2-2.02. Intermediate and Finish Coatings.

Epoxy Enamel (NSF certified systems)	
Ferrous Metal Surfaces and Concrete Surfaces in Contact with Treated or Raw Water in Potable Water Facilities	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", ICI Devoe "Bar-Rust 233H" Tnemec "Series N140 Pota-Pox Plus", or Sherwin-Williams "Macropoxy 646NSF"; immersion service.
Epoxy Enamel	
Concrete Floors	Ameron "Amerlock 400", Carboline "Carboguard 890", ICI Devoe "Devran 224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Armorseal 1000HS"; nonskid.
Ferrous Metal Surfaces and Masonry or Concrete Surfaces Other Than Floors	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", ICI Devoe Devran "224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Macropoxy 646".
Aliphatic Polyurethane	Ameron "Amercoat 450H", Carboline "Carbothane 134HG", ICI Devoe "Devthane 379H" Tnemec "Series 1074 Endura-Shield II", or Sherwin-Williams "Acrolon 218HS".
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol".

Vinyl Ester	Tnemec "Series 120 Vinester" Carboline "Plasite 4110" or Sherwin-Williams "Magnalux 304FF".
Heat-Resistant	Suitable for temperatures up to 400°F; Ameron "Amerlock 400", Carboline "Thermaline 450", Tnemec "43-36 Chrome Aluminum", or Sherwin-Williams "Silver-Brite Aluminum".
High Heat-Resistant	Suitable for temperatures up to 1000°F; Ameron " Amercoat 878", Carboline "Thermaline 4700 VOC", Tnemec "Series 39 Silicone Aluminum" or Sherwin-Williams "Silver-Brite Hi-Heat Silicone Aluminum".

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Freshly coated surfaces shall be protected from dust and other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss on previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film, except for concrete block construction where a rough surface is an inherent characteristic.

smooth transition that will not be noticeable after the coating is applied. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

3-1.01. Galvanized Surfaces. Galvanized surfaces shall be prepared for coating according to the instructions of the manufacturer of the epoxy enamel. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clean water.

3-1.02. Ferrous Metal Surfaces. Ungalvanized ferrous metal surfaces shall be prepared for coating by using one or more of the following cleaning procedures as specified: solvents (SSPC-SP1); blasting (SSPC-SP5, -SP6, -SP7, or -SP10);

power tools (SSPC-SP3 or -SP11); or hand tools (SSPC-SP2). Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components that will be inaccessible after installation shall have the surfaces prepared and coated before installation. Motors, drive trains, and bearings shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

All cut or sheared edges shall be ground smooth to a 1/8 inch minimum radius for all material 1/4 inch thickness and larger. For material thickness less than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch will not be required.

All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard RPO178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as required by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory adhesion of paint.

The cleaning methods and surface profiles specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement.

3-1.02.01. Ferrous Metal Surfaces – Non-immersion Service. Ferrous metal surfaces, including fabricated equipment, in non-immersion service shall be cleaned to the degree recommended by the coating manufacturer for surfaces to be coated with coal tar epoxy, epoxy enamel, and heat-resistant coatings, except galvanized surfaces. Blast cleaning to at least SSPC-SP6 shall be used where recommended by the coating manufacturer, and may be used elsewhere at the option of Contractor, provided that no dust is permitted to settle on adjacent wet coating. Surface profile shall be as recommended by coating manufacturer, but not less than 2 mils.

3-1.02.02. Ferrous Metal Surfaces - Immersion Service. Surface preparation of ferrous metal surfaces in immersion service shall consist of blast cleaning to at least SSPC-SP10 and the first application of coating shall be performed on the

same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 3.5 mils.

3-1.03. Concrete Surfaces. All concrete surfaces shall be free of objectionable substances and shall meet the coating manufacturer's recommendations for surface preparation. Any other surface preparation recommended by the coating material manufacturer shall be brought to Engineer's attention and may be incorporated into the work if acceptable to Engineer.

All concrete surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, and other objectionable substances. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started.

New concrete shall have cured for at least 4 weeks before coating is applied as recommended by the material manufacturer. Concrete surfaces shall be tested for capillary moisture in accordance with ASTM D4263. There shall be no capillary moisture when coatings are applied on concrete.

All surfaces to be coated shall be cleaned in accordance with ASTM D4258 and abraded in accordance with ASTM D4259. Surface profile shall be at least 25 percent of the dry film thickness specified for the coating system. Prior to application of the coating, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue. Spalled areas, voids, and cracks shall be repaired in accordance with the Concrete section and as acceptable to the Engineer. Fins and other surface projections shall be removed to provide a flush surface before application of coating.

Except where epoxy enamel is applied as damp-proofing, the concrete surfaces, including those with bug holes less than 1 inch in any dimension, shall be prepared when required and as recommended by the manufacturer, using an epoxy concrete filler and surfacer. Where coating with a vinyl ester the concrete filler and surfacer shall be as recommended by the manufacturer to be compatible with vinyl ester.

3-1.04. Concrete Block Surfaces. Voids and openings in concrete block surfaces shall be pointed. All exposed exterior surfaces and surfaces to be coated with epoxy enamel, including the joints, shall be filled so that a continuous unbroken coating film is obtained.

3-1.05. Copper Tubing. All flux residue shall be removed from joints in copper tubing. Immediately before coating is started, tubing shall be wiped with a clean rag soaked in xylol.

3-1.06. Plastic Surfaces. Not used. All wax and oil shall be removed from plastic surfaces that are to be coated, including PVC and FRP, by wiping with a solvent compatible with the specified coating.

3-1.07. Hardware. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to coating if there is no evidence of dirt, corrosion, or foreign material.

3-1.08. Aluminum. When a coating system is required, remove all oil or deleterious substance with neutral detergent or emulsion cleaner or blast lightly with fine abrasive.

3-1.09. Stainless Steel. When a coating system is required, surface preparation shall conform to the coating manufacturer's recommendations.

3-2. MIXING AND THINNING. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

3-3. APPLICATION. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be thoroughly dry and hard before the next coat is applied. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.

3-3.01. Priming. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) of primer before application of the primer coat. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating.

Abraded and otherwise damaged portions of shop-applied coating shall be cleaned and recoated as recommended by the manufacturer of the finish coating. Welded seams and other uncoated surfaces, heads and nuts of field-installed bolts, and surfaces where coating has been damaged by heat shall be given a brush coat of the specified primer. Before the specified spot or touchup coating of metal surfaces, edges, corners, crevices, welds, and bolts in the area of the spot or touchup coating shall be given a brush coat of primer. This patch, spot, or touchup coating shall be completed, and the paint film shall be dry and hard, before additional coating is applied.

3-3.02. Epoxy Enamel. When used, epoxy enamel shall be applied in accordance with the coating manufacturer's recommendations, including temperature limitations and protection from sunlight until top-coated.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

When applying high build epoxy coatings with a roller or brush and where a dry film thickness of at least 4-6 mils per coat is required, two or more coats shall be applied to achieve the recommended dry film thickness equal to a spray applied coating.

3-3.03. Coal Tar Epoxy. When used, the application of coal tar epoxy, including time limits for recoating, shall conform to the recommendations of the coating manufacturer.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

3-3.04. Vinyl Ester. When used, the application of vinyl ester coating system, including time limits for recoating and temperature requirements of the materials, shall conform to the recommendations of the coating manufacturer.

3-3.05. Film Thickness. The total coating film thickness including intermediate coats and finish coat, shall be not less than the following:

Type of Coating	Minimum Dry Film Thickness
Medium consistency coal tar	20 mils.
Coal tar epoxy (two coats)	20 mils.
Epoxy enamel	
Floors	5 mils.
Surfaces with first coat of epoxy enamel and final coat of aliphatic polyurethane	7 mils (5 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Surfaces with first and second coat of epoxy enamel and final coat of aliphatic polyurethane	12 mils (10 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Other surfaces (two coats)	10 mils.
Immersion service (three coats)	15 mils.
Vinyl ester	30 mils.
Heat-resistant (silicone)	3 mils.
High heat-resistant (silicone)	3 mils.
Other surfaces (one coat)	5 mils.
Other surfaces (two coats)	10 mils.

3-3.06. Weather Conditions. Coatings shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces such as tanks or pipe containing cold water, regardless of the air temperature, when metal conditions are likely to cause condensation. When necessary for proper application, a temporary enclosure shall be erected and kept heated until the coating has fully cured.

Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, Contractor and the coatings manufacturer shall be jointly responsible to ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100°F including shading application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature,

Vinyl ester coating materials, when required, shall be maintained during transportation, storage, mixing, and application at the temperature required by the coating manufacturer, 35°F to 90°F.

3-4. REPAIRING FACTORY FINISHED SURFACES. Factory finished surfaces damaged prior to acceptance by Owner shall be spot primed and recoated with materials equivalent to the original coatings. If, in the opinion of Engineer, spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

3-5. PROTECTION OF SURFACES. Throughout the work Contractor shall use drop cloths, masking tape, and other suitable measures to protect adjacent surfaces. Contractor shall be responsible for correcting and repairing any damage resulting from its or its subcontractors' operations. Coatings spilled or spattered on adjacent surfaces which are not being coated at the time shall be immediately removed. Exposed concrete or masonry not specified to be coated which is damaged by coatings shall be either removed and rebuilt or, where authorized by Owner, coated with two coats of masonry coating.

3-6. FIELD QUALITY CONTROL. The following inspection and testing shall be performed: surface profile, visual inspection, and wet and dry film thickness testing. All inspection and testing shall be witnessed by Engineer.

3-6.01. Surface Profile Testing. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile. The surface profile for concrete shall comply with SSPC 13/NACE 6 Table 1 for severe service.

3-6.02. Visual Inspection. The surface of the protective coatings shall be visually inspected.

3.6.03. Film Thickness. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ±0.5 mil. Dry film thickness shall be measured in accordance with SSPC-PA 2.

3-6.04. Spark Testing. Not required.

3-6.05. Adhesion Testing. Not required.

3-7. FIELD PRIMING SCHEDULE. In general, steel and cast iron surfaces of equipment are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Damaged or failed shop coatings which have been determined unsuitable by Engineer shall be removed and the surfaces

shall be field coated, including prime coat (if any). Galvanized, aluminum, stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

Surface To Be Primed	Material
Equipment, surfaces to be coated with	
Aliphatic polyurethane	Universal primer.
Epoxy enamel	Same as finish coats.
Coal tar coating	Same as finish coats.
Vinyl ester	Same as finish coats.
Steel and cast iron, surfaces to be coated with	
Epoxy enamel	Same as finish coats.
Coal tar coating	Same as finish coats.
Aluminum	Epoxy enamel.
Galvanized	Epoxy enamel.
Copper	Epoxy enamel.
Stainless steel	Epoxy enamel.
Plastic surfaces, including PVC and FRP	Same as finish coats.
Insulated piping	As recommended by manufacturer of finish coats.
Concrete, surfaces to be coated with epoxy enamel	
For damp-proofing	Epoxy enamel.
For all other surfaces	Epoxy concrete filler and surfacer.
Concrete block exposed in exterior locations	Epoxy concrete block filler.
Concrete block to be coated with epoxy enamel	Epoxy concrete block filler.

Unless otherwise recommended by the coating manufacturer or specified herein, priming will not be required on concrete, or concrete block, nor on metal surfaces specified to be coated with epoxy enamel, coal tar epoxy, and heat-resistant coatings. Concrete surfaces to be coated with epoxy enamel shall be filled with epoxy concrete filler and surfacer so that a continuous film is obtained, except where concrete is damp-proofed with epoxy enamel.

3-8. FINISH COATING SYSTEMS. The following schedule lists coatings systems and coating system designations.

No.	Finish Coating Systems	Coating System Designation						
		A	C	E	F	G	H	P
1.	Epoxy enamel – One coat	x			x	x		
2.	Epoxy enamel – Two coats	x	x	x	x	x		x
3.	Epoxy enamel / NSF – Two coats		x	x				
4.	Epoxy enamel – Three coats	x	x	x				
5.	Epoxy enamel / NSF – Three coats		x	x				
6.	Epoxy enamel – First coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		x
7.	Epoxy enamel – First and second coat Aliphatic polyurethane – Finish coat			x	x	x		
8.	Universal primer – First coat Aliphatic polyurethane – Finish coat	x		x				
9.	Medium consistency coal tar – Two coats	x	x	x				
10.	Coal tar epoxy -- Two coats	x	x	x				
11.	Vinyl ester – Two coats			x				
12.	Heat resistant – Two coats						x	
13.	High heat resistant – Two coats						x	

3-8.01. Surfaces Not To Be Coated. Unless otherwise specified, the following surfaces shall be left uncoated:

Exposed aluminum, except ductwork.
Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.
Nickel or chromium.
Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.
Rubber and plastics, except as specified.
Exterior concrete.
Surfaces specified to be factory finished.

3-8.02. Shop Finishing. Items to be shop finished include the following. Shop finishing shall be in accordance with the coating schedule and the manufacturer's recommendations.

a. All slide gates.
b. All conveyors.
c. Other surfaces where blast cleaning cannot be or is not recommended to be performed in the field.
d. Other items as otherwise specified.

3-8.03. Field Coating. Items to be field coated include the following. Field coating shall be in accordance with the field priming schedule, the coating schedule, and the manufacturer's recommendations.

a. Exterior surface of the sludge hopper.
b. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.
c. All interior ferrous metal surfaces except stainless steel on the digester cover.
d. Other items as otherwise specified.

3-9. METAL SURFACES COATING SCHEDULE.

Surface To Be Coated	Finish Coating System
Non-galvanized structural and miscellaneous steel exposed to view or to the elements in exterior locations.	A6
Non-galvanized structural and miscellaneous steel exposed to view inside buildings.	A2
Steel handrails, steel floor plates .	A8
Unless otherwise specified, pumps, motors, speed reducers, and other machines and equipment exposed to view.	E8
Actuator surfaces for valves, unless factory finished.	Indoor - E6
Cast Iron and steel piping inside buildings, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A2

Surface To Be Coated	Finish Coating System
Cast Iron and steel piping above grade exposed to the elements and to view outdoors, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A6
Copper pipe and tubing, including fittings and valves.	F2
Copper pipe and tubing, including fittings and valves exposed to view in exterior locations.	F7
All metal surfaces, unless otherwise specified, which will be submerged or buried, all or in part, including valves, but excluding piping laid in the ground.	E3
All metal harness anchorage for buried piping.	A10
Aluminum in contact with concrete.	F1
Aluminum and galvanized ductwork and conduit indoors.	F2 or G2
Aluminum and galvanized ductwork and conduit exposed to elements outdoors.	F7 or G7
Aluminum materials exposed to the elements outdoors.	F7

3-10. CONCRETE AND MASONRY SURFACES COATING SCHEDULE.

Surface To Be Coated	Finish Coating System
All concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.	Indoor –C2 Outdoor –C7
All walls in contact with liquid where the opposite face forms a part of an interior room or dry pit.	C4 C5
All walls in contact with treated or potable water where the opposite face is above grade or which form is a part of an interior room or a dry pit.	C5

All interior surfaces of walls in a clearwell where the wall is also part of an interior room or dry pit.	C5

3-11. MISCELLANEOUS SURFACES COATING SCHEDULE.

Plastic Surfaces, including PVC and FRP.	Outdoor - P6 Indoor - P2
Piping Insulation	Outdoor - P6 Indoor - P2

3-12. PIPING IDENTIFICATION SCHEDULE. Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, marked with flow directional arrows, and color coded.

Piping scheduled to be color coded shall be completely coated with the indicated colors, except surfaces specified to remain uncoated shall include sufficiently long segments of the specified color to accommodate the lettering and arrows. All other piping shall be coated to match adjacent surfaces, unless otherwise directed by Engineer.

3-12.01. Location. Lettering and flow direction arrows shall be provided on pipe near the equipment served, adjacent to valves, on both sides of wall and floor penetrations, at each branch or tee, and at least every 50 feet in straight runs of pipe. If, in the opinion of Engineer, this requirement will result in an excessive number of labels or arrows, the number required shall be reduced as directed.

3-12.02. Metal Tags. Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, aluminum or stainless steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.

3-12.03. Lettering. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915" or Seton "Setmark". Letter size shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 inch and smaller	Metal tags -1/4 inch
3/4 to 4 inches	3/4 inch
5 inches and larger	2 inches

3-12.04. Color Coding and Lettering. All piping for the following services shall be color coded. Bands shall be 6 inches wide spaced along the pipe at 5 foot intervals. The color of pipe and letters for services shall match existing and be acceptable to the Owner.

Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by Engineer. Vent lines shall be coated to match surfaces they adjoin.

In addition, special coating of the following items will be required:

Item	Color
Valve handwheels and levers	Red
Hoist hooks and blocks	Yellow and black stripes

Numerals at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the drawings or in the specifications by number.

End of Section

SURFACE DESCRIPTION	SYSTEM NO. -

SURFACE PREPARATION DESCRIPTION
☐ Solvent SSPC-SP1
☐ Ferrous Metal Nonimmersion SSPC-SP6
☐ Ferrous Metal Immersion
☐ SSPC-SP10
☐ SSPC-SP-5
☐ Other

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
First Coat (Primer)		
Second Coat		
Third Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 1-09940

SURFACE DESCRIPTION	SYSTEM NO. - -F

SURFACE PREPARATION DESCRIPTION
☐ Solvent SSPC-SP1
☐ Other:

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
Shop (Primer)		(Identify Product/Type)
Touchup		
Intermediate Coat		
Finish Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 2-09940

Section 11060

EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers installation of new equipment units that have been purchased by Contractor as part of this Work.

Startup requirements shall be as indicated in Section 01650 – Startup Requirements.

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Any existing equipment which is removed shall be handled as indicated in Section 01015 – Project Requirements.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services furnished by others.

Flanged connections to equipment including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Section 01614 – Handling and Storage until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on or come into contact with the ground, grass, or any other type of vegetation. Contractor shall keep the equipment dry at all times.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be as follows:

Grout	As specified in Section 03600 – Grout.

PART 3 – EXECUTION

3-1. INSTALLATION.

3-1.01. General. The following items shall be installed by the Contractor:

UV disinfection systems

Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results as specified in Section 01650 – Startup Requirements.

Each equipment unit shall be leveled, aligned, and shimmed into position. Installation procedures shall be as recommended by the equipment manufacturer and as required herein. Shimming between machined surfaces will not be permitted.

Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Baseplates shall be anchored to the concrete base with required anchor bolts. For equipment with grouted bases, the space beneath shall be filled with grout as specified in Section 03600 – Grout. The equipment base shall be grouted after initial fitting and alignment.

Anti-seize thread lubricant shall be liberally applied to the threaded portion of all stainless steel bolts during assembly.

When specified in the equipment sections, the equipment manufacturer will provide installation supervision and installation checks. For installation supervision, the manufacturer's field representative will observe, instruct, guide, and direct Contractor's erection or installation procedures as specified in the equipment specifications. For installation checks, the manufacturer's field representative will inspect the equipment installation immediately following erection by Contractor, and observe the tests indicated in Section 01650 – Startup Requirements. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

3-1.02. Pumping Units. Not used.

3-1.02.01. Vertical End Suction Centrifugal Pumps. Not used.

3-1.02.02. Submersible Pumps. Not used.

3-1.02.03. Plunger Pumps. Not used.

3-1.03. Circular Sludge Collecting Mechanism. Not used.

3-1.04. Straight Line Sludge Collecting Mechanism. Not used.

3-1.05. Submersible Mixers. Not used.

3-1.06. Plate Settlers. Not used.

3-1.07. Surface Aeration Equipment. Not used.

3-1.08. Diffused Aeration Equipment. Not used.

3-1.09. Multistage Centrifugal Blowers. Not used.

3-1.10. Engine-Generators. Not used.

3-1.11. Water Pressure Booster Systems. Not used.

3-1.12. UV Disinfection Equipment. UV reactors shall be installed level, plumb and in-line with the piping as indicated on the drawings. The UV reactors shall be handled and installed in accordance with the manufacturer's recommendations.

The exposed finish shall be inspected after completing installation, including pipe connections, fittings, valves and specialties. Burrs, dirt and construction debris shall be removed and damaged finishes, including chops, scratches and abrasions shall be repaired in accordance with the manufacturer's recommendations.

The Contractor shall protect the equipment after installation, but prior to final acceptance by Owner. Protection provisions shall be as recommended by the manufacturer, and shall include provisions to prevent rust, mechanical damage and foreign objects entering the equipment.

3-2. STARTUP AND TESTING. Startup requirements, and tests associated with startup shall be as indicated in Section 01650 – Startup Requirements. Other field tests shall be as indicated in the specific equipment sections. Startup and tests required shall occur in the order listed in the following paragraphs. Tests shall not begin until any installation supervision and installation checks by the equipment manufacturer have been completed, except where noted below.

3-2.01. Preliminary Field Tests. Preliminary field tests shall be conducted on all equipment by Contractor as indicated in Section 01650 – Startup Requirements. When an installation check is specified in the equipment sections, the equipment manufacturer's representative will participate in these tests to the extent

described in Section 01650 -- Startup Requirements and in the equipment sections.

3-2.02. Field System Operation Tests. Field system operation tests shall be conducted on all equipment by Contractor as indicated in Section 01650 -- Startup Requirements. When an installation check is specified in the equipment sections, the equipment manufacturer's service personnel will participate in these tests to the extent described in Section 01650 -- Startup Requirements and in the equipment sections.

3-2.03. Field Demonstration Tests. Field demonstration tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.04. Field Performance Tests & Distribution Tests. Field performance tests or distribution tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.05. Field Baseline Performance Tests. Field baseline performance tests shall be conducted by Contractor on the equipment indicated in the equipment sections, and the tests shall be performed as indicated. When indicated in the equipment sections, the equipment manufacturer will participate in these tests. This test shall not be considered an acceptance test, but rather a test to determine initial performance curves and efficiency just prior to the equipment entering service.

End of Section

Section 13500

INSTRUMENTATION AND CONTROL SYSTEM

Data Sheet

Para-graph	Description	Data	Units
	General (PR 1-1 & 1-2)		
	System designation	☐ Supervisory Control and Data Acquisition (SCADA) System ☐ Distributed Control System ☉ Plant Control System ☐ Other	
	When "Other" is selected, indicate alternative.		
1-1.02	System equipment	☐ Computer system hardware (13510) ☐ Computer system software (13520) ☑ Programmable logic controllers (13530) ☐ Remote terminal units (13531) ☐ Distributed control units (13532) ☐ Communications equipment (13540) ☑ Software control block descriptions (13550) ☑ Instrumentation - General Requirements (13560) ☑ Panel Mounted Instruments (13561) ☐ Flow Instruments (13562) ☐ Pressure and Level Instruments (13563) ☐ Analytical Instruments (13564) ☐ Miscellaneous Instruments (13565) ☑ Panels, consoles, and appurtenances (13570) ☐ Uninterruptible power supply (13580)	

	System Equipment	☐ Network Systems (13590) ☐ Ethernet Networks (13591) ☐ Device Networks (13592) ☐ Miscellaneous Network Hardware (13593) ☐ Network Cabling (13594)	
1-2.02	Input/output lists	☑ Attached as an appendix to Section 13530 ☐ Attached to this Data Sheet ☐ Furnished later ☐ Located on the drawings	
1-2.01	General Equipment Requirements required	☑ Yes ☐ No	
1-2.01	5 Years supplier's experience required	☑ Yes ☐ No	
1-2.03	Listed or labeled by approved testing laboratory	☑ Yes ☐ No ☑ UL ☐ Other	
	When "Other" is selected indicate alternative		
	Spare Parts		
	Performance and Design Requirements (PR 2-2 & 2-3)		
	Power Supply - Type	☐ Three phase and neutral (TPN) ☐ Three phase (TP) ☑ Single phase and neutral (SPN)	
2-3.04	Uninterruptible power supply (UPS)	☑ Yes ☐ No	
	Provisions for the number of future RTU's or PLC's		No.
	Provisions for the total number of future I/O points		No.
	Provisions for the number of future operator workstations.		No.
	Provisions for the number of future communications channels		No.

	Configuration (PR 2-5)		
	Software configuration to be performed by:	☒ Owner or Engineer ☐ SYSTEM SUPPLIER	
2-5 d.	When configuration by Owner or Engineer is selected: Number of working days for on-site assistance	10	No.
2-5 e.	When configuration by Owner or Engineer is selected: Number of hours for telephone assistance	24	No.
2-5 f.	When configuration by Owner or Engineer is selected: Supply of system at Owner's or the Engineer's offices located at:	N/A	
2-5 f.	When configuration by Owner or Engineer is selected: Required delivery date	N/A	
2-5 f.	When configuration by Owner or Engineer is selected: Configuration peripherals to be supplied with the system	☐ Printer ☐ Color video copier ☐ Field control device	
2-5.02	When configuration by System Supplier selected, minimum number of custom graphic displays to be provided.		No.
2-5.03	When configuration by System Supplier is selected, minimum number of separate daily reports to be provided.		No.
	Systems Check (PR 3-2)		
3-2.01	Field manager required	☒ Yes ☐ No	
3-2.02	Field inspection at delivery required.	☒ Yes ☐ No	
	Number of working days for field inspection at delivery	1	No.
3-2.03	Training of Installation personnel in installation and wiring procedures required	☒ Yes ☐ No	
	Number of working days for Installation Contractor training	2	No.
3-2.04	Field inspection prior to start up	☒ Yes ☐ No	
	Number of working days for field inspection prior to start up	5	No.

3-2.05	Start up assistance	☑ SYSTEM SUPPLIER'S Engineer ☐ Programmer	
	Number of working days for start up assistance	5	No.
3-2.04.04	System check out report	◉ Yes ○ No	
	Testing (PR 3-3)		
3-3.01	Factory Acceptance Testing (FAT)	○ Complete system ◉ Minimum system	
3-3.02	Site Acceptance Testing (SAT)	◉ Yes ○ No	
	Number of working days for Site Acceptance Testing	5	No.
	Provide written Site Acceptance Test Report	◉ Yes ○ No	
	Operational Demonstration	◉ Yes ○ No	
	Training (PR 3-4)		
3-4.01.03	Video Taping required	○ Yes ◉ No	
3-4.02	Instrument Training required	◉ Yes ○ No	
	Required hours at System Supplier facility		No.
	Number of students at System Supplier facility		No.
	Required hours at Owner facility	8	No.
	Number of students at Owner facility	8	No.
3-4.03	Control System Maintenance Training required	◉ Yes ○ No	
	Required hours at System Supplier facility		No.
	Number of students at System Supplier facility		No.
	Required hours at Owner facility	8	No.
	Number of students at Owner facility	8	No.
3-4.04.01.01	Operator training required (Pre-Installation)	○ Yes ◉ No	

	Required hours at System Supplier facility		No.
	Number of students at System Supplier facility		No.
	Required hours at Owner facility		No.
	Number of students at Owner facility		No.
3-4.04.01.02	Operator training required (Post-Installation)	☐ Yes ☒ No	
	Required hours at Owner facility		No.
	Number of students at Owner facility		No.
3-4.05	Programmer training required (HMI Software)	☐ Yes ☒ No	
	First session required hours at Owner or Engineer's facility		No.
	First session number of students at Owner or Engineer's facility		No.
	Second session required hours at Owner facility		No.
	Second session number of students at Owner facility		No.
3-4.06	Programmer training required (PLC Software)	☐ Yes ☒ No	
	Required hours at Owner or Engineer's facility		No.
	Number of students at Owner or Engineer's facility		No.
	Supplemental Training required	☐ Yes ☒ No	
	Required hours at Owner facility		No.
	Number of students at Owner facility		No.

Section 13500

INSTRUMENTATION AND CONTROL SYSTEM

PART 1 – GENERAL

1-1. SCOPE. This section covers the furnishing and installation of an instrumentation and control system as designated and as required. This section also provides reference to the control system provided by the UV System Supplier.

The System Supplier shall provide a discrete input and a discrete output module to be installed in the Owner's existing PLC panel. Refer to the drawings and PLC specifications for additional information. All components and wire necessary for the installation of the input/outputs as shown on the drawings and in the I/O listing shall be provided and installed. The System Supplier shall also be responsible for the supply, installation, and configuration of the communication cabling and equipment as specified within the 13500 series of specifications.

1-1.01. **Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".**

1-1.02. Associated Sections. This section also includes the equipment and services specified in the following sections and Data Sheets as required.

Section 13530	PROGRAMMABLE LOGIC CONTROLLERS
Section 13550	SOFTWARE CONTROL BLOCK DESCRIPTIONS
Section 13560	INSTRUMENTATION – GENERAL REQUIREMENTS
Section 13561	PANEL MOUNTED INSTRUMENTS
Section 13570	PANELS, CONSOLES, AND APPURTENANCES

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Requirements. As required, the General Equipment Requirements shall apply to all equipment provided under this section.

The supplier shall have as a minimum 5 years in the design, coordination and supply of computer-based monitoring, control, and data acquisition systems.

1-2.02. Drawings. The drawings indicate locations and arrangements of equipment and may include input/output lists and block and one-line diagrams showing connections and interfaces with other equipment. The input/output (I/O) lists are included as required.

1-2.03. Codes, Permits and Agency Approvals. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Where mandated by codes, panels, assemblies, materials, and equipment shall be listed by Underwriters' Laboratories or other testing organizations acceptable to the governing authority as required. Contractor shall, as part of their work, arrange for and obtain all necessary permits, inspections, and approvals by the authorities having local jurisdiction of such work. This shall include any third-party inspections and testing of panels and equipment.

1-2.04. Supplier's Qualifications. Equipment and software furnished under this section and under other related sections listed in the Scope paragraph above shall be designed, coordinated, and supplied by a single manufacturer or supplier, hereinafter referred to as the System Supplier. The System Supplier shall be regularly engaged in the business of supplying computer-based monitoring, control, and data acquisition systems. The Contractor shall utilize the services of the System Supplier to coordinate all control system related items, to check-out and calibrate instruments, and to perform all testing, training, and startup activities specified to be provided.

The System Supplier shall have the following minimum qualifications:

- The supplier shall maintain a design office staffed with qualified technical design personnel.
- The supplier shall maintain competent and experienced service personnel to service the hardware and software furnished for this project.
- The intended supplier shall furnish the information requested in the Instrumentation and Control System Supplier Questionnaire bound elsewhere in the Documents. References including contact names, telephone numbers, and general project description shall be included in the questionnaire. The users and project lists shall be for similar control equipment, software, and type of projects.

1-2.05. Coordination. Systems supplied under this section shall be designed and coordinated by System Supplier for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications, under other contracts, and, where applicable, with related existing equipment. All equipment shall be designed and installed in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, and the manufacturer of the related equipment.

1-2.06. Related Equipment and Materials. Related equipment and materials may include, but will not be limited to, instrumentation, motor controllers, valve actuators, chemical feeders, analytical measuring devices, conduit, cable, and piping as described in other sections or furnished under other contracts.

1-3. GENERAL REQUIREMENTS. The drawings and specifications indicate the extent and general arrangement of the systems. If any departures from the drawings or specifications are deemed necessary by System Supplier, details of such departures and the reasons shall be submitted to Engineer for review with or before the first stage submittal. No departures shall be made without prior written acceptance.

The specifications describe the minimum requirements for hardware and software. Where System Supplier's standard configuration includes additional items of equipment or software features not specifically described herein, such equipment or features shall be furnished as a part of the system and shall be warranted as specified herein.

1-3.01. Governing Standards. Equipment furnished under this section shall be designed, constructed, and tested in accordance with IEEE 519, ANSI C37.90, FCC Part 15 - Class A, and NEMA ICS-1-109.60.

1-3.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. The System Supplier shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make any modifications requisite for proper installation subject to acceptance by Engineer. At least three feet of clear access space shall be provided in front of all components of the instrumentation and control system components.

1-3.03. Workmanship and Materials. System Supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except for testing.

1-3.04. Abbreviations. Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
FCC	Federal Communications Commission
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrumentation, Systems and Automation (Society)
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

1-4. SUBMITTALS. Complete dimensional, assembly, and installation drawings, wiring and schematic diagrams; and details, specifications, and data covering the materials used and the parts, devices and accessories forming a part of the system furnished, shall be submitted in accordance with Section 01300 – Submittals. Submittal data shall be grouped and submitted in three separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Equipment tag numbers or identifications used on the drawings shall be referenced where applicable.

1-4.01. First Stage Submittal. The first stage submittal shall include the following items.

a. A detailed list of any exceptions, functional differences, or discrepancies between the system proposed by System Supplier and this specification.

b. Product data sheets and catalog cut sheets on all hardware items. Product data sheets shall be created by the System Supplier and shall list at a minimum the complete model number, materials of construction, special or optional features, and intended service of each device.

c. A brief, concise description of the proposed system, including major hardware and software components, field services, and personnel training.

d. A block diagram or schematic drawing showing the principal items of equipment furnished, including model numbers, and their interrelationships.

e. Drawings showing floor space or desktop area requirements for all equipment items, including allowances for door swings and maintenance access.

f. Environmental and power requirements, including heat release information for each equipment item.

g. Standard system engineering and user manuals describing the use of the system and application programming techniques for creating reports, graphics, database, historical records, and adding new process I/O nodes to the system.

h. Standard field termination drawings for all process input/output equipment, showing typical terminations for each type of point available in the system.

i. A copy of the proposed software licenses for all software associated with the system.

1-4.02. Second Stage Submittal. Before any equipment is released for shipment to the site and before factory testing is scheduled, the following data shall be submitted.

At System Supplier's option, the first and second stage submittals may be combined.

a. Detailed functional descriptions of all software modules specified and furnished as part of System Supplier's standard system. The descriptions shall be identified with the applicable specification paragraph.

b. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall include overall dimensions, metal thickness, door swing, mounting details, weight, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.

c. Wiring and installation drawings for all interconnecting wiring between components of the system and between related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections. If panel terminal designations, interdevice connections, device features and options, or other features are modified during the fabrication or factory testing, revised drawings shall be submitted before shipment of the equipment to the site.

d. Review of drawings submitted prior to the final determination of related equipment shall not relieve System Supplier from supplying systems in full compliance with the specific requirements of the related equipment.

e. Input/output listings showing point names, numbers, and addresses. Input/output identification numbers from the contract documents shall be cross-referenced in this submittal.

f. Proposed lesson plans or outlines for all training courses specified herein, including schedule, instructors' qualifications and experience, and recommended prerequisites.

1-4.03. Third Stage Submittal. Complete system documentation, in the form of Operation and Maintenance Manuals, shall be submitted before the commencement of field acceptance testing. Operation and Maintenance Manuals shall include complete instruction books for each item of equipment furnished. Where instruction booklets cover more than one specific model or range of device, product data sheets shall be included which indicate the device model number and other special features. A complete set of "as-built" wiring, fabrication, and interconnection drawings shall be included with the manuals. If field-wiring modifications are made after these drawings are submitted, the affected drawings shall be revised and resubmitted.

1-5. PREPARATION FOR SHIPMENT. All electronic equipment and instruments shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the

elements, shall be kept dry at all times, and shall not be exposed to adverse ambient conditions.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces that are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each shipment shall include an appropriate shipping list that indicates the contents of the package, including the specific instrument tags. The shipping list shall be accessible without exposing the instruments to the atmosphere. The shipping list shall also contain any cautionary notes regarding storage of the instruments, including requirements to protect the instrument from static discharge, desensitizing chemicals (solvents, paints, etc.), or ambient atmospheric conditions.

Individual instruments shall be appropriately tagged or labeled to positively identify the device. All identification shall be visible without the need to unpack the instrument from its protective packaging.

Instrument shipment and storage requirements shall be coordinated with Engineer or Owner prior to shipment. System Supplier shall provide adequate storage and be ready to accept the shipment before shipping any equipment to the site. Additional shipping and storage requirements shall be as detailed in the individual instrument specifications.

Components which are shipped loose due to transportation limitations shall be assembled and disassembled by the manufacturer prior to shipment to assure that all components fit together and are adequately supported.

1-6. DELIVERY, STORAGE, AND SHIPPING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

1-7. SPARE PARTS. Spare parts and consumable items shall be provided as required.

1-7.01. Packaging. All spare parts shall be delivered to Owner before final acceptance of the system. Packaging of spare parts shall provide protection against dust and moisture and shall be suitable for storage. Circuit boards and other electronic parts shall be enclosed in anti-static material. All packages shall be clearly marked with the manufacturer's name, part number or other identification, date of manufacture, and approximate shelf life.

1-7.02. Replacement. System Supplier may utilize spare parts and supplies during system installation, de-bugging, startup, or training, but shall restore all

such materials and supplies to the specified quantities before final acceptance of the systems.

PART 2 - PRODUCTS

2-1. GENERAL REQUIREMENTS. All equipment furnished under each section referenced in SCOPE is a part of this section and shall be selected by System Supplier for its superior quality and intended performance. Equipment and materials used shall be subject to review.

2-1.01. Standard Products. The systems furnished shall be standard products. Where two or more units of the same type of equipment are supplied, they shall be the products of the same manufacturer; however, all components of the systems furnished hereunder need not be the products of one manufacturer unless specified herein.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. The design of the systems furnished hereunder shall utilize concepts, techniques and features that provide maximum reliability and ease of maintenance and repair. The systems shall include board-level devices such as light emitting diodes or other indicators to facilitate quick diagnosis and repair. Diagnostic software shall be furnished to facilitate system-level troubleshooting.

Where redundant hardware is provided, the system shall be capable of performing all specified functions, without reconfiguring hardware or software, with only one device of each category in service.

2-2.01. Factory Assembly. Equipment shall be shipped completely factory assembled, except where its physical size, arrangement, configuration, or shipping and handling limitations make the shipment of completely assembled units impracticable.

2-2.02. Expandability. The system shall be capable of expansion as required.

2-3. POWER SUPPLY. Unless otherwise specified, power supply to all equipment will be 120 volts, 60 Hz, single phase. System Supplier shall be responsible for distribution of power among enclosures, consoles, peripherals, and other components of the system from the power supply receptacles and junction boxes indicated on the drawings. Power distribution hardware shall include cables and branch circuit overcurrent protection installed in accordance with Section 16050 – Electrical.

2-3.01. Facility Distribution System. Equipment not indicated to be powered from an uninterruptible power source shall be suitable for being supplied from

the facility distribution system and shall be capable of withstanding voltage variations of ±10 percent and harmonics up to the limits of IEEE 519 without affecting operation. System Supplier shall provide voltage conditioning or filtering equipment if necessary to meet the requirements specified.

2-3.02. Power Supplies. Power supplies for voltages other than those listed above shall be an integral part of the equipment furnished. Internal power supplies shall be regulated, current limiting, and self-protected.

2-3.03. Surge Withstand. All equipment shall meet all surge withstand capability tests as defined in ANSI C37.90 without damage to the equipment.

2-3.04. Uninterruptible Power Supply. As required, an uninterruptible power supply (UPS) shall be furnished hereunder to power the equipment indicated on the drawings or will be furnished under another section. System Supplier shall be responsible for coordinating the size of the UPS unit with the equipment furnished hereunder, and shall advise Engineer if a unit of higher capacity is necessary.

2-4. SERVICE CONDITIONS AND ENVIRONMENTAL REQUIREMENTS. The equipment provided for the instrumentation and control system shall be suitable for the service conditions specified in the attached equipment sections.

All equipment shall be designed and selected to operate without degradation in performance throughout the environmental extremes specified. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.

2-4.01. Ambient Temperature. All system equipment located in air conditioned rooms shall be suitable for operation in ambient temperatures from 10°C to 35°C and a relative humidity of 10 to 80 percent, noncondensing. All equipment located in non air conditioned indoor areas shall be suitable for an ambient temperature range of 0°C to 50°C and a relative humidity of 10 to 95 percent, noncondensing. All equipment located outdoors shall be suitable for operation in an ambient temperature range 0°C to 60°C and a relative humidity of 5 to 100 percent. Heaters and air conditioning/cooling equipment shall be provided where essential to maintain equipment within its manufacturer-recommended operating ranges.

2-4.02. Deleterious Effects. All system equipment will be installed in areas without anti-static floor construction and without any provisions for control of particulates or corrosive gases other than ordinary office-type HVAC filtering. System Supplier shall furnish any additional air cleaning equipment, anti-static

chair pads, or other protective measures necessary for proper operation of the system.

All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

2-4.03. Noise Level. The equivalent "A" weighted sound level for any system equipment located in the control room, except printers, shall not exceed 35 dBA. The sound level for printers shall not exceed 65 dBA. Sound reduction enclosures shall be provided where necessary to comply with these limits.

2-4.04. Lightning Protection. In addition to other environmental protection specified herein, the entire system shall be provided with lightning protection. Lightning protection measures shall include the following.

2-4.04.01. Grounding. All major components of the system shall have a low resistance ground connection. Grounding system provisions indicated on the drawings shall be modified as recommended by System Supplier.

2-4.04.02. Surge Suppressors. Surge and lightning supressors shall be non-faulting, non-interrupting, and shall protect against line-to-line and line-to-ground surges. Devices shall be solid-state metal oxide varistor (MOV) or silicon junction type, with a response time of less than 50 nanoseconds. Surge protective devices shall be applied for the following:

a. All power connections to RTUs, PLCs, DCUs, instruments and control room equipment. Surge arresters shall be Phoenix Contact "Mains PlugTrab",

b. All connections to coaxial-based networked equipment (including CCTV, CATV, ethernet, Arcnet, and satellite) where any part of the circuit is outside of the building envelope. Surge arresters shall be Telematic "VP08", Transtector "TCP Series", Phoenix Contact "CoaxTrab Series", or Northern Technologies "TCS-CP3 Series".

c. All analog signal circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Surge protection devices shall not impede or interfere with the use of smart transmitter calibration/communication. Protection devices located near the transmitter shall be Telematic "TP48." Protection devices in control panels shall be Transtector "TSP Series", Telematic "SD Series", Phoenix Contact "PipeTrab Series", or Citel "BP1-24."

d. All metallic pair (twisted and untwisted) conductor local area network and data highway termination points, where any part of the data highway cable is routed outside of the building envelope. Single-port protective devices shall be Phoenix Contact "PlugTrab Series" or Telematic "NP Series."

e. All serial, PLC data highway, and remote I/O network termination points where any part of the circuit is routed outside of the building envelope. Surge protection devices shall be Transtector "DLP Series" (RS-232); Transtector "FSP4000MC Series" (RS-422); Phoenix Contact "PlugTrab Series"; or Citel "E280 Series".

f. All radio antenna leads. Surge protection devices shall be as specified in Section 13540.

g. All telephone lines at points of connection to the system. Protection devices for dial-up circuits shall be Transtector "TSJ Series", Telebyte "Model 22PX", Citel "BP1-T", or equal. Protection devices for full period circuits shall be Transtector "LMP Series", Northern Technologies "DLP-S Series", Phoenix Contact "TeleTrab Series", or Circuit Components, Inc. "SPR-TM Series."

2-5. SYSTEM SOFTWARE CONFIGURATION. The system software will be configured by Engineer or Owner. System Supplier shall be responsible for the following configuration support tasks:

a. Furnish and install the necessary operating system software, utilities, and all standard software packages. All software provided shall be fully configured for use as specified herein and in related sections. This configuration should include but not limited to, security access from the Administrator functionality to the Operator functions, printing functions (including graphics, reports, system documentation parameters, etc.), reporting functions, and historical interface and historical data accessibility.

b. Furnish and apply all standard communications software and develop any custom communications software needed for the components of the system to communicate information as indicated on the functional block diagram on the drawings.

c. Configure the hardware and provide any necessary firmware or software programming associated with the hardware, configuration such as DCU, PLC, and RTU device address assignments.

d. Provide the services of an experienced applications engineer for the number of 8-hour day visits as required, at Owner's or Engineer's facilities, to assist with the configuration. One of these visits shall be scheduled to coincide with the delivery of equipment for configuration. The remaining visits shall be scheduled with Engineer and Owner.

e. Provide the services of the applications engineer for telephone consultation and trouble shooting from System Supplier's facility for the total number of hours as required.

f. Provide early shipment of the terminal and hardware equipment for configuration of the system as defined herein. This equipment shall be delivered to Owner's or Engineer's offices as required, but not before submittal information and drawings for the equipment have been approved. System Supplier shall also be responsible for subsequent retransport of this equipment to the project site.

g. Provide configuration information to Engineer at least two weeks before the shipment of equipment. Include specific I/O address numbering schemes for all field I/O points, database tag numbering format, address numbers of points for internal use, and other information necessary to begin database, HMI , and PLC, RTU, or DCU programming.

h. Provide complete startup, checkout, and calibration of all system hardware and I/O specified herein.

i. Provide any programming requisite to implementing the features and functions described herein that are not a standard part of the system software. Software that must be Engineer-Owner produced custom programming code is unacceptable.

2-6. SOFTWARE DOCUMENTATION. System Supplier shall furnish complete documentation on all software supplied with the systems specified herein. Operating systems, compilers, assemblers, and utility and diagnostic programs that are standard commercial products of third parties need not be included in the magnetic media backup. Software documentation shall consist of the following principal items.

a. One backup set of any integrated circuit or solid-state memory-based plug-in firmware used.

b. Two complete back up copies of system and application software in executable format on magnetic media compatible with the system furnished.

c. Three sets of user reference manuals for all standard system and application software.

d. One set of user reference manuals for all operating system software.

e. Three sets of printed as-built reference documentation for any special software provided specifically for this contract.

f. For each licensed software product, all documentation provided by the product manufacturer shall be provided. This includes all reference manuals and any other documents that were provided by the manufacturer. There should be one set of this documentation for each and every piece of equipment provided. Multiple pieces of similar equipment or software require multiple copies of this documentation.

2-7. SOFTWARE LICENSE. All software programs supplied as a standard part of System Supplier's products for this project shall be licensed to Owner for use on the system specified herein. Such license shall not restrict Owner from using the software on the system provided hereunder or its replacement. Owner shall have the right to make copies of the software for use on the system provided. Specific requirements of System Supplier's software license are subject to review and approval by Owner and Engineer.

2-8. INSTALLATION TEST EQUIPMENT. All necessary testing equipment for calibration and checking of system components shall be provided by System Supplier. System Supplier shall also furnish calibration and maintenance records for all testing and calibration equipment used on the site if requested by Engineer.

PART 3 – EXECUTION

3-1. INSTALLATION REQUIREMENTS. The installation of equipment furnished hereunder shall be by the Contractor or their assigned subcontractors.

3-1.01. Field Wiring. Field wiring materials and installation shall be in accordance with Section 16050 – Electrical.

3-1.02. Instrument Installation. Additional requirements for mounting, piping, and calibration of field instruments are described in Section 13560 – Instrumentation General Requirements.

3-1.03. Salvage of Existing Equipment. Existing equipment and materials removed or replaced under this contract shall be delivered to Owner at a location designated by Owner, or shall be properly disposed of at Owner's discretion. Care shall be taken to avoid damage to equipment delivered to Owner.

Any mounting brackets, enclosures, stilling wells, piping, conduits, wiring, or openings that remain after removal of equipment and support hardware shall be removed or repaired in a manner acceptable to Owner and Engineer. Transmitters or switches containing mercury shall be removed and disposed of by personnel trained in the handling of hazardous materials and using approved procedures.

3-2. SYSTEMS CHECK. As required, System Supplier shall provide the services of a field manager and a trained and experienced field supervisor to assist the installation contractor during installation, and to calibrate, test, and advise others of the procedures for installation, adjustment, and operation.

3-2.01. Field Manager. As required, System Supplier shall appoint a field services manager who shall be responsible for the coordination of all system check-out and startup activities, and who shall be immediately available to Engineer and Owner by phone or on site for the duration of this project.

3-2.02. Field Inspection at Delivery. As required, the field supervisor shall inspect major equipment items within five working days of delivery, to assure that the equipment was not damaged during shipment and shall supervise or assist with unpacking, initial placement, and initial wiring of the system.

3-2.03. Training for Installation Personnel. As required, the field supervisor shall train the installation personnel in reading and understanding submittal drawings, and in the correct installation and wiring procedures for the equipment.

3-2.04. Field Inspection Prior to Start Up. After installation and wiring connections are complete, the field supervisor, with additional System Supplier's personnel for the number of days as required, shall verify that each external connection to the system is correctly wired and field process components and devices are functioning as intended.

3-2.04.01. Analog Signals. Analog input signals shall be simulated at the transmitting source, and verified to be received at the proper register address in the control system. Analog outputs shall be generated at the control system, and verified to be received with the correct polarity, at the respective receiving device.

3-2.04.02. Discrete Signals. Discrete input and output signals shall be simulated and verified that they are received at the respective receiving device, and at the proper voltage.

3-2.04.03. Devices by Other Suppliers. If interrelated devices furnished by other suppliers or under other contracts, such as valve actuators, motor controls, chemical feeders, and instruments, do not perform properly at the time of system checkout, the field supervisor shall use suitable test equipment to introduce simulated signals to and/or measure signals from these devices to locate the sources of trouble or malfunction.

3-2.04.04. System Check Out Report. The System Supplier shall submit a written report on the results of such tests to Engineer. Additional documentation shall be furnished as requested by Engineer to establish responsibility for corrective measures. System Supplier shall verify, in writing, to Engineer or Owner that System Supplier has successfully completed the external connection check before beginning system startup or field acceptance testing.

3-2.05. Start Up Assistance. After the field supervisor has completed the system check and submitted his report, System Supplier shall supply a factory-trained engineer and a programmer to provide on site start up assistance for the number of days as required. During the startup period, these personnel shall thoroughly check all equipment, correct any deficiencies, and verify the proper operation of all components.

3-3. TESTING. The system shall be acceptance tested at the factory and on site.

System Supplier shall prepare a testing procedure to be approved by Owner and Engineer that shall demonstrate that the system conforms to the specifications. The testing procedure shall be submitted at least 30 days in advance of testing. The testing shall be conducted by System Supplier and witnessed by Owner and/or Engineer.

System Supplier shall notify Engineer and Owner in writing at least 14 days before the proposed testing date. If the factory acceptance test is concluded unsuccessfully, the test shall be repeated. System Supplier shall reimburse Owner and Engineer for all expenses incurred in connection with attending repeated factory or site testing necessitated by system failure or inadequate preparation.

3-3.01. Factory Acceptance Testing. After system assembly and debugging at System Supplier's facility, the system shall be tested before the system is shipped to the site. As required, the factory test shall be conducted on the complete system, including all field I/O devices, communications equipment, and

peripherals; or as required, using at least the minimum system consisting of computer hardware, software, printer, and one field I/O device.

The entire system, including all peripherals and associated software, shall be factory tested under simulated operating conditions. Both normal operating sequences and fault conditions shall be simulated. The results shall be noted on the CRT displays and the logging printer for hard copy. The testing procedures for hardware and software are described below.

All basic functions shall be demonstrated, including I/O processing, communications, alarm handling, HMI display functions, alarm logging, report generation, and historical data storage, as well as the specific functions listed herein. The system shall operate continuously for at least a 72 hours without faults. This operational test may run concurrently with the demonstration of hardware and software functions. The test procedure shall also include at a least four-hour period for discretionary tests to be conducted by Engineer or Owner.

For systems with software configuration by Engineer/Owner, a preliminary version of such configured software may be used as part of the factory acceptance test.

3-3.01.01. Hardware Test. Processors, processor modules, and peripheral devices associated with the system shall be assembled together as they will be installed in the field and shall be tested. The test shall demonstrate proper operation of each hardware device and communications among devices, and shall include verification of selected analog and discrete inputs and outputs.

3-3.01.02. Software Test. All system software modules specified herein shall be demonstrated. Software tests shall include running all diagnostics, debugging routines, and system test routines. The operating system, advanced process control language compiler, and all associated drivers shall be fully tested and operable for the system test. Software "patches" or changes to bypass failed or flawed modules during the test will not be acceptable.

3-3.02. Site Acceptance Testing. After installation and checkout by System Supplier's personnel, the system shall be subjected to an acceptance test.

Site acceptance testing shall be scheduled after receipt of the System Check Out Report and System Supplier shall verify that all field signal changes are reflected in the proper address locations in the system database.

The site acceptance testing shall follow the same procedure as the factory testing and shall operate without loss of basic functions. The number of days of continuous operation for the test shall be as required. The operational

demonstration shall confirm that the status, alarm, and process variable signals are valid and are being updated appropriately, and that the discrete and analog output signals from the control system are being correctly transmitted and implemented. Any errors or abnormal occurrences shall be recorded by System Supplier's field representative. System Supplier's field representative need not be continuously present during the site acceptance testing, but shall be available to respond to the site within one hour of notification. The representative shall inspect the system for faults at least once every 24 hours and shall log or record any noted problems. The log shall include a description of the problem, its apparent cause, and any corrective action taken.

3-3.02.01. Failure of Redundant Equipment. Failure of redundant equipment shall not be considered downtime provided that automatic failover occurs as specified and, in the opinion of Engineer, the failure was not caused by deficiency in design or installation. In the event of repeated failure of any hardware component or software module, the acceptance test shall be terminated and re-started.

3-3.02.02. Completion of Test. Successful completion of the site acceptance test, including the operational demonstration, is prerequisite to Substantial Completion as specified in Section 00800 – Supplementary Conditions.

3-4. TRAINING. System Supplier shall conduct training courses for personnel selected by Owner. Seven categories of training, instrument, control system maintenance, operator (pre-installation), operator (post-installation), programmer (HMI software), programmer (PLC software), and supplemental shall be provided as required. Training shall be conducted by experienced instructors who are familiar with the specific system supplied.

3-4.01. General Training Requirements. In general, System Supplier's standard training courses may be used to meet the training objectives specified. Where standard courses do not meet these objectives, additional coursework shall be developed. Clock hour requirements for each level of training are listed on the data sheet. A "clock hour" is defined as one hour of instruction or supervised training exercise. Minimum requirements listed for each training category shall be as required. Training hour requirements noted in the data sheet are the number of hours of training to be provided for each student. Additional training time shall be provided if considered necessary to meet the training objectives.

3-4.01.01. Training Costs. All costs associated with the training program; excluding travel, lodging, and per diem expenses for Owner's and Engineer's personnel to attend off-site training programs; shall be the responsibility of System Supplier and shall be included in the contract price.

3-4.01.02. Lessons. Training lesson plans and other information for the second stage submittal as defined herein shall be submitted at least 30 days prior to the start of training.

3-4.01.03. Video Taping. Not used.

3-4.02. Instrument Training. Training on the calibration, maintenance, troubleshooting, and repair for the instrument devices provided under this project shall be provided. Training shall be conducted at the System Supplier's or Owner's facilities as required. Training shall also be provided for any hand-held or computer-based calibration devices and their associated software.

3-4.03. Control System Maintenance Training. System maintenance training shall be provided to enable Owner's personnel to perform routine and preventive maintenance, troubleshoot, and repair all hardware furnished with the system, except equipment provided by the HMI computer manufacturer. Maintenance and repair instruction shall assume that Owner's personnel will repair equipment by replacing circuit boards and modules, and shall not include instruction on circuit board level repair.

3-4.03.01. Classes. All maintenance training shall be conducted at Owner's facilities. Each training session shall consist of the number of hours and for the number of Owner's personnel as required.

3-4.03.02. Content of Classes. The training shall cover at least the following topics:

a. Preventive, scheduled maintenance for all equipment.

b. Function and normal operation of circuit boards and modules.

c. Diagnosis of hardware failures to the faulted board or module.

d. Removal and replacement of removable circuit boards and modules.

e. Emergency maintenance and restoration procedures.

The maintenance training program shall be developed for personnel who have experience in electronics maintenance and repair and a general knowledge of computer systems, but not necessarily any familiarity with the specific hardware furnished.

3-4.04. Operator Training.

3-4.05. Programmer Training (HMI Software). Not used.

3-4.06. Programmer Training (PLC Software). Not used.

3-4.07. Supplemental Training. Not used.

End of Section

Section 13530

PROGRAMMABLE LOGIC CONTROLLERS

Data Sheet

Para-graph	Description	Data	Units
	General (PR 1-1 thru 1-5)		
	PLC designations.	As designated on the P&ID Legends and Abbreviations – Sheet P2.	
1-2.01	General Equipment Requirements required.	☐ Yes ☐ No	
1-5	Spare parts. Number of spare processor modules of each type used in the PLCs.	1	No.
1-5	Number of spare power supply modules of each type used in the PLCs.	1	No.
1-5	Number of spare I/O racks of each type (size) used in the PLCs.	1	No.
1-5	Number of spare I/O cards of each type used in the PLCs.	2	No.
1-5	Number of spare Local Operator Interfaces of each type (size) used in the PLCs.	1	No.
1-5	Number of spare communications modules used in the PLCs.	1	No.
	Service Conditions		
	Location.	☐ Air conditioned room ☑ Non air conditioned room ☐ Outdoors	
	Outdoor location ambient temperature range.		°F [°C]
	Required environmental controls.	☐ Sun shades ☐ Air conditioned enclosures ☑ Heated enclosure	
	Products (PR 2-1)		
	Initial, spare, and future memory (RAM).	1756-L55M16 or higher if required by application	

2-1.05	Manufacturer.	☑ Allen-Bradley ☐ GE-Fanuc ☐ Modicon ☐ Siemens ☐ Other ☐ Or equal ◉ Without exception	
	Type	Refer to itemized table.	
2-1.04	Expandability	25	%
2-1.06	Signal power supplies required for:	☐ Digital output ☐ Digital input ☑ Analog input ☐ Analog output ☐ Other	
	When "Other" is selected, indicate alternative.		
	Separate fused power supply required for digital inputs.	◉ Yes ☐ No ☐ 24 Vdc ☑ 120 Vac	
2-1.08	PLC arrangement.	☐ As indicated on block diagram ☐ As summarized	
	Large PLC Processor (PR 2-2)	NOTE: Refer to itemized table.	
2-2	Large industrial rack mounted type with rack mounted I/O.	☐ Yes ◉ No	
	EPROM memory required.	☐ Yes ☐ No	
	Input/Output Hardware		
	High speed pulse accumulator input.	☐ Yes ☐ No	
	Platinum RTD analog input.	☐ Yes ☐ No	
	Binary-Coded-Decimal (BCD) thumbwheel input.	☐ Yes ☐ No	
	Discrete Input (DI) Modules.	☐ 100 - 130 volts ac ☐ 20 - 28 volts dc ☐ With isolation - 100-130 volts ac ☐ With isolation - 20-28 volts ac	

	Discrete Output (DO) Modules.	☐ 1 amp at 100 - 130 volts ac ☐ 1 amp at 20 - 28 volts dc ☐ Isolated modules - 100-130 volts ac ☐ Isolated modules - 20-28 volts dc ☐ Relay modules	
	Interposing relays.	◉ Yes ○ No ☐ On all I/O circuits ☑ As shown on I/O lists ☑ Discrete outputs only	
	Analog Inputs (AI) Modules.	☐ 4-20mA ☐ With isolation ☐ With (I/I) signal isolators ☐ Other	
	When "Other" is selected, indicate alternative.		
	Analog Output (AO) Modules required.	○ Yes ○ No	
2-3	**Mini PLC Processor**	NOTE: Refer to itemized table.	
	Mini PLC type with rack mounted I/O.	○ Yes ◉ No	
	I/O hardware contained entirely in PLC enclosure.	○ Yes ○ No	
	Type of I/O hardware.	○ Removable ○ Non-removable	
	Discrete Input (DI) Modules.	☐ 100-130 volts ac ☐ 20-28 volts dc ☐ With isolation	
	Discrete Output (DO) Modules.	☐ 1 amp at 100-130 volts ac ☐ 1 amp at 20-28 volts dc ☐ Isolated modules ☐ Relay modules	
	Analog Inputs (AI) Modules.	☐ 4-20mA ☐ With (I/I) signal isolators ☐ Other	
	When "Other" is selected, indicate alternative.		
	Analog Output (AO) Modules.	☐ 4-20mA ☐ Other	

	When "Other" is selected, indicate alternative.		
	Communications (PR 2-4)		
	Communications modules required for:	☑ Local input/output hardware ☑ Remote input/output hardware ☑ Other PLCs ☑ Host computers	
	Communications media.	☑ Cable ☐ Data highway ☐ Fiber optics ☐ Radio	
	Number of addressable nodes required for network.	◉ 30 minimum ○ Other	
	When "Other" is selected, indicate alternative.		
	PLC to PLC Communication hardware.	◉ Yes ○ No	
	PLC to Remote Communication hardware.	◉ Yes ○ No	
	PLC to Host Communications hardware.	◉ Yes ○ No	
	Communication media.	○ PLC comm. network ○ Remote I/O network ◉ Both	
	Data Highway Plus cabling.	○ Yes ◉ No	
	Modbus Plus cabling.	○ Yes ◉ No	
	Metallic LAN cabling.	◉ Yes ○ No	
	Type of metallic LAN cabling.	○ Coaxial ◉ STP	
	Fiber Optic cable.	○ Yes ◉ No	
	Fiber Optic Comm hardware.	○ Yes ◉ No	
	Radio Comm hardware.	○ Yes ◉ No	
	Other Communication equipment required	○ Yes ◉ No	

Case No. 2007-00052

NORTHERN KENTUCKY
WATER DISTRICT

TAYLOR MILL TREATMENT PLANT

UV DISINFECTION

11/20/06

11/20/06

BLACK & VEATCH CORPORATION
CINCINNATI, OHIO
Project Number 143757
2006

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT UV DISINFECTION

Project No. 143757

ADDENDUM NO. 1

December 26, 2006

A. SCOPE. This Addendum No. 1 includes the following:

Addendum: Pages AD1-1 through AD1-4
Prevailing Wage Rates
Pre-Bid Meeting Minutes and Attendance Sheet

This Addendum No. 1 shall cover the following additions, clarifications and changes to the documents and drawings for this project.

B. SPECIFICATIONS.

1. SECTION 00800 – SUPPLEMENTARY CONDITIONS.

   Add the Prevailing Wage Rates in the Attachments to the Supplementary Conditions.

2. SECTION 01300 – SUBMITTALS.

   Replace paragraph 3.02 with the following:

   3.02. Electronic Operation and Maintenance Manuals. Each electronic copy shall be delivered on a unique CD-ROM in Adobe Acrobat's Portable Document Format (PDF).

   Scanned images shall be readable with a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these images. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.

   File size shall be limited to 10 MB. When multiple files are required the least number of files possible shall be created. File names shall use the "eight dot three" convention (XXXXX_YY.pdf), where X is the five digit number corresponding to the specification section, and YY is a two digit number set in sequential order when there is more than one PDF document (more than one O&M manual) per specification section. The initial filename for the O&M submittal will be provided with the request for

final O&M manuals. Example: "11727_00.pdf" is the first file of the Polymer Feed System ESM. Subsequent files shall be named incrementally, 11727_01.pdf, 11727_02.pdf, etc.

Documents prepared in PDF format shall be processed as follows:

1. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.

2. Pages shall be rotated for viewing in proper orientation.

3. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.

4. Embed thumbnails shall be generated for each completed PDF file.

5. The opening view for PDF files shall be as follows:

    i. Initial View: Bookmarks and Page
    ii. Page Number: Title Page (usually Page 1)
    iii. Magnification: Set to Fit in Window
    iv. Page: Single Page

6. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.

7. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.

8. Drawings shall be bookmarked individually.

9. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

3. SECTION 01320 – CONSTRUCTION PROGRESS DOCUMENTATION

   Under Data Sheet, page 1 – Delete the bullet which indicates that the survey data is required.

   Under Data Sheet, page 1 – Add a bullet which indicates that the survey data is not required.

4. SECTION 13700 – UV DISINFECTION SYSTEM

   Under Data Sheet, page 1 – Delete text which indicates that the power enclosure type shall be NEMA 4.

   Under Data Sheet, page 1 – Add the following text to indicate the power enclosure type shall be "NEMA 4 – Control panel; NEMA 12 – Main Power/Ballast panel(s)".

   Under Data Sheet, page 2 – The uninterruptible power supply (UPS) required for UV system indicated shall provide power to the entire UV Disinfection System and shall be provided by the Contractor. Please refer to Specification Section 16610 – Uninterruptible Power Supply for details. A separate UPS shall be provided for the programmable logic controller (PLC) for the UV Disinfection System as indicated in Specification Sections 13500 – Instrumentation and Control System and 13530 – Programmable Logic Controllers.

   Revise the first sentence of the second paragraph of Article 2-4.01, Power Distribution, to state "The main/power ballast enclosure shall be rated NEMA Type 12."

   Revise the first sentence of the third paragraph of Article 2-4.01, Power Distribution, to state "Enclosure cooling shall be rated NEMA Type 12."

5. SECTION 13703 – UV SYSTEM PERFORMANCE TESTING

   Delete the first sentence from the second paragraph of Article 2, Testing, which states "The performance testing protocol shall be done using the test organism MS2 coliphage."

C. DRAWINGS.

1. SHEET G4 – SITE PLAN

   Add the following Note:

   "3. Contractor's staging area shall be acceptable to Owner and Engineer."

2. SHEET C2 – BASEMENT AND FILTER PIPE GALLERY DEMOLITION SECTIONS

   Add the following Note:

   "2. Existing electrical conduit and connections, piping, equipment, etc. interfering with new work shall be relocated or demolished as acceptable to Owner and Engineer."

3. SHEET C5 – MISCELLANEOUS DETAILS

   For Detail E – Connection to Existing Manhole, replace the callout which states "Modular Casing Seals" with the following callout:

   "Grout after pipe installation".

D. PRE-BID MEETING.

1. A copy of the Pre-Bid Meeting Minutes and the Attendance Sheet are attached to this Addendum for the Bidder's reference.

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 his Bid.

December 26, 2006 BLACK & VEATCH CORPORATION

KENTUCKY DEPARTMENT OF LABOR
PREVAILING WAGE DETERMINATION
CURRENT REVISION
LOCALITY NO. 15

KENTON COUNTY

Determination No. CR-2-015 2006

Date of Determination: August 14, 2006

Project No. 059-H-00346-06-2
Type: Heavy/Highway

This schedule of the prevailing rate of wages for Kenton County has been determined in accordance with the provisions of KRS 337.505 to 337.550. This determination shall be referred to as Prevailing Wage Determination No. CR-2-015 2006.

Apprentices shall be permitted to work as such subject to Administrative Regulations adopted by the Executive Director of Workplace Standards. Copies of these regulations will be furnished upon request to any interested person.

Overtime is to be computed at not less than one and one-half (1 1/2) times the indicated BASE RATE for all hours worked in excess of eight (8) per day, and/or in excess of forty (40) per week. However, KRS 337.540 permits an employee and employer to agree, in writing, that the employee will be compensated at a straight time base rate for hours worked in excess of eight (8) hours in any one calendar day, but not more than ten (10) hours worked in any one calendar day, if such written agreement is prior to the over eight (8) hours in a calendar day actually being worked, or where provided for in a collective bargaining agreement. The fringe benefit rate is to be paid for each hour worked at a straight time rate for all hours worked.

Fringe benefit amounts are applicable for all hours worked except when otherwise noted. Welders will receive rate for craft in which welding is incidental.

NOTE: The type of construction shall be determined by applying the following definitions:

BUILDING CONSTRUCTION

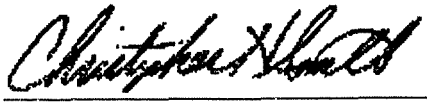
Building construction is the construction of sheltered enclosures with walk-in access for the purpose of housing persons, machinery, equipment, or supplies. It includes all construction of such structures, the installation of utilities and the installation of equipment, both above and below grade level, as well as incidental grading, utilities and paving.

HIGHWAY CONSTRUCTION

Highway construction includes the construction, alteration or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, parking areas, and other similar projects not incidental to building or heavy construction. It includes all incidental construction in conjunction with the highway construction project.

HEAVY CONSTRUCTION

Heavy projects are those projects that are not properly classified as either "building" or "highway". For example, dredging projects, water and sewer line projects, dams, flood control projects, sewage treatment plants and facilities, and water treatment plants and facilities are considered heavy.



Christopher H. Smith, Executive Director
Office of Workplace Standards
Kentucky Department of Labor

Determination No. CR-2-015 2006
August 14, 2006

CLASSIFICATIONS		RATE AND FRINGE BENEFITS	
ASBESTOS/INSULATION WORKERS:			
Asbestos/Insulation Workers: (Includes application of all insulating materials, protective coverings, coatings and finishings to al types of mechanical systems):		BASE RATE FRINGE BENEFITS	$23.18 10.44
Hazardous Material Handlers: (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging & disposing of all insulation materials, whether they contain asbestos or nor, from mechanical systems):		BASE RATE FRINGE BENEFITS	$20.35 7.50
BOILERMAKERS:		BASE RATE FRINGE BENEFITS	$31.29 15.47
BRICKLAYERS:			
Bricklayers, Caulkers, Cleaners, Pointers & Stone Masons:		BASE RATE FRINGE BENEFITS	$25.96 8.64
Refractory:	BUILDING	BASE RATE FRINGE BENEFITS	$26.46 8.64
Marble Setters, Terrazzo Workers, & Tile Setters:	BUILDING	BASE RATE FRINGE BENEFITS	$25.92 7.84
Marble, Terrazzo & Tile Finishers:			
Finishers:	BUILDING	BASE RATE FRINGE BENEFITS	$21.48 7.84
Marble Sanders, Polishers, Waxers, & Sawyers:	BUILDING	BASE RATE FRINGE BENEFITS	$21.55 7.84
Terrazzo Base Grinders (While operating base grinding machine):	BUILDING	BASE RATE FRINGE BENEFITS	$21.90 7.84

CLASSIFICATIONS		RATE AND FRINGE BENEFITS	
CARPENTERS:			
Carpenters & Piledrivermen (Does not include Walls & Ceiling Work):			
	BUILDING	BASE RATE	$19.22
		FRINGE BENEFITS	4.77
	HEAVY & HIGHWAY	BASE RATE	$22.42
		FRINGE BENEFITS	4.73
Carpenters & Lathers (Walls & Ceiling Work Only):			
	BUILDING	BASE RATE	$18.99
		FRINGE BENEFITS	4.98
Divers:	HEAVY & HIGHWAY	BASE RATE	$33.63
		FRINGE BENEFITS	4.73
CEMENT MASONS:	BUILDING	BASE RATE	$21.25
		FRINGE BENEFITS	8.05
	HEAVY & HIGHWAY	BASE RATE	$24.18
		FRINGE BENEFITS	7.35
ELECTRICIANS:			
Electricians:		BASE RATE	$24.24
		FRINGE BENEFITS	9.34
LINE CONSTRUCTION:			
Linemen:	BUILDING	BASE RATE	$24.10
		FRINGE BENEFITS	6.66
Equipment Operator:	BUILDING	BASE RATE	$21.69
		FRINGE BENEFITS	6.21
Groundmen:	BUILDING	BASE RATE	$15.67
		FRINGE BENEFITS	5.10
ELECTRICIAN SOUND COMMUNICATION:			
Installer:		BASE RATE	$18.00
		FRINGE BENEFITS	3.475
Cable Puller:		BASE RATE	$9.00
		FRINGE BENEFITS	2.64

CLASSIFICATIONS		RATE AND FRINGE BENEFITS	
ELEVATOR MECHANICS:		BASE RATE	$30.775
		FRINGE BENEFITS	12.015
GLAZIERS:		BASE RATE	$23.00
		FRINGE BENEFITS	8.40
IRONWORKERS:			
Structural & Ornamental:		BASE RATE	$24.50
		FRINGE BENEFITS	14.62
Fence Erector:		BASE RATE	$22.05
		FRINGE BENEFITS	14.62
Reinforcing:			
Beyond 30-mile radius of Hamilton County, OH Courthouse		BASE RATE	$23.95
		FRINGE BENEFITS	14.00
Up to and including 30-mile radius of Hamilton County, OH Courthouse		BASE RATE	$23.70
		FRINGE BENEFITS	14.00
LABORERS/BUILDING:			
Building & Common Laborer, Cement Mason Tender, Hand Operated Mechanical Mule, Mechanical Sweeper, Signal Person, Asbestos Removal, & Tunnel Laborer:			
	BUILDING	BASE RATE	$22.10
		FRINGE BENEFITS	5.95
Skid Steer, Burning Torch Operator, Jackhammer, Air Spade, Chipping Hammer, Mechanical & Air Tamper Operator, Mechanical Concrete Buggy, Power Operated Mechanical Mule, Concrete Pump Hose Man, Vibrator Man, CERCLA Trained Hazardous Material Removal – Levels A, B, C:			
	BUILDING	BASE RATE	$22.25
		FRINGE BENEFITS	5.95
Gunnite Nozzle Operator:	BUILDING	BASE RATE	$22.85
		FRINGE BENEFITS	5.95
ick Mason Tender:	BUILDING	BASE RATE	$23.75
		FRINGE BENEFITS	5.95

LABORER/HEAVY HIGHWAY:

GROUP 1:
Asphalt Laborer, Carpenter Tender, Concrete Curing applicator, Dump Man (Batch Truck), Guardrail and Fence Installer, Joint Setter, Laborer (Construction), Landscape Laborer, Mesh Handlers & Placer, Right-of-way Laborer, Riprap Laborer & Grouter, Scaffold Erector, Seal Coating, Surface Treatment or Road Mix Laborer, Sign Installer, Slurry Seal, Utility Man, Bridge Man, Handyman, waterproofing Laborer, Flagperson, Hazardous Waste (Level D), Diver Tender, Zone Person & Traffic Control:

HEAVY & HIGHWAY	BASE RATE	$22.97
	FRINGE BENEFITS	6.55

GROUP 2:
Skid Steer, Asphalt Raker, Concrete Puddler, Kettle Man (Pipeline), Machine Driven Tools (Gas, Electric, Air), Mason Tender, Brick Paver, Mortar Mixer, Power Buggy or Power Wheelbarrow, Sheeting & Shoring Man, Surface Grinder Man, Plastic Fusing Machine Operator, Pug Mill Operator, & Vacuum Devices (wet or dry), Rodding Machine Operator, Diver, Screwman or Paver, Screed Person, Water Blast, Hand Held Wand, Pumps 4" & Under (Gas, Air or Electric) & Hazardous Waste (Level C), Air Track and Wagon Drill, Bottom Person, Cofferdam (below 25 ft. deep), Concrete Saw Person, Cutting with Burning Torch, Form Setter, Hand Spiker (Railroad), Pipelayer, tunnel Laborer (without air) & Caisson, Underground Person (working in Sewer and Waterline, Cleaning, Repairing & Reconditioning), Sandblaster Nozzle Person, & Hazardous Waste (Level B):

HEAVY & HIGHWAY	BASE RATE	$23.14
	FRINGE BENEFITS	6.55

GROUP 3:
Blaster, Mucker, Powder Person, Top Lander, Wrencher (Mechanical Joints & Utility Pipeline), Yarner, Hazardous Waste (Level A), Concrete Specialist, Concrete Crew in Tunnels (With Air-pressurized - $1.00 premium), Curb Setter & Cutter, Grade Checker, Utility Pipeline Tapper, Waterline, and Caulker:

HEAVY & HIGHWAY	BASE RATE	$23.47
	FRINGE BENEFITS	6.55

GROUP 4:
Miner (With Air-pressurized - $1.00 premium), & Gunnite Nozzle Person:

HEAVY & HIGHWAY	BASE RATE	$23.92
	FRINGE BENEFITS	6.55

Signal Person will receive the rate equal to the rate paid the laborer classification for which he or she is signaling

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MILLWRIGHTS:	BASE RATE	$21.90
	FRINGE BENEFITS	7.92

CLASSIFICATIONS		RATE AND FRINGE BENEFITS	
OPERATING ENGINEERS/BUILDING:			
GROUP 1			
Boom & Jib 250' over:	BUILDING	BASE RATE	$28.59
		FRINGE BENEFITS	9.31
GROUP 2			
Boom & Jib Over 180' through 249:			
	BUILDING	BASE RATE	$28.34
		FRINGE BENEFITS	9.31
GROUP 3			
Boom & Jib 150' through 180':	BUILDING	BASE RATE	$27.84
		FRINGE BENEFITS	9.31
GROUP 4			
Master Mechanic:	BUILDING	BASE RATE	$27.59
		FRINGE BENEFITS	9.31

GROUP 5

Barrier Moving Machine; Boiler or Compressor Mounted on Crane (Piggy-Back Operation); Boom Truck (All Types); Cableway; Cherry Picker; Combination Concrete Mixer & Tower; All Concrete Pumps with Booms; Crane (All Types); Crane-Compact, Track or Rubber Over 4,000 lbs Capacity; Crane-Self Erecting, Stationary, Track or Truck (All Configurations); Derrick (All Types); Dragline; Dredge (Dipper, Clam or Suction) 3 Man Crew; Elevating Grader or Euclid Loader; Floating Equipment; Forklift(rough terrain with winch/hoist) Gradual; Helicopter Operator & Helicopter Winch Operator (Hoisting Builders Materials); Hoe (All Types); Hoist (Two or More Drums); Horizontal Directional Drill; Hydraulic Gantry (Lift System); Laser Finishing Machine; Laser Screed and Like Equipment; Lift Slab or Panel Jack; Locomotive (All Types); Maintenance Engineer (Mechanic and/or Welder); Mixer, Paving (Multiple Drum); Mobile Concrete Pump With Boom; Panelboard (All Types on Site); Pile Driver; Power Shovel; Prentice Loader; Rail Tamper (with Automatic Lifting & Aligning device); Rotary Drill (All) used on Caisson Work for Foundations & Substructure work; Side Boom; Slip Form Paver; Straddle Carrier (Building Construction on Site); Trench Machine (Over 24" Wide); & Tug Boat:

	BUILDING	BASE RATE	$27.34
		FRINGE BENEFITS	9.31

GROUP 6

Asphalt Paver; Bobcat-type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Bulldozer; C.M.I. Type Equipment; Endloader; Hydro Milling Machine; Kolman Type Loader (Dirt Loading); Lead Greaseman; Mucking Machine; Pettibone-Rail Equipment; Power Grader; Power Scoop; Power Scraper; Push Cat; Rotomill (All), Grinders & Planers of All Types & Vermeer Type Concrete Saw:

	BUILDING	BASE RATE	$27.22
		FRINGE BENEFITS	9.31

OPERATING ENGINEERS/ BUILDING: (Continued)

GROUP 7
A-Frame; Air Compressor Pressurizing Shafts or Tunnels; Asphalt Roller (All); Bobcat-type and/or Skid Steer Loader with or without Attachments; Boiler (15 lbs. pressure & over); All Concrete Pumps without Booms & with 5" System; Forklift (Except Masonry); Highway Drills-All Types (with Integral Power); Hoist (One Drum); House Elevator (except those automatic call button controlled); Man Lift; Material Hoist/Elevator; Mud Jack; Pressure Grouting; Pump (Installing or Operating Well Points or other Type of Dewatering Systems); Pump (4" and over Discharge); Railroad Tie Inserter/Remover; Rotovator (Lime soil Stabilizer); Submersible Pump (4" and over Discharge); Switch & Tie Tamper (w/o lifting & aligning device); Trench Machine (24" & under); & Utility:

	BUILDING	BASE RATE	$26.18
		FRINGE BENEFITS	9.31

GROUP 8
Ballast Relocator; Backfiller & Tamper; Batch Plant; Bar & Joint Installing Machine; Bull Floats; Burlap & Curing Machines; Clefplanes; Compressor on Building Construction; Concrete Mixer, Capacity more than one bag; Concrete Mixer, one bag capacity (side loader); All Concrete Pumps without Booms with 4" or Smaller System; Concrete Spreading Machine; Conveyor, used for handling building materials; Crusher; Deckhand; Drum Fireman in Asphalt Plant; Farm Type Tractor, Pulling Attachments; Finishing Machines; Form Trencher; Generator; Gunite Machine; Hydro-Seeder; Pavement Breaker (Hydraulic or Cable); Post Driver; Post Hole Digger; Pressure Pump (over 1/2" discharge); Road Widening Trencher; Roller (except Asphalt); Self-propelled Power Spreader; Self-propelled Sub-Grader; Shotcrete Machine; Tire Repairman; Tractor (Pulling Sheep Foot Roller or Grader); VAC/ALL; Vibratory Compactor (with Integral Power) & Welder:

	BUILDING	BASE RATE	$25.00
		FRINGE BENEFITS	9.31

GROUP 9
Allen Screed Paver(concrete); Boiler (Less than 15 lbs. pressure); Crane-Compact, Track or Rubber under 4,000 lbs.; Directional Drill "Locator"; Inboard & Outboard Motor Boat Launch; Light Plant; Masonry Forklift; Oiler; Power Driven Heater (Oil Fired); Power Scrubber; Power Sweeper; Pump (Under 4" discharge); & Submersible Pump (Under 4" discharge):

	BUILDING	BASE RATE	$19.54
		FRINGE BENEFITS	9.31

OPERATING ENGINEERS/HEAVY HIGHWAY:

Master Mechanic:	HEAVY & HIGHWAY	BASE RATE	$27.59
		FRINGE BENEFITS	9.31

GROUP 1
Air Compressor on Steel Erection; Barrier Moving Machine; Boiler Operator on Compressor or Generator when mounted on a Rig; Cableway; Combination Concrete Mixer & Tower; Concrete Plant (over 4 yd. capacity); Concrete Pump; Crane (All Types, Including Boom Truck, Cherry Picker); Crane-Compact, Track or Rubber over 4,000 lbs. capacity; Cranes-Self Erecting, Stationary, Track or Truck (All Configurations); Derrick; Dragline; Dredge (Dipper, Clam or Suction); Elevating Grader or Euclid Loader; Floating Equipment (All Types); Gradual; Helicopter Crew (Operator-Hoist or Winch); Hoe (all

OPERATING ENGINEERS: (Continued)

GROUP 1 (Continued):
types); Hoisting Engine on Shaft or Tunnel Work; Horizontal Directional Drill (over 500,000 ft. lbs. thrust); Hydraulic Gantry (Lifting System); Industrial-Type Tractor; Jet Engine Dryer (D8 or D9) Diesel Tractor; Locomotive (Standard Gauge); Maintenance Operator Class A; Mixer, Paving (Single or Double Drum); Mucking Machine; Multiple Scraper; Piledriving Machine (All Types); Power Shovel; Prentice Loader; Quad 9 (Double Pusher); Rail Tamper (with auto lifting & aligning device); Refrigerating Machine (Freezer Operation); Rotary Drill, on Caisson work; Rough Terrain Fork Lift with Winch/Hoist; Side-Boom; Slip-Form Paver; Tower Derrick; Tree Shredder; Trench Machine (Over 24" wide); Truck Mounted Concrete Pump; Tug Boat; Tunnel Machine and/or Mining Machine; & Wheel Excavator:

HEAVY & HIGHWAY	BASE RATE	$27.34
	FRINGE BENEFITS	9.31

GROUP 2
Asphalt Paver; Automatic Subgrader Machine, Self-Propelled (CMI Type); Bobcat Type and/or Skid Steer Loader with Hoe Attachment Greater than 7,000 lbs.; Boring Machine More than 48"; Bulldozer; Endloader; Hydro Milling Machine; Kolman-type Loader (production type-Dirt); Lead Greaseman; Lighting & Traffic Signal Installation Equipment (includes all groups or classifications); Material Transfer Equipment (Shuttle Buggy) Asphalt; Pettibone-Rail Equipment; Power Grader; Power Scraper; Push Cat; Rotomill (all), Grinders & Planers of All types; Trench Machine (24" wide & under); & Vermeer type Concrete Saw:

HEAVY & HIGHWAY	BASE RATE	$27.22
	FRINGE BENEFITS	9.31

GROUP 3
A-Frame; Air Compressor on Tunnel Work (low pressure); Asphalt Plant Engineer; Bobcat-type and/or Skid Steer Loader with or without Attachments; Highway Drills (all types); Locomotive (narrow gauge); Material Hoist/Elevator; Mixer, Concrete (more than one bag capacity); Mixer, one bag capacity (Side Loader); Power Boiler (Over 15 lbs. Pressure) Pump Operator installing & operating Well Points; Pump (4" & over discharge); Roller, Asphalt; Rotovator (lime soil stabilizer); Switch & Tie Tampers (without lifting & aligning device); Utility Operator (Small equipment); & Welding Machines:

HEAVY & HIGHWAY	BASE RATE	$26.18
	FRINGE BENEFITS	9.31

GROUP 4
Backfiller; Ballast Re-locator; Bars, Joint & Mesh Installing Machine; Batch Plant; Boring Machine Operator (48" or less); Bull Floats; Burlap & Curing Machine; Concrete Plant (capacity 4 yd. & under); Concrete Saw (Multiple); Conveyor (Highway); Crusher; Deckhand; Farm-type Tractor with attachments (highway) except Masonry); Finishing Machine; Fireperson, Floating Equipment (all types); Fork Lift (highway); Form Trencher; Hydro Hammer; Hydro Seeder; Pavement Breaker; Plant Mixer; Post Driver; Post Hole Digger (Power Auger); Power Brush Burner; Power Form Handling Equipment; Road Widening Trencher; Roller (Brick, Grade & Macadam); Self-Propelled Power Spreader; Self-Propelled Power Subgrader; Steam Fireperson; Tractor (Pulling Sheepfoot, Roller or Grader); & Vibratory Compactor with Integral Power:

HEAVY & HIGHWAY	BASE RATE	$25.00
	FRINGE BENEFITS	9.31

OPERATING ENGINEERS/HEAVY HIGHWAY: (Continued)

GROUP 5
Compressor (Portable, Sewer, Heavy & Highway); Drum Fireperson (Asphalt); Generator; Inboard-Outboard Motor Boat Launch; Masonry Fork Lift; Oil Heater (asphalt plant); Oiler; Power Driven Heater; Power Sweeper & Scrubber; Pump (under 4" discharge); Signalperson; Tire Repairperson; & VAC/ALLS:

	HEAVY & HIGHWAY	BASE RATE	$19.54
		FRINGE BENEFITS	9.31

PAINTERS:

Brush, Roller, Paper Hanging & Drywall Taping:

	BUILDING	BASE RATE	$22.45
		FRINGE BENEFITS	6.20
Spray:	BUILDING	BASE RATE	$22.95
		FRINGE BENEFITS	6.20
Sandblasting, Waterblasting:	BUILDING	BASE RATE	$23.20
		FRINGE BENEFITS	6.20
Lead Abatement:	BUILDING	BASE RATE	$23.45
		FRINGE BENEFITS	6.20
Sign Painter & Erector:	BUILDING	BASE RATE	$17.57
		FRINGE BENEFITS	4.55

PAINTERS/ HEAVY & HIGHWAY

Bridge/Equipment Tender and/or Containment Builder:

	HEAVY & HIGHWAY	BASE RATE	$19.93
		FRINGE BENEFITS	6.20
Brush & Roller:	HEAVY & HIGHWAY	BASE RATE	$22.45
		FRINGE BENEFITS	6.20
Spray:	HEAVY & HIGHWAY	BASE RATE	$22.95
		FRINGE BENEFITS	6.20

PAINTERS/ Bridges – Guardrails-Lightpoles- Striping: (Continued)

Sandblasting & Water Blasting:			
	HEAVY & HIGHWAY	BASE RATE	$23.20
		FRINGE BENEFITS	6.20
Elevated Tanks; Steeplejack Work; Bridge & Led Abatement:			
	HEAVY & HIGHWAY	BASE RATE	$23.45
		FRINGE BENEFITS	6.20
PIPEFITTERS & PLUMBERS:		BASE RATE	$26.32
		FRINGE BENEFITS	11.72
PLASTERERS:	BUILDING	BASE RATE	$20.65
		FRINGE BENEFITS	7.25
ROOFERS (excluding sheetmetal):			
Roofers:		BASE RATE	$24.12
		FRINGE BENEFITS	7.62
Pitch:		BASE RATE	$25.12
		FRINGE BENEFITS	7.62
SHEETMETAL WORKERS (including metal roofs):		BASE RATE	$24.84
		FRINGE BENEFITS	12.55
SPRINKLER FITTERS:		BASE RATE	$27.05
		FRINGE BENEFITS	11.65
TRUCK DRIVERS/BUILDING:			
3 Tons & Under, Greaser, Tire Changer, & Mechanic Tender:			
	BUILDING	*BASE RATE	$17.52
		FRINGE BENEFITS	8.04

TRUCK DRIVERS/BUILDING: (Continued)

Over 3 Tons, Semi-Trailer or Pole Trailer, Dump Tandem Axles, Farm Tractor (When used to pull building material & equipment):

	BUILDING	*BASE RATE	$17.63
		FRINGE BENEFITS	8.04

Concrete Mixer (Hauling on jobsites), & Truck Mechanic:

	BUILDING	*BASE RATE	$17.70
		FRINGE BENEFITS	8.04

Euclids & Other Heavy Moving Equipment, Lowboy, Winch, A-Frame & Monorail Truck (To transport building materials):

	BUILDING	*BASE RATE	$17.80
		FRINGE BENEFITS	8.04

***Work on Hazardous or Toxic Waste Site - $4.00 Premium**

TRUCK DRIVER/HEAVY HIGHWAY:

Driver:	HEAVY & HIGHWAY	BASE RATE	$15.85
		FRINGE BENEFITS	4.60

Euclid Wagon, End Dump, Lowboy, Heavy Duty Equipment, Tractor-Trailer Combination, & Drag:

	HEAVY & HIGHWAY	BASE RATE	$16.29
		FRINGE BENEFITS	4.60

End of Document CR-2-015 2006
August 14, 2006

BLACK & VEATCH

CONFERENCE MEMORANDUM

Northern Kentucky Water District
Taylor Mill Treatment Plant UV Disinfection
Pre-Bid Meeting Minutes

B&V Project 143757.420
December 21, 2006

Meeting held on December 19, 2006, at 9:00 a.m., local time, at the Northern Kentucky Water District (NKWD) Taylor Mill Treatment Plant.

Recorded by: Marissa Albright

Attending: See attached attendance sheet

1. Attendance – Attendance sheet is attached. The Pre-Bid meeting is not mandatory. The meeting minutes to the Pre-Bid Meeting will be distributed with Addendum No. 1.

2. Introductions of Owner and Engineer staff present at the meeting:
   - Bari Joslyn, Vice President of Water Quality & Production – NKWD
   - Amy Kramer, Design Engineering Manager – NKWD
   - Bill Wulfeck, Operations Manager – NKWD
   - Jim Dierig, Maintenance Manager – NKWD
   - Donnie Ginn, Project Manager – B&V
   - Marissa Albright, Engineering Manager – B&V
   - Mark Magella, Electrical Engineer – B&V

3. Project Discussion – The following facilities and areas of work were discussed.
   - UV Disinfection
     - UV reactors and control panels
     - Piping modifications
     - Chemical modifications
   - New Electrical Service
     - Service connections from the power lines located along Grand Avenue
     - Vault construction
     - Equipment
   - Uninterruptible Power Supply – location and electrical connections.

4. Contract Documents
   - Contract specifications
   - Contract drawings

5. Addenda – One Addendum is planned to be during the week of December 26, 2006. B&V will send the Addendum via regular mail to the Plan Holders. The addendum will address questions raised at the Pre-Bid Meeting and other questions received.

6. Bid Form – The Lump Sum Base Bid includes all Work indicated on the drawings and specifications. The Alternative Bid item is listed in the Bid Form separately.
   - Alternative Bids (see Bid Form for additional details).
     - Uninterruptible Power Supply. (deduct)
   - The Bidder must provide a Bid for each of the bid lines, including the Lump Sum Base Bid and Alternative Bid items.
   - Bidder shall include a completed Guaranteed Present Worth Form and information provided by the UV equipment supplier for the UV Disinfection System as indicated in specification section 13700, 1-3, including but not limited to references, calculations, guaranteed operating life of components, recommended spare parts list, maintenance schedules and description and fee for the Service and Maintenance Agreement.
   - Completion dates
     - Substantial Completion is 370 days following the Notice to Proceed.
     - Final Completion is 400 days following the Notice to Proceed.
   - Liquidated Damages – The fees are on a per day basis.
     - Substantial Completion = $750.00 for each day past the Substantial Completion date until the Work is substantially complete.
     - Final Completion = $350.00 for each day past the Final Completion date until work is finally complete.

7. Other Bid Forms – These forms shall be filled out with the Bid.
   - List of Subcontractors
   - Equipment Questionnaire
   - Bid Bond

8. Owner's Forms – The following forms shall be filled out with the Bid:
   - Non-Collusion Affidavit

   The following forms are required if the Bidder is awarded the Contract:
   - Construction Contract
   - Escrow Agreement
   - Performance Bond
   - Construction Payment Bond

- Certificate of Liability Insurance
- Certificate of Property Insurance

9. Employment Requirements and Wage Rates – Employment requirements and wage rates will be included with Addendum No. 1.

10. Insurance and Bonds Requirements – The insurance and bonds requirements for the Contract are explained in detail in Section 00800, Supplementary Conditions. Bidder's attention is directed to the requirements, including but not limited to: the waiver of subrogation requirements, "all states" or "other states" endorsement, and naming of additional insured. The Bidder shall be familiar with the requirements in order to submit correct insurance and bond forms and verify that all requirements are met if they are the Successful Bidder.

11. Other Construction Contracts – Work consists of connection of a new service line by Duke Energy and installation of conduit to the new electrical transformer. Duke Energy will also install the new electrical transformer.

    Work also consisting of construction and installation of a new backwash treatment system east of the Sludge Handling Facility.

    Contractor shall coordinate work as required with the other contractors and utilities.

12. Connections to Existing Facilities, Shutdowns and Coordination – Existing facilities shall be kept in continuous operation throughout the construction period. Operational constraints, construction coordination, construction plans and connections to existing facilities are discussed in Section 01015. Provided permission is obtained from the Owner in advance, portions of the existing facilities may be taken out of service for short periods corresponding with periods of minimum service demands. The Contractor shall notify the Owner and Engineer in writing at least 14 days in advance of a proposed shutdown. Extended plant shutdowns shall not exceed 14 consecutive days and may be permitted between October 1 and May 1 when acceptable to the Owner.

    Contractor shall provide temporary facilities and make temporary modifications (temporary bypass pumping and/or temporary bypass piping) as necessary to keep the existing facilities in operation during the construction

period. Refer to Section 01015 for all constraints as well as details on developing a Construction Plan.

13. Training – Training shall be provided as described in specification section 01020. The training is separate from normal start-up and includes both classroom and site training, as specified. The training shall include the following equipment:

    - Ultraviolet Disinfection System
    - Miscellaneous Equipment
        - AWWA Butterfly valves
        - Uninterruptible Power Supply

14. Submittals
    - Construction Scheduling – A progress schedule shall be submitted in accordance with Section 01310. Revised schedules shall be submitted at a minimum frequency of every 30 days. An electronic copy and 5 hard copies shall be submitted.
    - Construction Progress Documentation – A Schedule of Values and Schedule of Payments shall be submitted in accordance with Section 01320.
    - Concrete submittal requirements – Reports and certifications on the proposed materials and mixture proportions for each concrete mixture design shall be submitted for review within 30 days after the Notice to Proceed. Refer to Section 03301 for details.
    - Instrumentation and control (I&C) submittal requirements – Refer to Section 13500 for First Stage and Second Stage submittal requirements. Prior to any equipment being released for shipment to the site and before factory testing is scheduled; the First and Second Stage I&C submittals shall be submitted and accepted.

15. SCADA and Configuration Work – The control system configuration work associated with this Contract will be performed by the Owner. Refer to Division 13 for the control system configuration specifications. Contractor shall coordinate with the Owner as specified in Division 13 to complete the configuration work.

16. Site Security and Administration – Contractor shall be responsible for all areas of site used by it, and by all subcontractors and suppliers in the

performance of the Work. Contractor shall keep the site secure at all times. Refer to Sections 01015 and 01500 for requirements.

17. Bid Opening – Tuesday, January 9, 2007 at 2:00 p.m. local time at the Northern Kentucky Water District, 2835 Crescent Springs Road, P.O. Box 18640, Erlanger, Kentucky 41018.

18. Miscellaneous Items
    - For additional site visits, please contact Amy Kramer, Design Engineering Manager with the Northern Kentucky Water District at (859) 578-9898.

19. Questions

    - Q. Is the conduit between the electrical vault and the building existing?
      A. The conduit between the existing electrical handhole located north of the existing Filter to Waste Basin and the building is existing. The conduit from the vault to this electrical handhole will be new.

    - Q. How far will the flagpole be relocated from its current location?
      A. For bidding purposes, it should be assumed that the flagpole will be relocated within 50 feet of its existing location and not beyond the existing pavement.

20. Plant Tour – A plant tour followed the Pre-Bid Meeting to give the Bidders an opportunity to visit the site and ask additional questions.

NORTHERN KENTUCKY WATER DISTRICT
Taylor Mill Treatment Plant UV Disinfection
Pre-Bid Meeting

Attendance Sheet

December 19, 2006

Name	Company	Telephone
MARISSA ALBRIGHT	B&V	513·936·5148
Bill Wulfeck	NKWD	859-547-3295
Jim Dierig	NKWD	859-547-3263
Kim Gilman	BCI	859-781-9500
Donnie Ginn	B&V	513-936-5117
MARK MAGELLA	BV	513-936-5105
BARI JOSLYN	NKWD	859 547 3272
DONALD J. JANSEN	SECO ELECTRIC	859-491-2884
Amy Kramer	NKWD	859-426-2734

NORTHERN KENTUCKY WATER DISTRICT
TAYLOR MILL TREATMENT PLANT UV DISINFECTION

Project No. 143757

ADDENDUM NO. 2

January 4, 2007

A. SCOPE. This Addendum No. 2 includes the following:

Addendum: Pages AD2-1 through AD2-2

This Addendum No. 2 shall cover the following additions, clarifications and changes to the documents and drawings for this project.

B. DRAWINGS.

1. SHEET E4 – POWER ONE-LINE DIAGRAMS

   For circuit designated UPS-1, replace the circuit description "UPS-1:3-250KCML, #2G, 2-1/2" with the following:

   "UPS-1:3-500KCML, #4G, 3".

   For circuit designated PPU-1, replace the circuit description "PPU-1:3-#1/0, #8G, 2" with the following:

   "PPU-1:3-#1/0, #6G, 2".

   For circuit designated PPU-2, replace the circuit description "PPU-2:3-#1/0, #8G, 2" with the following:

   "PPU-2:3-#1/0, #6G, 2".

2. SHEET E6 – BASEMENT AND FILTER PIPE GALLERY POWER PLAN

   For the area bounded by Filters 1 through 4, identified FILTER PIPE GALLERY, the area shall be designated "AREA TYPE 4" requiring minimum NEMA type 4 enclosures, unless noted otherwise, for equipment and gasketed fittings in a conduit system.

For the remaining basement area, identified BASEMENT PIPE GALLERY, the area shall be designated "AREA TYPE 12" including the continuation into the corridor requiring minimum NEMA type 12 gasketed enclosures, unless noted otherwise, for equipment and gasketed fittings in conduit system.

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 his Bid.

January 4, 2007 BLACK & VEATCH CORPORATION

NORTHERN KENTUCKY WATER DISTRICT

TAYLOR MILL TREATMENT PLANT

UV DISINFECTION

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Section 00020

INVITATION TO BID

Date: November 30, 2006

Sealed Bids will be received by the Northern Kentucky Water District (Owner) at 2835 Crescent Springs Road, P.O. Box 18640, Erlanger, Kentucky 41018 until 2:00 p.m., local time, January 9, 2007, for the Taylor Mill Treatment UV Disinfection project.

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

The proposed Work is generally described as follows:

The installation of a new ultraviolet (UV) disinfection system, electrical utility service and uninterruptible power supply (UPS) at the Taylor Mill Treatment Plant. The UV disinfection system will include two UV reactors, local control panels for each reactor, piping, valves and associated electrical and instrumentation. The UV disinfection system also includes chemical feed piping modifications for sodium hypochlorite, caustic soda, corrosion inhibitor and fluoride. The new electrical utility service will include a concrete vault for a new pad mounted transformer (to be provided by others), service entrance switchboard and distribution power panels.

A Service and Maintenance Contract for maintaining the UV disinfection system shall be prepared by the UV equipment manufacturer.

All Bids must be in accordance with the Bidding Documents on file with Owner at 2835 Crescent Springs Road, P.O. Box 18640, Erlanger, Kentucky, 41018, Tel: (859) 578-9898, and at the office of Black & Veatch Corporation, 11500 Northlake Drive, Suite 205, Cincinnati, Ohio 45249, Tel: (513) 984-6630.

Copies of the Bidding Documents have also been provided to:

F. W. Dodge
7625 Kenwood Road, Suite 200
Cincinnati, Ohio 45236
(513) 345-8200

Copies of the Bidding Documents may be obtained from Black & Veatch Corporation at the address indicated herein on the following basis:

	Charge
Complete set of Bidding Documents	$130
Complete set of Drawings	$50
Complete copy of the Project Manual	$80

Charges for Bidding Documents and mailing and handling, if applicable, will not be refunded.

Neither Owner nor Engineer has any responsibility for the accuracy, completeness or sufficiency of any bid documents obtained from any source other than the source indicated in these documents. Obtaining these documents from any other source(s) may result in obtaining incomplete and inaccurate information. Obtaining these documents from any source other than directly from the source listed herein may also result in failure to receive any addenda, corrections, or other revisions to these documents that may be issued.

All entities doing business in the State of Kentucky must be registered in and licensed by the Secretary of State. Subcontractors must be licensed in the State of Kentucky as required.

Attendance at a pre-Bid conference, as specified in the Instructions to Bidders, is not mandatory.

Bids will be received on a lump sum basis, including alternatives and forms as described in the Contract Documents.

Bid security in the form of a certified check or Bid Bond in the amount of ten percent of the maximum total bid price must accompany each Bid.

The Successful Bidder will be required to furnish a Construction Performance Bond and a Construction Payment Bond as security for the faithful performance and the payment of all bills and obligations arising from the performance of the Contract.

Contractor and all Subcontractors will be required to conform to the labor standards set forth in the Contract Documents. This project falls under the provisions of KRS 337.505 to 337.550 for prevailing wages.

Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, non-responsive, incomplete, unbalanced, or conditional Bids, 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 waive informalities.

Owner reserves the right to negotiate with the apparent Successful Bidder to such an extent as may be determined by Owner.

If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within the number of days set forth in the Bid Form for acceptance of the Bid.

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. Arrangements for site visits shall be made by calling Ms. Amy Kramer with the Northern Kentucky Water District at (859) 578-9898 x 2048. Minority Bidders are encouraged to bid.

By: Bari Joslyn
Vice President
Water Quality & Distribution

End of Section

Section 00100

INSTRUCTIONS TO BIDDERS

ARTICLE 1 - DEFINED TERMS

1.01. Terms used in these Instructions to Bidders shall have the meanings assigned to them in the General Conditions and in the Supplementary Conditions. Additional terms used in these Instructions to Bidders shall have the meanings indicated below, which are applicable to both the singular and plural thereof.

A. Bidder – An individual or entity who submits a Bid directly to the Owner.

B. Issuing Office – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

C. Successful Bidder – The Bidder to whom Owner (on the basis of Owner's evaluation as herein provided) makes an award.

1.02. Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

2.01. Bidding Documents may be obtained from the Issuing Office of Black & Veatch Corporation, 11500 Northlake Drive, Suite 205, Cincinnati, Ohio 45249, Tel: (513) 984-6630, on the following basis:

	Charge
Complete set of Bidding Documents	$130
Complete set of Drawings	$50
Complete copy of the Project Manual	$80

Charges for Bidding Documents are not refundable.

2.02. Complete sets of Bidding Documents must be used in preparing Bids; Owner and Engineer will assume no responsibility for errors or misrepresentations resulting from the use of incomplete sets of Bidding Documents.

2.03. 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.

2.04. Neither Owner nor Engineer has any responsibility for the accuracy, completeness or sufficiency of any bid documents obtained from any source other than the source indicated in these documents. Obtaining these documents from any other source(s) may result in obtaining incomplete and inaccurate information. Obtaining these documents from any source other than directly from the source listed herein may also result in failure to receive any addenda, corrections, or other revisions to these documents that may be issued.

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

3.01. To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid written evidence on financial data, previous experience, present commitments, and other such data as may be requested by Owner or Engineer. The Bid shall contain evidence of Bidder's qualification to do business in the state of Kentucky. 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 Bidder shall provide a list of all UV disinfection equipment type projects it has completed, stating location, completion date, contact names and telephone numbers.

ARTICLE 4 - EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01. Underground Facilities

A. Information and data reflected in the Bidding Documents with respect to Underground Facilities at or contiguous to the Site are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities 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. Hazardous Environmental Condition

A. The Supplementary Conditions identify those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that Engineer has used in preparing the Bidding Documents.

B. Copies of such reports and drawings will be made available by Owner to Bidder upon request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.06 of the General Conditions has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports, or shown or indicated on such drawings.

4.03. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Bidding Documents or identified in the Contract Documents to be within the scope of the Work appear in Paragraph 4.06 of the General Conditions.

4.04. 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.

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. Arrangements for Site visits shall be made by calling Ms. Amy Kramer with the Northern Kentucky Water District at (859) 578-9898 x 2048.

4.05. Reference is made to the Supplementary Conditions and the Project Requirements section of Division 1 for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities or other prime contractors) that relates to the Work for which a Bid is to be submitted.

4.06. It is the responsibility of each Bidder before submitting a Bid to:

A. Examine and carefully study the Bidding Documents, including any Addenda and other related data identified in the Bidding Documents;

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

D. Carefully study all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions, and carefully study all reports and drawings of a Hazardous Environmental Condition, if any, at the Site which have been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions;

E. Obtain and carefully study (or assume responsibility for doing so) all additional or supplementary examinations, 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 any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents and safety precautions and programs incident thereto;

F. 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 Bidding Documents;

G. Become aware of the general nature of the Work to be performed by Owner or others at the Site that relates to the Work indicated in the Bidding Documents;

H. Correlate 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;

I. Promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

J. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

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

ARTICLE 5 - PRE-BID CONFERENCE

5.01. A pre-Bid conference will be held at 9:00 a.m. on the 19th day of December, 2006 at the Taylor Mill Treatment Plant, located at 608 Grand Avenue in Taylor Mill, Kentucky 41015 and will include a plant site visit. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are recommended to attend and participate in the conference. In response to questions arising at the conference, Engineer will issue Addenda as Engineer considers necessary. Minutes of the meeting will be distributed as part of an Addendum.

5.02. Bidders are responsible for legibly signing the attendance list and for making sure their names appear on the attendance list which will be attached to the minutes of the pre-Bid conference.

ARTICLE 6 - SITE AND OTHER AREAS

6.01. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and other lands designated for use by Contractor in performing the Work are identified in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise specified in the Bidding Documents.

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

7.01. All questions about the meaning or intent of the Bidding Documents shall be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than 10 days prior to the date for opening of Bids may not be answered. Only answers issued by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

ARTICLE 8 - BID SECURITY

8.01. Each Bid must be accompanied by Bid security made payable without condition to Owner in an amount of 10 percent of Bidder's maximum Bid and in the form of a certified check or Bid Bond issued by a surety meeting the requirements set forth in the Supplementary Conditions. The Bid Bond shall be submitted on the form included in the Bidding Documents.

8.02. The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement, 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 Agreement and to furnish the required contract security within the number of days set forth in the Bid Form, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the later of 7 days after the Effective Date of the Agreement or the day after the last day the Bids remain subject to acceptance as set forth in the Bid Form, whereupon Bid security furnished by such Bidders will be returned.

ARTICLE 9 - CONTRACT TIMES

9.01. The numbers of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Times) are set forth in the Bid Form.

ARTICLE 10 - LIQUIDATED DAMAGES

10.01. Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 - SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01. 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. Application for review of substitute or "or-equal" materials or equipment will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any application for review of substitute or "or-equal" items by Contractor and consideration by Engineer is set forth in Paragraph 6.05 of the General Conditions and may be supplemented in the Project Requirements section of Division 1, General Requirements.

ARTICLE 12 - SUBCONTRACTORS, SUPPLIERS, AND OTHERS

12.01. If the Bidding Documents require the identity of certain Subcontractors, Suppliers, and other individuals or entities to be submitted to Owner, each Bidder shall submit to Owner with its Bid the List of Subcontractors, completed with the names of all such Subcontractors, Suppliers, and other individuals and entities proposed for those portions of the Work for which such identification is required. The list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity, if requested by Owner. If, after due investigation, Owner or Engineer has reasonable objection to any proposed Subcontractor, Supplier, or other individual or entity, Owner may, before the Notice of Award is given, request the apparent Successful Bidder to submit an acceptable substitute without an increase in the Bid.

12.02. If the apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to another Bidder that proposes to use acceptable Subcontractors, Suppliers, and other individuals and entities. Declining to make requested substitutions will not constitute grounds for sacrificing the bid security of any Bidder. Any Subcontractor, Supplier, or other individual or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer, subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General Conditions.

12.03. Contractor shall not be required to employ any Subcontractor, individual, or entity against whom Contractor has a reasonable objection.

12.04. Manufacturers' Data. The List of Subcontractors and the Questionnaires submitted as provided herein shall be accompanied by two prints or copies of data on equipment and materials to be furnished by each Supplier or manufacturer named on the List of Subcontractors and the Questionnaires. The data shall indicate the physical characteristics of the equipment and materials to be furnished. Although the drawings and specifications submitted prior to the Notice of Award need not be complete, they must contain sufficient detail for Engineer to determine whether the materials and equipment will comply with the Contract Documents.

Preliminary acceptance of equipment listed by manufacturer's name shall not in any way constitute a waiver of the specifications covering such equipment; final acceptance will be based on full conformity with the Contract Documents.

12.05. Any Bid conditioned upon furnishing equipment or materials which are not responsive to the Bidding Documents will be rejected.

ARTICLE 13 - PREPARATION OF BIDS

13.01. The Bid Forms listed in the Table of Contents are bound in the Bidding Documents and shall not be removed therefrom unless otherwise specified. The Bid shall be completed in ink.

13.02. All blanks in the Bid Form shall be filled. A bid price shall be indicated for each Bid item and alternative listed therein, or the words "No Bid", "No Charge", "No Change", or other appropriate phrase shall be entered.

13.03. A Bid by a corporation shall be executed in the corporate name by the president or the vice-president or by another corporate officer, accompanied by evidence of authority to sign for the corporation.

13.04. A Bid by a partnership shall be executed in the partnership name and signed by a partner, accompanied by evidence of authority to sign.

13.05. A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm shall be shown below the signature.

13.06. A Bid by an individual shall show the Bidder's name.

13.07. A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form.

13.08. The names of all persons signing shall be legibly printed below their signatures. A Bid by a person who affixes to its signature the word "president", "secretary", "agent", or other designation without disclosing its principal may be held to be the Bid of the individual signing. When requested by Owner, evidence of the authority of the person signing shall be furnished.

13.09. The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers and dates of which shall be filled in on the Bid Form.

13.10. No alterations in a Bid by erasures, interpolations, or otherwise, will be acceptable unless each such alteration is signed or initialed by Bidder; if initialed, Owner may require Bidder to identify any alteration so initialed.

13.11. The Bid shall contain the Guaranteed Present Worth form, completed by the UV equipment manufacturer named on the List of Subcontractors for the UV Disinfection System.

13.12. The Bid shall contain information provided by the UV equipment manufacturer named on the List of Subcontractors for the UV Disinfection System as indicated in specification 13700, 1-3.

ARTICLE 14 - BASIS OF BID; EVALUATION OF BIDS

14.01. Bids shall be priced on a lump sum basis for the base contract and the following alternative:

Alternative A:	Deletion of work associated with the installation of the Uninterruptible Power Supply. See Section 01015 – Project Requirements for a detailed description of the Work to be deleted (deduct).

The price bid for the alternative shall be the amount to be deducted from the Base Bid if Owner selects the alternative.

The lowest Base Bid and information provided in the Guaranteed Present Worth Table will be utilized in Bid evaluation.

14.02. Bidder shall prepare and submit with its Bid the Questionnaires listing the Suppliers and the manufacturers of items of equipment and materials that Bidder proposes to furnish.

ARTICLE 15 - SUBMISSION OF BIDS

15.01. Bids shall be submitted no later than the time and at the place indicated in the Invitation to Bid, or at the modified time and place indicated by Addendum. Bids shall be enclosed in an opaque, sealed envelope or wrapping, addressed to:

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

15.02. Bids shall be marked with the Project title, name and address of the Bidder, and shall be accompanied by the Bid security and other required documents. If the Bid is sent through the mail or by other delivery system, the sealed envelope shall be enclosed in a separate envelope, with the notation "BID ENCLOSED" on the face of it.

15.03. Each bid envelope shall be identified on the outside with the words "Bid for Taylor Mill Treatment Plant UV Disinfection".

15.04. 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 will be returned unopened.

15.05. Each Bid shall be accompanied by a completed Bid Form, including the Guaranteed Present Worth Table. Instructions for completing the table are included in Section 13700 – UV Disinfection System. A copy of the UV equipment manufacturer's Service and Maintenance Contract shall be included with the Bid.

15.06. Each Bid shall be accompanied by a completed Bid Bond, List of Subcontractors and Equipment Questionnaire.

15.07. Each Bid shall be accompanied by a properly executed Non-Collusion Affidavit.

15.08. 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 will be returned unopened.

15.09. One copy of the Project Manual that contains the Bid Form must be submitted with the Bid.

15.10. Oral, telephone, facsimile, electronic mail, or telegraph Bids are invalid and will not receive consideration.

15.11. No Bidder may submit more than one Bid. Multiple Bids under different names will not be accepted from one firm or association.

ARTICLE 16 - MODIFICATION AND WITHDRAWAL OF BID

16.01. 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.

16.02. If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 - OPENING OF BIDS

17.01. Bids will be publicly opened at the time and place indicated in the Invitation to Bid and, unless obviously non-responsive, read aloud. An abstract of the amounts of the Base Bids and major alternatives (if any) will be made available to Bidders after the opening of Bids.

ARTICLE 18 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01. All Bids shall remain subject to acceptance for the number of days set forth in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of that period.

ARTICLE 19 - AWARD OF CONTRACT

19.01. Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom 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 contract terms with the Successful Bidder.

19.02. More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and with such alternatives, unit prices, and other data as may be requested in the Bid Form or prior to the Notice of Award.

19.04. In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Bidding Documents. Owner also may consider the operating costs, maintenance requirements, performance data, and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data are required to be submitted prior to the Notice of Award.

19.05. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, and other individuals or entities to perform and furnish the Work in accordance with the Contract Documents.

19.06. If the Contract is to be awarded, it will be awarded to the Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of Owner.

19.07. The evaluation of Suppliers' or manufacturers' data submitted with the Bid, or submitted upon request prior to the Notice of Award, will include consideration of the following:

Information provided in the Guaranteed Present Worth Table.

Owner-required inventory of spare parts.

Building design changes which would be required to accommodate the proposed materials and equipment.

Installation requirements and related engineering, training, and operating costs.

Experience and performance record of the Supplier or the manufacturer.

Maintenance and frequency of inspections required to assure reliable performance of the equipment.

The Supplier's or the manufacturer's service facilities and availability of qualified field service personnel.

Efficiency and related operating expense during the anticipated useful life of the equipment.

ARTICLE 20 - CONTRACT SECURITY AND INSURANCE

20.01. The Supplementary Conditions set forth Owner's requirements as to Performance and Payment Bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such Bonds.

ARTICLE 21 - SIGNING OF AGREEMENT

21.01. When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by four unsigned counterparts of the Agreement, with all other Contract Documents except the Drawings which are identified in the Agreement as attached thereto. Within the number of days set forth in the Bid Form, the Successful Bidder shall sign, leaving the dates blank, and deliver the required number of counterparts of the Agreement and attached documents to Owner with the required Bonds and power of attorney. Within 15 days thereafter, Owner shall execute all copies of the Agreement and other Contract Documents submitted by Contractor (Successful Bidder); shall insert the date of contract on the Agreement, Bonds, and power of attorney; and shall return all copies to Engineer for review and distribution. Distribution of signed copies shall be as stipulated in the Agreement.

ARTICLE 22 - SALES AND USE TAXES

22.01. Provisions for sales and use taxes, if any, are set forth in the Supplementary Conditions.

ARTICLE 23 - RETAINAGE

23.01. Provisions concerning retainage are set forth in the Agreement.

ARTICLE 24 - LAWS AND REGULATIONS

24.01. Modifications, if any, to the General Conditions concerning Laws and Regulations are set forth in the Supplementary Conditions. Additional provisions, if any, concerning Laws and Regulations are set forth in the Agreement and the Supplementary Conditions.

End of Section

Section 00400

BID FORM

PROJECT IDENTIFICATION:

Taylor Mill Treatment Plant UV Disinfection

THIS BID IS SUBMITTED TO:

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

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

2.01. 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 90 days after the day of Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Documents to Engineer within 15 days after the date of Owner's Notice of Award.

3.01. In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents and the following Addenda, receipt of which is hereby acknowledged.

No. _____ Dated _____

No. _____ Dated _____

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 carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions, and reports and drawings of a Hazardous Environmental Condition, if any, which has been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions

E. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, 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 required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid or 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.

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

H. 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.

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

J. 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.

4.01. Bidder further represents that this Bid is genuine and is 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.

5.01. Bidder will complete the Work for the following price:

Lump Sum Base Bid $_____

Alternative A Deletion of work associated with the installation of the Uninterruptible Power Supply

Price Adjustment $_____(deduct)

Lump Sum Base Bid
with Alternative A applied $_____

6.01. Bidder agrees that the Work will be substantially completed within 370 days, and completed and ready for final payment in accordance with Paragraph 14.07.B of the General Conditions within 400 days, after the commencement of Contract Times as defined in the General Conditions.

6.02. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified above.

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

_____
_____
_____
_____

8.01. The terms used in this Bid have the meanings indicated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

SIGNATURE OF BIDDER

If an Individual

By_____
(signature of individual)

doing business as_____

Business address_____

_____

Phone No._____

Date_____, _____

If a Partnership

By_____
(firm name)

_____
(signature of general partner)

Business address_____

_____

Phone No._____

Date_____, _____

If a Corporation

By_____
(corporation name)

By_____
(signature of authorized person)

_____
(title)

Business address_____

_____

Phone No._____

Date_____, _____

If a Joint Venture (Other party must sign below.)

If an Individual

By_____
(signature of individual)

doing business as_____

Business address_____

_____

Phone No._____

Date_____, _____

If a Partnership

By_____
(firm name)

_____
(signature of general partner)

Business address_____

_____

Phone No._____

Date_____, _____

If a Corporation

By_____
(corporation name)

By_____

_____
(title)

Business address_____

_____

Phone No._____

Date_____, _____

End of Section

Guaranteed Present Worth Table

Design UVT as stated in Specification 13700 - UV Disinfection System

		Units	Flow (mgd)		
			4	6	12
1	Reduction Equivalent Dose	mJ/cm^2	40	40	40
2	UV Transmittance, average	%	93.7	93.7	93.7
3	Time Weight (frequency of occurrence)		0.28	0.55	0.18
4	Number of Reactors	No.	1	1	1
5	Guaranteed Total Power	kW			
6	Guaranteed Maximum Headloss through Reactor	in. of w.c.	8	8	8
7	Total No. of Lamps in Service	No.			
8	Total No. of Sleeves in Service	No.			
9	Total No. of Ballasts in Service	No.			
10	Total No. of Sensors in Service	No.			
11	Expected Lamp Life (Evaluation limited to 10,000 h)	hours			
12	Sleeve Life (Evaluation limited to 20 years)	years			
13	Ballast Life (Evaluation limited to 10 years)	years			
14	Sensor Life (Evaluation limited to 10 years)	years			
15	Lamp Replacement Cost (G.1 of POQF)	$ / lamp			
16	Sleeve Replacement Cost (G.1 of POQF)	$ / sleeve			
17	Ballast Replacement Cost (G.1 of POQF)	$ / ballast			
18	Sensor Replacement Cost (G.1 of POQF)	$ / sensor			
	Calculations				
19	Adjusted Flow	mgd	1.1	3.3	2.2
20	Adjusted Total Power with LF	KW			
21	Adjusted Total Annual Energy Cost	$ / year			
22	Adjusted Annual Lamp Replacement Cost	$ / year			
23	Adjusted Annual Sleeve Replacement Cost	$ / year			
24	Adjusted Annual Ballast Replacement Cost	$ / year			
25	Adjusted Sensor Replacement Cost	$ / year			
26	Sum of Adjusted Total Annual Energy Cost	$ / year			
27	Sum of Adjusted Annual Lamp Replacement	$ / year			
28	Sum of Adjusted Annual Sleeve Replacement	$ / year			
29	Sum of Adjusted Annual Ballast Replacement	$ / year			
30	Sum of Adjusted Annual Sensor Replacement	$ / year			
31	Present Worth Energy Cost (26*PWF)	$			
32	Present Worth Lamp Cost (27*PWF)	$			
33	Present Worth Sleeve Cost (28*PWF)	$			
34	Present Worth Ballast Cost (29*PWF)	$			
35	Present Worth Sensor Cost (30* PWF)	$			
36	**Total Present Worth Cost**	**$**			

AO	Annual Operations (hours) = 6258	LF	Lamp Factor = 0.80
EC	Energy Costs ($ / kWh) = $0.069	PWF	Present Worth Factor = 11.47

37 **Service and Maintenance Contract**[1] **$**

[1] Service and Maintenance Contract per Section 13700 - UV Disinfection System. The cost associated with the Service and Maintenance Contract is a fee for one year which is renewable for up to a total of five years. A copy of the contract shall be included with the Bid.

PENAL SUM FORM

BID BOND

Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

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)

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: Above addresses are to be used for giving required notice.

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. Payment of the penal sum is the extent of Surety's liability.

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 Notice 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 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 of 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.

Section 00440

LIST OF SUBCONTRACTORS

In compliance with the Instructions to Bidders and other Contract Documents, the undersigned submits the following names of Subcontractors to be used in performing the Work for Taylor Mill Treatment Plant UV Disinfection.

Bidder certifies that all Subcontractors listed are eligible to perform the Work.

Subcontractor's Work	Subcontractor's Name
Excavation	_____
Concrete	_____
Painting	_____
Mechanical	_____
Electrical	_____
Instrumentation	_____

NOTE: This form must be submitted with the Bid in accordance with the Instructions to Bidders.

_____

Bidder's Signature

Section 00450

EQUIPMENT QUESTIONNAIRE

The Bidder shall enter in the spaces provided the names of the manufacturers of equipment which Bidder proposes to furnish, and shall submit this Equipment Questionnaire with its Bid. Owner will review and evaluate the information before award of the Contract.

Only one manufacturer's name shall be listed for each item of equipment. Upon award of a contract, the named equipment shall be furnished. Substitutions will be permitted only if named equipment does not meet the requirements of the Contract Documents, the manufacturer is unable to meet the delivery requirements of the construction schedule, or the manufacturer is dilatory in complying with the requirements of the Contract Documents. Substitutions shall be subject to concurrence of Owner and shall be confirmed by Change Order.

Preliminary acceptance of equipment listed by manufacturer's name shall not in any way constitute a waiver of the specifications covering such equipment; final acceptance will be based on full conformity with the Contract Documents.

Failure to furnish all information requested or entering more than one manufacturer's name for any item in this Equipment Questionnaire may be cause for rejection of the Bid.

Equipment	Manufacturer
1. UV Disinfection System	_____
2. Butterfly Valves	_____
3. Uninterruptible Power Supply	_____

End of Section

NON-COLLUSION AFFIDAVIT

STATE OF: _____)

COUNTY OF: _____) SS

_____, 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

Section 00500

AGREEMENT

THIS AGREEMENT is by and between 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.

1.01. Contractor shall complete all Work as specified or indicated in the Contract Documents based on the acceptance by Owner of Contractor's Bid.

The Work is generally described as follows:

> The installation of a new ultraviolet (UV) disinfection system, electrical utility service and uninterruptible power supply (UPS) at the Taylor Mill Treatment Plant. The UV disinfection system will include two UV reactors, local control panels for each reactor, piping, valves and associated electrical and instrumentation. The UV disinfection system also includes chemical feed piping modifications for sodium hypochlorite, caustic soda, corrosion inhibitor and fluoride. The new electrical utility service will include a concrete vault for a new pad mounted transformer (to be provided by others), service entrance switchboard and distribution power panels.

ARTICLE 2 – ENGINEER.

2.01. The Project has been designed by Black & Veatch Corporation, 11500 Northlake Drive, Suite 205, Cincinnati, Ohio 45249 who is referred to in the Contract Documents as Engineer. Engineer, and its duly authorized agents, are to act as Owner's representatives, 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.

3.01. Time of the Essence.

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

3.02. Contract Times.

A. The Contract Times shall be as indicated in the Contractor's Bid. The Work shall be substantially completed within the number of days indicated in the Contractor's Bid 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 the number of days indicated in the Contractor's Bid after the date when the Contract Times commence to run.

3.03. Liquidated Damages.

A. 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 3.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration 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 3.02 for Substantial Completion until the Work is substantially completed. 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 $350.00 for each day that expires after the time specified in Paragraph 3.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

B. The liquidated damages set forth herein shall not be accumulative. If Substantial Completion of the Work is not met within the time specified for final completion of all Work, the liquidated damages shall continue to be at the rate or rates specified for default on Substantial Completion until Substantial Completion is attained. If the Work is not then finally completed, the rate or rates specified for default on final completion shall apply until final completion is attained.

C. 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 applicable dispute resolution procedures and to recover liquidated damages for nonperformance of this Contract within the time stipulated.

3.04. Delays and Damages.

A. In the event Contractor is delayed in the prosecution and completion of the Work because of any delays caused by Owner or Engineer and, except as set forth in Paragraph 4.01 of the General Conditions, Contractor shall have no claim against Owner or Engineer for 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.

B. Prior to the commencement of the acceleration of the Work, Contractor shall provide Owner and Engineer written notice of the acceleration, stating the Work to be accelerated and the expected duration of the acceleration. Owner shall not be responsible or liable for any acceleration costs or delay damages.

ARTICLE 4 – CONTRACT PRICE.

4.01. Owner shall pay Contractor in current funds, for completion of the Work designated in Article 1 in accordance with the Contract Documents, an amount tabulated as follows:

Lump Sum Base Bid		$_____
Alternative A:	Deletion of work associated with the installation of the Uninterruptible Power Supply	$_____

Total Contract Price:

_____ $_____

(words) (figures)

ARTICLE 5 – PAYMENT PROCEDURES.

5.01. Submittal and Processing of Payments.

A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

5.02. Progress Payments; Retainage.

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer, on or about the 30th day of each month during performance of the Work. All progress payments will be on the basis of the progress of the Work 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 Division 1, General Requirements.

B. Prior to Substantial Completion, Owner will retain from progress payments, less the aggregate of payments previously made and less such amounts as Engineer shall determine or Owner may withhold in accordance with Paragraph 14.02.B.5 of the General Conditions, an amount equal to the following percentages:

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

2. 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.A.1 of the General Conditions. Stored materials and equipment retainage will be released when the materials and equipment are incorporated in the Work.

C. Upon Substantial Completion, Owner may release a portion of the retainage to Contractor, retaining at all times an amount sufficient to cover the cost of the Work remaining to be completed.

D. The reduction or termination of additional retainage will not be initiated at any time if the Work is behind schedule; and, subsequent to reducing retainage, the full retainage of payments authorized may be reinstated any time the Work falls behind schedule.

E. Consent of the Surety shall be obtained before any 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.

5.03. Final Payment.

A. Upon completion and acceptance of the Work in accordance with Paragraph 14.07.A of the General Conditions, Owner shall pay the remainder of

the Contract Price as recommended by Engineer as provided in Paragraph 14.07.B.

ARTICLE 6 – CONTRACTOR'S REPRESENTATIONS.

6.01. 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 studied all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions and reports and drawings of a Hazardous Environmental Condition, if any, at the Site which has been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

E. Contractor has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, 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 application of 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.

F. 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.

G. 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.

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

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

J. 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.

A. The Contract Documents which comprise the entire agreement between Owner and Contractor concerning the Work consist of the following:

1. This Agreement.

2. Performance and Payment Bonds.

3. General Conditions.

4. Supplementary Conditions.

5. Specifications.

6. Drawings consisting of 26 sheets, with each sheet bearing the following general title:

   Northern Kentucky Water District
   Taylor Mill Treatment Plant
   UV Disinfection

   Sheet titles are listed on Sheet 1.

7. Addenda _____ through _____.

8. Exhibits to this Agreement, enumerated as follows:

   a. Contractor's Bid.

   b. Notice to Proceed.

   c. Documentation submitted by Contractor prior to Notice of Award, marked Exhibit _____.

9. Equipment Questionnaire.

10. Guaranteed Present Worth Table

11. Owner's Forms as listed in the Table of Contents.

12. The following, which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto:

   a. Work Change Directives.

   b. Change Orders.

   c. Field Orders.

B. There are no Contract Documents other than those listed in this Article.

C. The Contract Documents may be amended, modified, or supplemented only as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 8 – COMPLIANCE WITH KENTUCKY LAW.

8.01. 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 within the previous five years. Contractor further represents and warrants that it 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 9 – EQUAL OPPORTUNITY.

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

1. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, or national origin;

2. The 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, or national origin; however, when layoffs occur, employees shall be laid off according to seniority with the youngest employee being laid off first. When employees are recalled, this shall be done in the reverse of the way employees were laid off.

3. The Contractor will state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, or national origin.

4. The 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

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

ARTICLE 10 – MISCELLANEOUS.

10.01. Terms.

A. Terms used in this Agreement will have the meanings indicated in the General Conditions and Supplementary Conditions.

10.02. Assignment of Contract.

A. 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.

10.03. Successors and Assigns.

A. 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 to all covenants, agreements, and obligations contained in the Contract Documents.

10.04. Severability.

A. 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.

10.05. Business Addresses.

A. The business address of Contractor given herein and the address of Contractor's office in the vicinity of the Work are both hereby designated as the places to which all notices, letters, and other communication to Contractor will be mailed or delivered. The address of Owner appearing herein is hereby designated as the place to which all notices, letters, and other communication to Owner shall be mailed or delivered. Either party may change its address at any time by an instrument in writing delivered to Engineer and to the other party.

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 _____.

Owner:_____

Northern Kentucky Water District

By_____

Title:_____

Address for giving notices

2835 Crescent Springs Road
P.O. Box 18640
Erlanger, Kentucky 41018

Contractor:_____

_____

By_____

Title:_____

Address for giving notices

_____

_____

_____

Joint Venture

Contractor: _____

_____

By_____

Title: _____

Address for giving notices

_____

_____

_____

End of Section

CERTIFICATE OF LIABILITY INSURANCE

Issue Date: _____ (mm/dd/yy)

PRODUCER:	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
Code Sub-Code	COMPANY LETTER A
INSURED:	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	
	☐ COMMERCIAL GENERAL LIABILITY ☐ OCCURRENCE ☐ BLANKET CONTRACTUAL ☐ _____	(Completed Operations & Products Liability remains in force for 2 years after final payment)			PRODUCTS-COMP/OPS AGGREGATE PERSONAL & ADVERTISING INJURY EACH OCCURRENCE	
	AUTOMOBILE LIABILITY					
	☐ ANY AUTO ☐ HIRED AUTOS ☐ NON-OWNED AUTOS				COMBINED SINGLE LIMIT EACH OCCURRENCE Bodily Injury & Property Damage	
	EXCESS LIABILITY				EACH OCCURRENCE	
	☐ UMBRELLA FORM	(Follows Form of the Primary)			AGGREGATE	
	WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY	(Includes US Longshoremen and Harbor Workers Act and Maritime Coverage Where Applicable and All States Endorsement)			STATUTORY EACH ACCIDENT DISEASE-POLICY LIMIT DISEASE-EACH EMPLOYEE	
	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. Black & Veatch Corporation P.O. Box 8405 Kansas City, Missouri 64114 Attn: Insurance Certificate Coordinator	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. Owner:	**SIGNATURE OF AUTHORIZED AGENT OF THE COMPANY**

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 Site, on Completed Value Form.	Insurable value of completed Work.	

REMARKS

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 in 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. Black & Veatch Corporation, P.O. Box 8405, Kansas City, MO 64114 Attn: Insurance Certificate Coordinator	X Additional Named Insured
2. Owner:	**SIGNATURE OF AUTHORIZED AGENT OF THE COMPANY**

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
Bond Number:
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:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-610 (2002 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. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

2. If Contractor performs the Contract, Surety and 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, Surety's obligation under this Bond shall arise after:

3.1. Owner has notified Contractor and Surety, at the addresses described in Paragraph 10 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and

3.2. Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 3.1; and

3.3. Owner has agreed to pay the Balance of the Contract Price to:

1. Surety in accordance with the terms of the Contract;

2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

4. When Owner has satisfied the conditions of Paragraph 3, Surety shall promptly and at Surety's expense take one of the following actions:

4.1. Arrange for Contractor, with consent of 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 Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and Contractor selected with 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 Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by Owner resulting from 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:

1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or

2. Deny liability in whole or in part and notify Owner citing reasons therefor.

5. If Surety does not proceed as provided in Paragraph 4 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 4.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in
part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 4.1, 4.2, or 4.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To a limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

6.1. The responsibilities of Contractor for correction of defective Work and completion of the Contract;

6.2. Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions or failure to act of 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 Contractor.

7. Surety shall not be liable to Owner or others for obligations of 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 Owner or its heirs, executors, administrators, or successors.

8. Surety hereby waives notice of any change, including changes of time, to 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 Contractor ceased working or within two years after 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 Surety, Owner, or 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 requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory 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 Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.

12.2. Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3. Contractor Default: Failure of 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 Owner, which has neither been remedied nor waived, to pay 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
Surety Agency or Broker
Owner's Respresentative (engineer or other party)

PAYMENT 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
Bond Number:
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
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title

(Space is provided below for signatures of additional parties, if required.)

CONTRACTOR AS PRINCIPAL
Company:

Signature: _____ (Seal)
Name and Title:

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title
(Attach Power of Attorney)

Attest: _____
Signature and Title:

EJCDC No. C-615 (2002 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. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1. Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2. Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and 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 Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1. Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the addresses described in Paragraph 12) and sent a copy, or notice thereof, to 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 Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to 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 or equipment 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 Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which 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 Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:

6.1. Send an answer to that Claimant, with a copy to 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. 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 Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated to the Contract. 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. 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 Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or 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 requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory 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, 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 Contractor, or with a first-tier subcontractor of 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 Contractor and 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 Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3. Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay 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
Surety Agency or Broker:
Owner's Representative (engineer or other party):

Contractor's Application For Payment No. _____

o (Owner):	Application Period:	Application Date:
roject:	From (Contractor):	Via (Engineer)
)wner's Contract No.:	Contract:	
	Contractor's Project No.:	Engineer's Project No.:

APPLICATION FOR PAYMENT

Change Order Summary

Approved Change Orders

Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1.	**ORIGINAL CONTRACT PRICE**	$
2.	**Net change by Change Orders**	$
3.	**CURRENT CONTRACT PRICE (Line 1 ± 2)**	$
4.	**TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)**	$
5.	**RETAINAGE:**	
	a. _____ % x $_____ **Work Completed**	$
	b. _____ % x $_____ **Stored Material**	$
	c. **Total Retainage (Line 5a + Line 5b)**	$
6.	**AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)**	$
7.	**LESS PREVIOUS PAYMENTS (Line 6 from prior Application)**	$
8.	**AMOUNT DUE THIS APPLICATION**	$
9.	**BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above)**	$

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By: _____ Date: _____

Payment of: $_____
(Line 8 or other - attach explanation of other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $_____
(Line 8 or other - attach explanation of other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding Agency (if applicable) (Date)

EJCDC No. C-620 (2002 Edition)
Prepared by the Engineers' Joint Contract Documents Committee and endorsed by the Associated General Contractors of America and the Construction Specifications Institute.

Progress Estimate

Contractor's Application

For (contract):							
Application Period:					Application Number:		
					Application Date:		
A		B	Work Completed		E	F	G
Specification Section No.	Item Description	Scheduled Value	C From Previous Application (C + D)	D This Period	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F) B	Balance to Finish (B - F)
	Totals							

Contractor's Application

Progress Estimate

For (contract):	Application Number:
Application Period:	Application Date:

A				B	C	D	E	F		G
Item		Bid Quantity	Unit Price	Bid Value	Estimated Quantity Installed	Value	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F) B	Balance to Finish (B - F)
Bid Item No.	Description									
	Totals									

EJCDC No. C-620 (2002 Edition)
Prepared by the Engineers' Joint Contract Documents Committee and endorsed by the Associated General Contractors of America and the Construction Specifications Institute.

Stored Material Summary

Contractor's Application

For (contract):									
Application Period:							Application Number:		
							Application Date:		
A	B	C	D		E		F		G
Invoice No.	Shop Drawing Transmittal No.	Materials Description	Stored Previously		Stored this Month		Incorporated in Work		Materials Remaining in Storage ($) (D + E - F)
			Date (Month/Year)	Amount ($)	Amount ($)	Subtotal	Date (Month/Year)	Amount ($)	
		Totals							

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

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

National Society of Professional Engineers
Professional Engineers in Private Practice

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National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314

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American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 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 EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

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GENERAL CONDITIONS

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's 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.A 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. The General Requirements pertain to all sections 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 in connection with the Work.

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. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

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

38. *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.

39. *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.

40. *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.

41. *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.

42. *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.

43. *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.

44. *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.

45. *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.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

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

48. *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 any Subcontractor.

49. *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.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *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.

52. *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 following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following 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 requirements of and information in the Contract Documents and conformance with the design concept of the completed 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 which 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*

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.

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 may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended 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, or Engineer, or any of, their Related Entities, 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 may discover 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 any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, 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 knew or reasonably should have known 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, code, or instruction (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 or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, 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 Engineer's consultants, including electronic media editions; or

2. reuse any of 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 adaption by Engineer.

B. The prohibition 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. Copies of data furnished by Owner or Engineer to Contractor or 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 of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general 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 Related Entities 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 at or contiguous to the Site 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, Owner and Engineer, and any of their Related Entities 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.

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; 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:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general 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 Related Entities 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.

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 to Contractor written notice: (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, 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, 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 current 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 must be accompanied by a certified copy of the agent's authority to act.

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 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 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.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other 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, include as additional insured (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, 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 completed operations insurance;

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

5. 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);

6. 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

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. 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, 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 an insured or 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 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 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 additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery 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, 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 an insured or additional insured.

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 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 additional insured 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 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 to be listed as insureds or additional insureds (and the officers, directors, 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 additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, 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 to be listed as insured or additional insured (and the officers, directors, 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, 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, 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 insureds, 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. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

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,

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

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 that 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 in 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 or not 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 or not 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;

4) and 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 either a Change Order for a substitute or 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 item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the 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 anything in the Contract Documents 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 an additional insured 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, and Engineer,, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, 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, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 primary 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, 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. 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. 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 , 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).

D. 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 acceptable 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:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

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 determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria,

installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

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

d. shall also have 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.

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 Drawing's 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 Related Entities 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, 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 respective consultants, agents, officers, directors, partners, or employees 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, 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 via 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, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall 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 their work and will only cut or alter their 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 actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's 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 in respect of 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 in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in 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 in 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. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

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 and will not be changed without written consent of Owner and Engineer.

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 believe 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 respon-

sible 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.

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.B.

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 notice 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) is required by the provisions of any bond to be given to a surety, 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 Time 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 include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

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 at the Site. 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, 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, expresses, 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 and 11.01.B.

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 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 Paragraph 12.01.C.2.a 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 the Related Entities of each of them 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. All 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, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site 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 said 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, it must, if requested by Engineer, be uncovered 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 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 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 on the Site 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, to the

results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to 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. that 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 corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined 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.

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 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 will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion 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.7;

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 or Owner's property might in any way be responsible 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 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 their 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 00800

SUPPLEMENTARY CONDITIONS

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ATTACHMENTS

Section 00800

SUPPLEMENTARY CONDITIONS

SCOPE. These Supplementary Conditions amend or supplement the General Conditions 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.

SC-1. DEFINITIONS AND TERMINOLOGY.

SC-1.01. Defined Terms.

A. Delete and replace definitions 9, 15, 19, 29, and 52 in Paragraph 1.01.A of the General Conditions with the following:

9. Change Order – A document 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.

15. Contractor--The individual or entity with whom Owner has entered into the Agreement. The terms Contractor and CONTRACTOR are interchangeable and shall have the same meaning in the Contract Documents.

19. Engineer--The individual or entity named as such in the Agreement. The terms Engineer and ENGINEER are interchangeable and shall have the same meaning in 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. The terms Owner and OWNER are interchangeable and shall have the same meaning in the Contract Documents.

52. Work Change Directive – A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner 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.

B. Add the following definitions to Paragraph 1.01.A of the General Conditions:

53. float - The amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any of the activities in the progress schedule.

54. Resident Project Representative - In lieu of the definition set forth in Paragraph 1.01.A.37 of the General Conditions, the Resident Project Representative shall be the authorized representative of Black & Veatch Corporation, who may be assigned to the site or any part thereof.

55. 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 permitted.

SC-2. PRELIMINARY MATTERS.

SC-2.02. Copies of Documents. Delete Paragraph 2.02.A of the General Conditions, and replace it with the following new paragraph:

A. The Contractor to whom a contract is awarded will be furnished, free of charge, 5 copies of the Project Manual and 5 sets of the Drawings, together with all Addenda thereto. Additional copies of the Project Manual and Drawings may be obtained from Engineer on the following basis:

Full set of Drawings	$50
Each copy of the Project Manual	$80

SC-2.03. Commencement of Contract Times; Notice to Proceed. Delete the last sentence of Paragraph 2.03.A of the General Conditions.

SC-3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE. No modifications.

SC-4. AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS.

SC-4.02. Subsurface and Physical Conditions.

A. Reports and Drawings.

1. Delete Paragraph 4.02.A.1 of the General Conditions and replace it with the following:

1. No reports of explorations and tests of subsurface Conditions at or contiguous to the Site have been prepared.

2. Add the following new paragraphs immediately after Paragraph 4.02.A.2 of the General Conditions:

In preparation of the Contract Documents, the following drawings of physical conditions in or relating to existing surface and subsurface structures (except underground facilities) which are at or contiguous to the Site of the Work were relied upon:

a. Drawings dated 1953, prepared by Alfred LeFeber and Associates, titled "Water Treatment Plant Contract No. 3" consisting of 48 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

b. Drawings dated 1960, prepared by O.G. Loomis & Son Consulting Engineers, titled "Water Treatment Plant Extensions" consisting of 29 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

c. Drawings dated 1987, prepared by Burgess & Niple, titled "Taylor Mill WTP Improvements, Contract 87-4 – Construction Contract Drawings" consisting of 27 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

d. Drawings dated 1991, prepared by Burgess & Niple, titled "Taylor Mill WTP Filter Rehabilitation, Contract 91-2 – Construction Contract" consisting of 11 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

e. Drawings dated 1997, prepared by CH2MHill, titles "Taylor Mill WTP Chemical Building, Clarifier and Clearwell Improvements, Contract 184-410 – Construction Contract Drawings" consisting of 92 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

f. Drawings dated 2000, prepared by Burgess & Niple, titled "Taylor Mill WTP Filter Rehabilitation, Contract 184-423 – Construction Contract Drawings" consisting of 10 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

g. Drawings dated 2001, prepared by Black & Veatch Corporation, titled "Taylor Mill Water Treatment Plant Filter to Waste System" consisting of 31 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

h. Drawings dated 2005, prepared by Malcolm Pirnie, titled "Taylor Mill Filter Media Replacement and Pump No. 3 Retrofit Project" consisting of 5 sheets. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

i. Drawing dated 2006, prepared by Viox & Viox, titled "Proposed 36" and 42" Water Main – Phase II Howard Avenue to Latonia Youth Club – Construction Drawings" consisting of 1 sheet. All of the information in such drawings shall be verified by the Contractor and is provided for reference only.

j. Drawings of physical conditions in or relating to existing surface and subsurface structures (except underground facilities) are available for review at Black & Veatch Corporation, 11500 Northlake Drive, Suite 205, Cincinnati, OH 45249, upon 72 hours' notice to Owner.

B. Limited Reliance by Contractor on Technical Data Authorized. Delete Paragraph 4.02.B of the General Conditions in its entirety and replace it with the following paragraph:

B. No Reliance by Contractor Authorized. Owner and Engineer do not warrant the accuracy of the physical conditions information and drawings which are not Contract Documents. Contractor uses such information at Contractor's sole risk.

It shall be understood that the information provided is not guaranteed by Owner or Engineer to be more than a general indication of the physical conditions likely to be found.

SC-4.06. Hazardous Environmental Conditions at Site.

J. Add the following new paragraph immediately after Paragraph 4.06.I of the General Conditions:

J. Asbestos abatement is covered in the Project Requirements section.

SC-5. BONDS AND INSURANCE. Delete Article 5 of the General Conditions in its entirety, and insert the following text in its place:

ARTICLE 5 - BONDS AND INSURANCE

SC-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 Contractor's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, 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 current 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 must be accompanied by a certified copy of such agent's authority to act.

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 within 20 days thereafter substitute another Bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

SC-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.

SC-5.03. Certificates of Insurance.

A. Contractor shall deliver to Owner, with copies to each additional insured 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 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. Certificates of insurance shall be submitted on the forms included in the Contract Documents

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

E. By requiring such insurance and insurance limits herein, Owner does not represent that coverage and limits will necessarily be adequate to protect Contractor, and such coverage and limits shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

SC-5.04. Contractor's Liability Insurance.

A. The policies of insurance so required by this Paragraph 5.04 to be purchased and maintained shall:

1. Include at least the specific coverages and be written for not less than the limits of liability specified or required by Laws or Regulations, whichever is greater;

2. Include completed operations insurance;

3. Include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.07, 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 to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 shall 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;

6. With respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and Contractor shall furnish Owner and each other additional insured 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);

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; and

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.

B. Worker's Compensation and Employer's Liability Insurance. This insurance shall protect Contractor against all claims under applicable state workers' compensation laws, including coverage as necessary for the benefits provided under the United States Longshoremen's and Harbor Workers' Act and the Jones Act. Contractor shall also be protected against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workers' compensation law. This policy shall include an "all states" or "other states" endorsement.

The liability limits shall be not less than:

Workers' compensation	Statutory
Employers' liability	$1,000,000 each occurrence

C. Comprehensive Automobile Liability Insurance. This insurance shall be occurrence type, written in comprehensive form, and shall protect Contractor, and Owner, Engineer's Consultants, 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 project site whether they are owned, nonowned, or hired.

The liability limits shall be not less than:

Bodily injury and property damage	$1,000,000 combined single limit for each occurrence

D. Commercial General Liability Insurance. This insurance shall be occurrence type, written in comprehensive form, and shall protect Contractor, and Owner, Engineer's Consultants, 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 project aggregate limit endorsement, personal injury liability coverage, contractual liability coverage, completed operations and products liability coverage, and coverage for blasting, explosion, collapse of buildings, and damage to underground property.

The liability limits shall be not less than:

Bodily injury and property damage	$1,000,000 combined single limit for each occurrence
	$1,000,000 general aggregate

E. Pollution Liability Insurance. This insurance shall protect Contractor, and Owner, Engineer's Consultants, and Engineer as additional insureds, against claims arising out of pollution and excluded from the commercial general liability and comprehensive automobile liability policies. This insurance shall be coordinated with the commercial general liability policy and provide bodily injury and property damage coverage similar to and to the limits specified for the commercial general liability policy. Coverage shall include contractual liability.

F. Asbestos Abatement Liability Insurance. This insurance is required in addition to the other liability coverages specified herein. Asbestos abatement liability insurance shall be written as an "occurrence" type policy and shall cover Contractor, and Owner and Engineer as additional insureds, against claims arising from bodily injury, sickness, disease, or death of any person other than Contractor's employees arising out of any act related to asbestos abatement work.

The liability limits shall be not less than:

Personal injury and property damage	$2,000,000 each occurrence
	$2,000,000 general aggregate

G. Umbrella Liability Insurance. This insurance shall protect Contractor, and Owner, Engineer's Consultants, 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 form 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

H. Owner's Protective Liability Insurance. This insurance shall be issued in the name of Owner and shall protect and defend Owner, Engineer's Consultants, and Engineer against claims arising as a result of the operations of Contractor or Contractor's Subcontractors.

The liability limits shall be not less than:

Bodily injury and property damage	$1,000,000 combined single limit for each occurrence
	$1,000,000 general aggregate

SC-5.05. Property Insurance.

A. Contractor, with sole liability for payment of premiums, shall purchase and maintain property insurance 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 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 a named 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, 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, flood, and damage caused by frost and freezing;

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 named insured to whom a certificate of insurance has been issued.

B. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.05 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 named insured to whom a certificate of insurance has been issued, and shall contain waiver provisions in accordance with Paragraph 5.06.

C. If Owner requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.05, Contractor shall, if possible, include such insurance, and the cost thereof will be charged to Owner by appropriate Change Order or Work Change Directive. Prior to commencement of the Work at the Site, Contractor shall in writing advise Owner whether or not such other insurance has been procured by Contractor.

SC-5.06. Waiver of Rights.

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.05 will protect Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants, and all other individuals or entities listed as named insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) 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 named insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, and other 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. 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. Any insurance policy covering any loss, damage, or consequential loss referred to in Paragraph 5.06.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 Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants, or the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them.

SC-5.07. Receipt and Application of Insurance Proceeds.

A. Any insured loss under the policies of insurance required by Paragraph 5.05 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.07.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 or Work Change Directive.

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.

SC-5.08. 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. 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.

SC-5.09. 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 5.05 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.

SC-6. CONTRACTOR'S RESPONSIBILITIES.

SC-6.02. Labor; Working Hours. Add the following new paragraphs immediately after Paragraph 6.02.B of the General Conditions:

C. No Work shall be done between 6 p.m. and 7 a.m. without permission of Owner. However, emergency work may be done without prior permission.

D. Night Work may be undertaken 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 Work at night.

SC-6.03. Services, Materials, and Equipment. Add the following new paragraphs immediately after Paragraph 6.03.C of the General Conditions:

D. Until final completion of the Work is acknowledged by Owner, Contractor shall have responsible charge and care of the Work and of all equipment and materials to be used herein and shall bear the risk of injury, loss, or damage to any part thereof by action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the Work.

F. Contractor shall rebuild, repair, restore, and make good all injuries, losses, or damages to any portion of the Work or the equipment or materials occasioned by any cause before completion and acceptance of the Work and shall bear the expense therefore. Contractor shall, at no additional cost to Owner, provide suitable drainage and suitable structures as necessary to protect the Work or any portion thereof from damage.

G. Suspension of the Work or the granting of an extension of time for any cause whatever shall not relieve Contractor of his responsibilities for the Work as specified herein.

SC-6.06. Concerning Subcontractors, Suppliers, and Others. Delete Paragraph 6.06.B of the General Conditions in its entirety and insert the following two paragraphs in its place:

B. If the Bidding Documents or the Contract Documents 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 Bidding Documents or the Contract Documents, 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.

Particular consideration will be given to the qualifications of each Subcontractor proposed on the List of Subcontractors. The use of Subcontractors proposed by Bidder and accepted by Owner prior to the Notice of Award will be required in the performance of the Work unless otherwise permitted or directed by Owner.

SC-6.08. Permits. Add the following new paragraph immediately after Paragraph 6.08.A of the General Conditions:

B. Owner will obtain and pay for the following permits:

1. Kentucky Division of Water – Construction Permit

SC-6.09. Laws and Regulations. Modify the following paragraphs of the General Conditions and add the following new paragraphs immediately after Paragraph 6.09.C of the General Conditions:

C. At the end of Paragraph 6.09.C of the General Conditions, add the following new sentences:

The provisions of Paragraph 6.09.C of the General Conditions shall not apply to any changes to prevailing wage rates. Changes to wage rates during the life of the Contract shall be the responsibility of the Contractor, and shall not be eligible for Claims for changes to the Contract Price.

D. Safety and Health Regulations. OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR Part 1926, shall apply to Work under this Contract. The U.S. Department of Labor will be responsible for compliance review and enforcement of the regulations.

E. Employment Requirements. Employment requirements shall be as specified herein and in the attachments at the end of the Supplementary Conditions.

F. Work in Confined Spaces. The provisions of 29 CFR Section 1910.146, "Permit-Required Confined Spaces", have been adopted by Owner and shall apply to Work under this Contract.

Contractor is hereby notified that manholes and other structures included under the confined-space definition of 29 CFR 1910.146, shall be considered as hazardous locations with hazardous atmospheric conditions. The structures may contain methane, hydrogen sulfide, carbon dioxide, and other gases which are dangerous to life or health. Contractor shall allow its personnel or Subcontractors to enter these confined spaces only through compliance with an entry permit program as specified herein.

Contractor shall establish and maintain a confined-space entry program appropriate to the structures and conditions encountered. The program shall meet the requirements of 29 CFR 1910.146 and shall specifically address the provisions of Paragraph (d) therein. Contractor shall enforce the requirements of Paragraphs (e) and (f), shall establish and conduct a training program in accordance with Paragraph (g), and shall comply with all other applicable requirements of the referenced regulation.

Contractor shall prepare a complete written program covering the requirements of this paragraph and the referenced regulation. The written program shall be submitted through Engineer for review and approval by Owner, and shall be modified and resubmitted if required. No Work shall be done by Contractor or any of Contractor's personnel or Subcontractors in any confined spaces until Contractor's program has been approved by Owner and Owner is satisfied that the program provisions are in place.

Upon request, Owner's confined-space entry program will be made available to Contractor for review, but Owner's program shall not be considered as necessarily addressing all steps and measures to be taken into account. Contractor shall cooperate with Owner for coordination of activities whenever Contractor's personnel and Owner's personnel will both be working in or near the confined spaces at the same time.

G. NSF Requirements. The following materials which will be in contact with water before or during the treatment process, water to be added or returned to the treatment process, or treated potable water, shall have been tested and certified to meet the requirements of ANSI/NSF 60 or ANSI/NSF 61. The materials shall be guaranteed by the manufacturer to have the required certification and to be suitable for the intended service. Evidence of the certification shall be submitted to the Engineer with the appropriate drawings and data. Any materials which cannot be so guaranteed, whether or not specified by manufacturer and product designation, shall not be used.

- Chemical treatment additives
- Pipes and related products (including coated and uncoated pipes, fittings, small storage devices, tubing, and screens)
- Protective (barrier) materials (including paints, coatings, linings, and diaphragms)
- Joining and sealing materials (including gaskets, sealing materials, and lubricants)
- Process media (including media used in ion exchange, aeration, adsorption, oxidation, and filtration operations)
- Mechanical devices (including chemical feeders, pumps, valves, aeration equipment, clarifiers, mixers, strainers, and other water treatment process devices)

- Mechanical plumbing products

SC-6.10. Taxes. Add the following new paragraph immediately after Paragraph 6.10.A of the General Conditions:

B. Portions of the project may be exempt from taxes. It is the Contractor's responsibility to determine the exemptions for this.

SC-6.17. Shop Drawings and Samples. Delete Paragraph 6.17 of the General Conditions in its entirety. Requirements for shop drawings, samples, and submittal procedures shall be as specified in Division 1, Section 01300 – Submittals.

SC-6.19. Contractor's General Warranty and Guarantee. Delete Paragraph 6.19.C.7 of the General Conditions and replace with the following Paragraphs 6.19.C.7 and 6.19.C.8.

7. any correction of defective Work by Owner; or

8. any expiration of a correction period.

SC- 6.21 Delegation of Professional Design Services.

D. Delete Paragraph 6.21.D of the General Conditions in its entirety, and replace with the following Paragraph 6.21.D:

D. Pursuant to this Paragraph 6.21, Engineer's review and acceptance of signed and sealed certifications of performance and design criteria used when designing systems, materials, or equipment 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 acceptance of Shop Drawings and other submittals (except performance and design criteria and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

F. Add the following new Paragraph 6.21.F immediately after Paragraph 6.21.E of the General Conditions:

F. When professional design services are required by the Contract Documents, Contractor shall provide certification that the design has been performed by a design professional in accordance with the Contact Documents and that the association construction conforms to the design provided by the design professional.

SC-7. OTHER WORK AT THE SITE.

SC-7.01. Related Work at Site. Add the following new paragraph at the end of Paragraph 7.01.A of the General Conditions:

> In addition to the Work under this Contract, other work related to the Project to be performed at the Site. Such work is listed in Division 1, Section 01015 – General Requirements.

SC-7.04. Delays and Damages. Add the following new paragraph immediately after Paragraph 7.03 of the General Conditions:

7.04. Delays and Damages.

A. In the event Contractor is delayed in the prosecution and completion of the Work because of the rate of progress of the work to be performed by other utilities or other contracts, or damage to the Work or the property of Contractor by contractors on other contracts, Contractor shall have no claim against Owner for damages or contract adjustment other than an extension of Contract Time and the waiving of liquidated damages for the period of delay.

B. Time limitations required by Owner shall be for the benefit of Owner and contractor under other contracts who have entered into such contracts with Owner in reliance on the time limitations set forth in these Contract Documents. Any claim by Contractor for damages due to delay or damage to the Work or the property of Contractor by another contractor shall be asserted against that contractor.

SC-8. OWNER'S RESPONSIBILITIES.

SC-8.01. Communications to Contractor. Replace the first sentence of Paragraph 8.01.A of the General Conditions with the following:

A. Except as otherwise provided in these General Conditions, if Owner issues communications to Contractor a copy shall be provided to Engineer.

SC-9. ENGINEER'S STATUS DURING CONSTRUCTION.

SC-9.01. Owner's Representative. Add the following sentence at the end of Paragraph 9.01.A of the General Conditions:

The action of the Engineer in performance of these duties shall not be construed to make the Engineer the Agent for the Owner with respect to changes in the cost of the work or changes in the Contract Documents.

SC-9.03. Project Representative. Add the following new paragraph immediately after Paragraph 9.03.A of the General Conditions:

B. The duties, responsibilities, and limitation of authority of the Resident Project Representative (if provided by Engineer) are set forth in an attachment to the Supplementary Conditions.

SC-9.08. Decisions on Requirements of Contract Documents and Acceptability of Work.

A. Add the following new words at the end of the first sentence of Paragraph 9.08.A of the General Conditions;

...insofar as the subject matter of any pertinent claim, dispute, or other matter falls within the realm of the technical expertise of Engineer.

B. Add the following new sentence at the end of Paragraph 9.08.A of the General Conditions:

Engineer shall not render any decision on any claims, disputes, or other matters the subject matter of which, at Engineer's sole discretion, requires legal, rather than technical, interpretation.

SC-10. CHANGES IN THE WORK; CLAIMS.

SC-10.03. Execution of Change Orders. Replace the first sentence of Paragraph 10.03.A of the General Conditions with the following:

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

SC-10.05. Claims. Delete Paragraph 10.05.E. of the General Conditions in its entirety, and replace with the following:

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 the Supplementary Conditions within 30 days of such action or denial.

SC-11. COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK. No modifications.

SC-12. CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES.

SC-12.02. Change of Contract Times. Add the following new paragraphs after Paragraph 12.02.B of the General Conditions:

C. A claim for an extension of the Contract Times (or Milestones), otherwise allowable under the Contract Documents, shall be granted only to the extent the time lost exceeds the float for the delayed activity at the time of the event giving rise to the claim. Float, whether expressly disclosed or implied in any manner, is jointly owned by the project participants.

D. Contractor shall not use float suppression techniques (including, but not limited to, preferential sequencing caused by late starts of follow-up trades, unreasonably small crews, extended durations, or imposed dates) in information provided to Engineer.

SC-12.03. Delays. Delete Paragraph 12.03.B of the General Conditions in its entirety, and replace with the following:

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 Times. 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.

SC-13. TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK.

SC-13.03. Tests and Inspections. Delete the first sentence of Paragraph 13.03.B of the General Conditions and replace with the following:

B. Contractor 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:

SC-13.07. Correction Period. Add the following new paragraph paragraphs immediately after Paragraph 13.07.E of the General Conditions:

F. Nothing in this 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.

SC-14. PAYMENTS TO CONTRACTOR AND COMPLETION.

SC-14.02. Progress Payments. Add the following new paragraphs immediately following Paragraph 14.02.A.3 of the General Conditions:

4. Materials and Equipment. 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.

5. Schedules and Data. 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, values of materials and equipment on hand included in application, and other data specified or reasonably required by Engineer.

SC-14.02.C. Payment Becomes Due. Delete Paragraph 14.02.C.1 of the General Conditions in its entirety and insert the following text in its place:

1. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer, on or about the 30th day of each month during construction. All progress payments will be on the basis of the progress of the Work measured by the Schedule of Valves established in Paragraph 2.07 of the General Conditions.

Contractor shall submit the progress payment application to the Engineer within the first five days of each month for Engineer's review and recommendation to the Owner.

SC-14.04. Substantial Completion. Add the following new paragraphs immediately after Paragraph 14.04.A of the General Conditions:

1. "Substantial Completion" means that the facilities are completed to the point that finished water can be produced in the quantity and quality satisfactory to Owner and Engineer. All process equipment shall be installed and operational, or temporary arrangements satisfactory to Owner shall have been made. All performance testing need not have been completed prior to the date of Substantial Completion. All training shall be complete and all operation and maintenance manuals shall be approved.

2. To be considered substantially complete, the following portions of the Work must be operational and ready for Owner's continuous use as intended:

   UV Disinfection System, including performance testing

   Chemical Feed Piping

   All Piping, Valves and Accessories

   Uninterruptible Power Supply (if constructed)

   Painting of equipment, piping and valves

3. Portions of the Work not essential to plant operation, which can be completed without interruption of plant operation, may be completed after the Work is accepted as substantially complete, and may include the following items:

   Fencing

   Seeding and sodding

SC-14.07. Final Payment. Add the following new sentence at the end of Paragraph 14.07.A.2 of the General Conditions:

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.

SC-15. SUSPENSION OF WORK AND TERMINATION. No modifications.

SC-16. DISPUTE RESOLUTION. Delete Article 16 of the General Conditions in its entirety, and insert the following text in its place:

ARTICLE 16. DISPUTE RESOLUTION.

16.01. Neither mediation nor arbitration will be acceptable as a means for settling claims, disputes, or other matters.

SC-17. MISCELLANEOUS.

SC-17.04. Survival of Obligations. Add the following new paragraph immediately after Paragraph 17.04.A of the General Conditions:

B. Contractor shall obtain from all Suppliers and manufacturers any and all warranties and guarantees of such Suppliers and manufacturers, whether or not specifically required 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

ATTACHMENT 00800A

DUTIES, RESPONSIBILITIES, AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE AS SET FORTH IN THE OWNER/ENGINEER AGREEMENT

The Engineer will provide part-time Resident Project Representative services.

The Resident Project Representative will observe the Contractor's work and perform the services listed below. The Resident Project Representative shall not have responsibility for the superintendence of construction site conditions, safety, safe practices or unsafe practices or conditions, operation, equipment, or personnel other than employees of the Engineer. This service will in no way relieve the Contractor of complete supervision of the work or the Contractor's obligation for complete compliance to the drawings and specifications. The Contractor shall have sole responsibility for safety and for maintaining safe practices and avoiding unsafe practices or conditions.

Specific services performed by the Resident Project Representative shall be as follows:

- Conduct necessary onsite observations of the general progress of the work to assist the Engineer in determining if the work is conducted and proceeding in accordance with the construction Contract Documents

- Serve as Engineer's liaison with Contractor, working principally through Contractor's onsite superintendent, and assist Engineer in providing interpretations of the construction Contract Documents. Transmit associated Engineer's clarifications and interpretations of the construction Contract Documents to Contractor.

- Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's onsite operation.

- As requested by Engineer, assist in obtaining from Owner additional details or information when required at the jobsite for proper execution of the work.

- Consult with the Owner and the Contractor, giving opinions and suggestions based on the Resident Project Representative's observations regarding defects or deficiencies in the Contractors' work and relating to compliance with drawings, specifications, and design concepts.

- Advise Engineer and Contractor or Contractor's permanent superintendent when work commences that requires shop drawing or sample submission if the submission has not been accepted by the Engineer.

- Observe field tests of piping, equipment and building materials, and review the resulting reports, commenting to Owner as appropriate.

- Report to Engineer whenever work is known to be defective, or does not meet the requirements of any inspections, tests or approval required to be made, or has been damaged prior to final payment; advise Engineer when the work should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection, or approval.

- Record date of receipt of shop drawings and samples. Receive samples which are furnished at the site by Contractors and notify Engineer of their availability for examination.

End of Section

ATTACHMENT 00800B

EMPLOYMENT REQUIREMENTS

The employment requirements will be issued by Addendum.

Section 01015

PROJECT REQUIREMENTS

1. GENERAL DESCRIPTION OF WORK. The Work to be performed under these Contract Documents is generally described as follows:

The installation of a new ultraviolet (UV) disinfection system, electrical utility service and uninterruptible power supply (UPS) at the Taylor Mill Treatment Plant. The UV disinfection system will include two UV reactors, local control panels for each reactor, piping, valves and associated electrical and instrumentation. The UV disinfection system also includes chemical feed piping modifications for sodium hypochlorite, caustic soda, corrosion inhibitor and fluoride. The new electrical utility service will include a concrete vault for a new pad mounted transformer (to be provided by others), service entrance switchboard and distribution power panels.

2. UNITS OF MEASUREMENT. Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

3. OTHER CONSTRUCTION CONTRACTS. Work at the site performed by others under separate contracts includes the following:

Work consists of connection of a new service line by Duke Energy and installation of conduit to the new electrical transformer.

Work consisting of construction and installation of a new backwash treatment system east of the existing Sludge Handling Building.

4. COORDINATION. Contractor shall plan, schedule, and coordinate its operations in a manner which will facilitate the simultaneous progress of the Work and work included under other contracts outside the scope of these Contract Documents.

5. UTILITIES. Electric and gas services at the Taylor Mill Treatment Plant is provided by Duke Energy. Water service is provided by the Northern Kentucky Water District and sewer service is provided by Northern Kentucky Sanitation District No. 1. Telephone service is provided by Cincinnati Bell. The Contractor shall be responsible for contacting these utilities prior to the Work.

6. RESPONSIBILITY FOR MATERIALS AND EQUIPMENT.

6.01. Items Furnished by Contractor. Contractor shall be fully responsible for all materials and equipment which it has furnished.

7. OFFSITE STORAGE. Offsite storage arrangements shall be approved by Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such offsite storage arrangements shall be presented in writing and shall afford adequate and satisfactory security and protection. Offsite storage facilities shall be accessible to Owner and Engineer.

8. 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 Engineer from anyone except Contractor, and such requests will not be considered until after the Effective Date of the Agreement.

Whenever the names of proprietary products or the names of particular manufacturers or vendors are used, it shall be understood that the words "or equal" following the enumeration, if not specifically stated, are implied.

9. 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 Engineer.

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.

10. SALVAGE OF MATERIALS AND EQUIPMENT. Existing materials and equipment removed and not reused as part of the Work shall become Contractor's property.

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.

Contractor may furnish and install new items instead of the 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.

11. LAND FOR CONSTRUCTION PURPOSES. Contractor will be permitted to use available land belonging to Owner, on or near the Site, for construction purposes and for storage of materials and equipment.

The locations and extent of the areas so used shall be as indicated on the Drawings.

Contractor shall immediately move stored materials or equipment if any occasion arises, as determined by Owner, requiring access to the storage area. Materials or equipment shall not be placed on the property of Owner until Owner has agreed to the location to be used for storage.

Contractor shall not enter any private property outside the designated construction easement boundaries without written permission from the Owner of the property.

12. OPERATION OF EXISTING FACILITIES. The existing treatment plant 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. The Contractor shall notify the Engineer and Owner in writing at least 14 days before a proposed shutdown. Extended plant shutdowns shall not exceed 14 consecutive days and may be permitted between October 1 and May 1 when acceptable to the Owner.

Contractor shall provide temporary facilities and make temporary modifications as necessary to keep the existing facilities in operation during the construction period.

12.01. Construction Plan. The Contractor is solely responsible for developing a Construction Plan to perform the Work. The Contractor shall submit a written construction procedure for all Work to be reviewed and approved by the Owner and Engineer. The Construction Plan shall outline the required Work, including a schedule indicating the time to perform each activity. The Construction Plan shall include demolition work to be completed as described in Section 02050 – Demolition and Salvage. The Construction Plan shall be submitted at least 30 days in advance of the execution of the Work. Contractor shall provide all material and labor to make temporary arrangements as required for performance of the Work.

13. 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.

14. 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 Engineer 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 Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking survey, layout, and measurement work performed by Contractor.

Contractor shall keep Engineer 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 Engineer may be done with minimum inconvenience to Engineer and minimum delay to Contractor.

Contractor shall remove and reconstruct work which is improperly located.

15. 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.

16. 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.

17. 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 Engineer'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 Engineer, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished.

18. ASBESTOS ABATEMENT. 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 abatement 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.

18.01. SubContractor's Qualifications. The SubContractor for asbestos abatement 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 abatement 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. Liability insurance covering the asbestos abatement work shall be provided as specified in the Supplementary Conditions.

18.02. Abatement Methods. The asbestos abatement SubContractor shall submit a work plan of its proposed abatement 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 abatement, 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.

19. 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 antipollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications.

20. APPLICABLE CODES. References in the Contract Documents to local codes mean the following:

- Kentucky Building Code, latest edition
- Great Lakes Upper Mississippi River Board of Public Health & Environmental Managers "Recommended Standards for Water Works" (Ten State Standards), 2003 edition
- Kentucky Public and Semipublic Drinking Water Regulations, Kentucky Division of Water
- National Pollutant Discharge Elimination System, Northern Kentucky Sanitation District No. 1
- National Electrical Code (NEC)

Other standard codes which apply to the Work are designated in the Specifications.

21. SPECIFICATION DATA SHEETS AND SCHEDULES. Specifications may have data sheets and schedules as part of specific specification sections. Locations for data entries on the data sheets and schedules may be left blank intentionally. When no data is entered in a respective cell, this indicates that no data is required for that cell of the data sheet or schedule.

22. ALTERNATIVES. The Work required under the Base Bid is indicated in the Specifications and on the Drawings. All requirements specified or indicated also apply to each alternative selected by Owner except as otherwise provided. The following alternatives are provided for in the Bid Form.

The manner in which various portions of the Work must be changed to accommodate each alternative and its related Work is not indicated on the drawings.

Alternative A:	Deletion of work associated with the installation of the Uninterruptible Power Supply (deduct).

The following paragraph identifies any changes that need to be made to the Scope of Work in the event the Owner decides to delete the Uninterruptible Power Supply from the Scope of Work. These are only major changes and may not cover all items of Work. Per the Contract Documents, it is the Contractor's responsibility to identify all items requiring changes and perform the work associated with all changes.

- The Uninterruptible Power Supply equipment, wiring, conduit and appurtenances specified to be provided for the Uninterruptible Power Supply per Section 16610 – Uninterruptible Power Supply shall be deleted from the Scope of Work.

23. ENGINEERING INSPECTION. The Owner may appoint (either directly or through the Engineer) such inspectors as deemed proper to inspect the materials furnished and the Work performed for compliance with the Contract Documents. The Contractor shall furnish all reasonable assistance required by the Engineer, or inspectors, for the proper inspection of the Work.

Inspectors and other authorized representatives of the Owner or Engineer shall be free at all times to perform their duties. Any attempted intimidation of one of them by the Contractor or his employees shall be sufficient reason, if the Owner so decides, to terminate the Contract.

Such inspection shall not relieve the Contractor from any obligation to construct the Work strictly in accordance with the Contract Documents. Work not so constructed shall be removed and replaced by the Contractor at his own expense.

24. PRECONSTRUCTION CONFERENCE. Prior to the commencement of Work at the Site, a preconstruction 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.

Engineer and its Resident Project Representative.

Representatives of Owner.

Government representatives as appropriate.

Others as requested by Contractor, Owner, or Engineer.

Unless previously submitted to Engineer, Contractor shall bring to the conference a preliminary schedule for each of the following:

Progress Schedule.

Procurement Schedule.

Schedule of Values for progress payment purposes.

Schedule of 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.

Major equipment deliveries and priorities.

Contractor 's assignments for safety and first aid.

Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

25. PROGRESS MEETINGS. Contractor shall schedule and hold regular progress meetings at least monthly and at other times as requested by Engineer or required by progress of the Work. Contractor, Engineer, 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 shall 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.

26. SITE ADMINISTRATION. Contractor shall be responsible for all areas of the Site used by it, by other Contractor's, and by all SubContractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to Owner or others. Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and

may require all persons on the Site (except Owner's employees) to observe the same regulations as Contractor requires of its employees.

27. RELATIONS WITH OTHER CONTRACTORS. The Contractor shall cooperate will all other contractors who may be performing work in behalf of the Owner and workmen who may be employed by the Owner on any work in the vicinity of the Work to be done under this Contract, and he shall so conduct his operations as to interfere to the least possible extent with the work of such contractors or workmen. Contractor shall promptly make good, at his own expense, any injury or damage that may be sustained by other contractors or employees of the Owner at his hands. Any difference or conflict which may arise between the Contractor and other contractors or between the Contractor and workmen of the Owner in regard to their work shall be adjusted and determined by the Engineer. If the work of the Contractor is delayed because of any acts or omissions of any other contractor, the Contractor shall have no claim against the Owner on that account other than an extension of time. Whenever there is interference with work under other contracts, the Engineer shall decide the manner in which the work shall proceed under each contract.

28. METHODS OF OPERATION. The Contractor shall inform the Engineer in advance concerning his plans for completing each part of the Work. If at any time the Contractor's plant, equipment, or his methods of executing the Work appear to the Engineer to be inadequate to insure the required safety, quality, or rate of progress of the Work, the Engineer may order the Contractor to alter or improve his facilities or methods and the Contractor shall promptly comply with such orders; but neither compliance with such orders nor failure of the Engineer to issue such orders shall relieve the Contractor from his obligation to secure the degree of safety, the quality of Work, and the rate of progress required by the Contract Documents. The Contractor alone shall be responsible for the safety, adequacy, and efficiency of his plant, equipment, and methods.

Any method of Work suggested by the Owner or Engineer, but not specified, shall be used at the risk and responsibility of the Contractor; and the Engineer and Owner will assume no responsibility therefore.

Approval by the Owner and Engineer of any plan or method of work proposed by the Contractor shall not relieve the Contractor of any responsibility therefore, and such approval shall not be considered as an assumption of any risk or liability by the Owner or Engineer, or any officer, agent, or employee, thereof. The Contractor shall have no claim on account of the failure or inefficiency of any plan or method so approved.

End of Section

Section 01020

TRAINING

1. SCOPE. This section describes training requirements to be provided by the Contractor for the Owner's personnel. All training sessions shall be conducted onsite at Owner's facilities and shall be provided for the following sections:

Ultraviolet Disinfection System

Miscellaneous Equipment

2. GENERAL. Contractor shall furnish the services of a competent manufacturer's technical representative who is regularly engaged in the training of the operation, maintenance and troubleshooting of the equipment furnished. Programmers, analysts or system engineers shall not be used as trainers unless these engineers are part of the training organization. The training shall not begin until after the completion of the equipment installation and the manufacturer has fulfilled the requirements for field supervision and tests. All equipment shall function properly as designed, including all automatic operating functions, prior to the start of training.

Contractor shall coordinate and schedule training sessions to be separate from the manufacturers' technical representatives' site visits for the equipment checkout and testing.

One session of the operation staff training shall occur during the first shift and the other sessions shall occur during the second shifts, as required by the Owner.

Any unused training hours shall be credited to the Owner or used for other purposes as acceptable to the Owner.

3. SUBMITTALS. The Contractor shall include the following training information in the submittal for this section:

a. A course syllabus for each section specified to have training.

b. A training schedule for each section, including proposed times and dates.

c. Detailed course outline, list of handouts, daily training schedule and daily training objectives a minimum of 30 days prior to each training session.

d. Instructor qualifications.

e. Two copies of handouts and training manuals.

All training content and duration shall be approved by the Owner and the Engineer prior to the start or scheduling of any training session.

4. TRAINING PROGRAM. Contractor shall provide instructors and instructional material, including trainees' workbooks, instructor's guides, training aids, equipment and system technical manuals. The quantity of training materials provided for the training session shall be sufficient for each attending trainee. Contractor shall provide competency (objective) based training which shall have a combination of classroom and hands-on instruction.

In general, the manufacturer's standard training courses may be used to meet the training objectives specified. Where standard courses do not meet these objectives, additional coursework shall be developed. Clock hour requirements for each level of training are listed in the appropriate equipment section. A "clock hour" is defined as one hour of instruction or supervised training exercise. Multiple sessions indicate that different persons will be attending each session, and the course shall be given the number of sessions indicated. The requirements listed for each training category are minimum requirements. Additional training time shall be provided if considered necessary to meet the training objectives. Sessions may have to be conducted outside normal working hours to accommodate the working schedule of the Owner's personnel.

Full time instructors who are familiar with the specific equipment supplied shall be used for each course. Contractor shall ensure that the instructor does not perform other duties that will interrupt instruction during this period. The Contractor shall distribute and collect an attendance list for each class.

All training sessions shall be satisfactory to the Owner and Engineer. Any training session that does not fulfill these requirements or is not satisfactory shall be repeated if the Owner and Engineer deem necessary. Repeated training shall be at no additional cost to the Owner.

Training manuals and handouts shall be specific to the equipment installed for this project.

Contractor shall provide maintenance and repair or replacement of failed or damaged equipment used for training. Software modified for training shall be restored to its original condition.

All costs associated with the complete training program shall be the responsibility of the Contractor and shall be included in the contract price.

The Owner may videotape on-site training sessions at his option.

5. TRAINING OBJECTIVES. Training shall be provided for the following equipment as listed herein. Courses shall be held to accommodate OWNER's operating schedule. Contractor shall coordinate the scheduling as acceptable to the Owner.

5-01. Ultraviolet Disinfection System. The training shall include the following sessions:

	Sessions	Clock hours/ Session	Persons/ Session
Maintenance	1	8	20
Operation	2	8	10

5-01.01. Maintenance Training. System maintenance training shall be provided to enable the Owner's personnel to perform routine and preventive maintenance, troubleshoot, and repair all equipment furnished with the system.

Maintenance training shall cover at least the following topics:

Functional description of system and components.

Storage and care of spare parts.

Instrumentation and Control.

Safety precautions, including lamp breakage.

Routine and preventive maintenance.

Troubleshooting.

Replacement and repairs of all parts.

Electrical system maintenance.

Cleaning procedures.

5-01.02. Operator Training. The Owner's operators will utilize the equipment for disinfecting the combined filter effluent before entering the clearwell. The training program shall provide operators with sufficient knowledge to react to and acknowledge alarms, adjust control setpoints and alarm limits, control system components, and react to and resolve minor system errors and equipment malfunctions. The installed equipment shall be used during training.

Operator training shall cover at least the following topics:

Functional description of system and components.

Startup and shutdown of system and components.

Troubleshooting.

Normal operating parameters.

System optimization.

Cleaning procedures.

5-02. Miscellaneous Equipment Training. Miscellaneous equipment training shall include training for the following equipment:

AWWA Butterfly Valves,
Uninterruptible Power Supply

Training for this equipment shall be provided by the respective equipment manufacturers. Training shall include the following sessions:

	Sessions	Clock hours/ Session	Persons/ Session
Maintenance	1	4	20

Training shall cover the following general topics, at a minimum:

Functional description of system and components.

Startup and shutdown of system and components.

Normal operating parameters.

System optimization.

Operating Instructions.

Routine and preventive maintenance.

Troubleshooting.

Replacement and repairs of all parts.

Electrical system maintenance.

Cleaning procedures.

End of Section

Section 01070

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Abbreviations for standards and organizations used in the Contract Documents are defined as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREMA	American Railway Engineers and Maintenance-of-Way Association
ARI	American Refrigeration Institute
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AVATI	See RTI
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society

AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
Fed Spec	Federal Specification
FCI	Fluid Controls Institute
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
FTI	Facing Tile Institute
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IBC	International Building Code
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society
MHI	Materials Handling Institute
MIL	Military Specification

MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NACE	NACE International
NBHA	National Builders Hardware Association
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBS	See NIST
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly NBS)
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	NSF International (formerly National Sanitation Foundation)
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
RTI	Resilient Tile Institute (formerly AVATI)
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SDI	Steel Door Institute
SFPA	Southern Forest Products Association
SI	Systéme International des Unités (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association

SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSI	Scaffolding and Shoring Institute
SSPC	SSPC: The Society for Protective Coatings
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
UV	Ultraviolet
WEF	Water Environment Federation

End of Section

Section 01300

SUBMITTALS

Data Sheet

Para-graph	Description	Data	Units
	General		
2.0	Address where shop drawings are to be sent.	☉ ENGINEER's address in the Agreement ☐ Consulting ENGINEER's address in the Supplementary Conditions ☐ Other	
	When "Other" is selected, indicate the alternative.		
2.02	Review period in consecutive calendar days required.	☉ 21 days ☐ 28 days ☐ 14 days ☐ Other	
	When "Other" is selected, indicate the alternative.		
2.0	Time required for resubmittal in calendar days.	☐ 60 days unless within 30 days ☉ 30 days unless within 14 days ☐ Other	
	When "Other" is selected, indicate the alternative.		
3.0	Number of Operations and Maintenance manuals required.	☉ 3 preliminary hardcopies, 3 final hardcopies, and 3 final electronic copies. ☐ Other	
	When "Other" is selected, indicate the alternative.		

Section 01300

SUBMITTALS

1. GENERAL.

1.01. Terminology. When the phrase "as required" is stated in this section, it shall mean "as required in the attached Data Sheet".

2. SHOP DRAWINGS AND ENGINEERING DATA.

2.01. General. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. 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 the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, Contractor's initial submittal shall be complete 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 submittal. Contractor's stamp of approval is a representation to Owner and Engineer 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 (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

Five copies (or one reproducible copy) of each drawing and the necessary data shall be submitted to Engineer. Engineer will return two marked copies (or one marked reproducible copy) to Contractor. Facsimile (fax) copies will not be acceptable. Engineer 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.

2.02. Engineer's Review of Submittals. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Engineer's submittal review period shall be the consecutive number of calendar days as required and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer'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 Engineer and five corrected copies (or one corrected reproducible copy) resubmitted. Facsimile (fax) copies will not be acceptable. When the drawings and data are returned marked "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer.

2.03. 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 Engineer are provided on the resubmittal.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. 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, etc.).

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information,

Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

When resubmittals are needed, resubmittals shall be made within the number of days of the date on the letter returning the material to be modified or corrected as required, unless within the number days, as required, Contractor submits an acceptable request for an extension of time, listing the reasons why the resubmittal cannot be completed within the stipulated time.

The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

2.04. Color Selection. Contractor shall submit samples of colors and finishes for all accepted products before Engineer will coordinate the selection of colors and finishes with Owner. Engineer will prepare a schedule of finishes that include the colors and finishes selected for both manufactured products and for surfaces to be field painted or finished and will furnish this schedule to Contractor within 60 days after the date of acceptance of the last color or finish sample.

3. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare an operation and maintenance manual for each type of equipment indicated in the individual equipment sections or the equipment schedule.

Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.

Operation and maintenance manuals shall include the following:

a. Equipment function, normal operating characteristics, and limiting conditions.

b. Assembly, installation, alignment, adjustment, and checking instructions.

c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.

d. Lubrication and maintenance instructions.

e. Guide to troubleshooting.

f. Parts lists and predicted life of parts subject to wear.

g. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.

h. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Contractor.

Preliminary copies of operation and maintenance manuals shall be submitted to Engineer before shipment of the equipment. Preliminary copies shall be in hardcopy format. The quantity of copies shall be as required.

After review by Engineer, final copies of operation and maintenance manuals shall be delivered to Engineer not later than 30 days prior to placing the equipment in operation. Final copies shall include the number of hardcopies and electronic copies as required.

Shipment of equipment will not be considered complete until all required manuals and data have been received.

3.01. Hardcopy Operation And Maintenance Manuals. Hardcopies for preliminary and final manuals shall be temporarily bound in heavy paper covers bearing suitable identification. All manuals and other data shall be printed on heavy, first quality 8-1/2 x 11 inch paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs. The final hardcopy of each manual shall be prepared and delivered in substantial, permanent, three-ring or three-post binders with a table of contents and suitable index tabs.

3.02. Electronic Operation And Maintenance Manuals. Each electronic copy shall be delivered on a unique CD-ROM in Adobe Acrobat's Portable Document Format (PDF). The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated.

File names shall use the "eight dot three" convention (XXXXX_YY.pdf), where X is the five digit number corresponding to the specification section, and YY is a two digit number set in sequential order when there are more than one PDF document (more than one O&M manual) per specification section. The initial filename for the O&M submittal will be provided with the request for final O&M manuals.

Scanned images must be at a readable resolution. For most documents, they should be scanned at 300 dots per inch (dpi). Optical Character Recognition (OCR) capture must be performed on these images. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.

One PDF document (PDF file) shall be created for each equipment service manual. The entire manual shall be converted to a single .PDF file via scanning or other method of conversion. Drawings or other graphics shall also be converted to .PDF format and included into the single PDF document. Pages that must be viewed in landscape format shall be rotated to the appropriate position for easy reading on screen.

The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

The opening view for each PDF document shall be as follows:

Initial View: Bookmarks and Page

Magnification: Fit In Window

The file shall open to the cover page of the manual, with bookmarks to the left, and the first bookmark shall be linked to the Table of Contents.

3.03. Labeling. As a minimum, the following information shall be included on all final O&M manual materials, including CD-ROM disks, jewel cases, and hardcopy manuals:

Manufacturer's name.

Equipment name and/or O&M title spelled out in complete words.

Example: "Operations and Maintenance Manual"

"_____"

Specification Section Number. Example: "Section 15500"

Project Name. "_____"

Owner/Contract Number. "Contract No. _____"

File Name and Date. Example: "15500_01.pdf", "5-05-02"

End of Section

Section 01310

CONSTRUCTION SCHEDULING

Data Sheet

Para-graph	Description	Data	Units
	General		
2.	Multiple sections of the Contract.	☐ Yes ☒ No	
	Type of construction schedule required.	☒ Progress Schedule ☐ Critical Path Progress Schedule	
2.	**Multiple Contract Sections**		
	Coordinating CONTRACTOR required.	☐ Yes ☒ No	
	When "Yes" is selected, indicate the Contract section awarded to the coordinating CONTRACTOR.		
	When "Yes" is selected, indicate the sections of the Contract that need to coordinate their operations with the coordinating CONTRACTOR.		
3.	**Progress Schedule**		
	Provide installation date for each major equipment item.	☒ Yes ☐ No	
	Provide time for making connection to existing piping, structures, or facilities.	☒ Yes ☐ No	
	Minimum frequency for submitting revised schedules.	☐ 60 days ☐ 90 days ☐ 120 days ☒ Other	
	When "Other" is selected, indicate the alterative frequency.	30 days	
	OWNER required to cooperate with CONTRACTOR for continuity of service.	☒ Yes ☐ No	
	Progress reports to include prints of the graphic schedule.	☒ Yes ☐ No	

4.	**Critical Path Progress Schedule**		
	Drawing sheet size for the schedule.	☐ 30 x 42 inches (750 x 1050 mm) ☐ 24 x 36 inches (600 x 900 mm) ☐ Other	
	When "Other" is selected, indicate the alternative sheet size.		
	Minimum number of arrow diagram copies required for submittal.	☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ Other	
	When "Other" is selected, indicate the alternative number of copies required.		
	Minimum frequency for submitting revised schedules.	☐ 60 days ☐ 90 days ☐ 120 days ☐ Other	
	When "Other" is selected, indicate the alternative frequency.		
	Number of calendar days permitted for each shop drawing submittal.	☐ 28 days ☐ 21 days ☐ 14 days ☐ 7 days ☐ Other	

Section 01310

CONSTRUCTION SCHEDULING

1. TERMINOLOGY. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".

2. MULTIPLE CONTRACT SECTIONS. Not used.

3. PROGRESS SCHEDULE. A progress schedule shall be submitted. The progress schedule shall indicate the sequence of the Work; the time of starting and completion of each part; the installation date for each major item of equipment; and the time for making connections to existing piping, structures, or facilities. An initial progress schedule shall be submitted after the preconstruction conference and before Work is started. The schedule shall be revised as necessary to reflect changes in the progress of the Work. Revised schedules shall be submitted at the frequency as required.

Owner shall cooperate with Contractor in arrangements for continuity of service and operation of valves and other control facilities.

Owner may require Contractor, at Contractor's expense, to add to its plant, equipment, or construction forces, as well as increase the working hours, if operations fall behind schedule at any time during the construction period.

The following requirements shall be taken into consideration in preparing the proposed schedule of construction operations.

3.01. Progress Reports. A progress report shall be furnished to Engineer with each Application for Payment. If the Work falls behind schedule, Contractor shall submit additional progress reports at such intervals as Engineer 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 Engineer, must be substantiated with satisfactory evidence.

Each progress report shall also include three prints of the accepted graphic schedule marked to indicate actual progress.

4. CRITICAL PATH PROGRESS SCHEDULE. Not used.

End of Section

Section 01320

CONSTRUCTION PROGRESS DOCUMENTATION

Data Sheet

Para-graph	Description	Data	Units
	General		
2	Schedule of Values required.	☒ Yes ☐ No	
3	Schedule of Payments required.	☒ Yes ☐ No	
4	Survey Data required.	☒ Yes ☐ No	
5	Layout Data required.	☒ Yes ☐ No	

Section 01320

CONSTRUCTION PROGRESS DOCUMENTATION

1. GENERAL.

1.01. Units of Measurement. Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

1.02. Terminology. When the phrase "as required" is stated in this section, it shall mean "as required in the attached Data Sheet".

2. SCHEDULE OF VALUES. After review of the preliminary schedule at the preconstruction conference, and before submission of the first Application for Payment, Contractor shall prepare and submit to Engineer a schedule of values covering each lump sum item. The schedule of values, showing the value of each kind of work, shall be acceptable to Engineer before any Application for Payment is prepared.

The sum of the items listed in the schedule of values shall equal the Contract Price. Such items as Bond premium, temporary construction facilities, and plant may be listed separately in the schedule of values, provided the amounts can be substantiated. Overhead and profit shall not be listed as separate items.

The schedule of values shall have sufficient detail such that partial completion of separable items of work can easily be calculated. The schedule of values shall have separate lines for manufacturer's field services, O&M manuals, and performance testing for each item of equipment requiring such services.

An unbalanced schedule of values providing for overpayment of Contractor on items of Work which would be performed first will not be accepted. The schedule of values shall be revised and resubmitted until acceptable to Engineer. Final acceptance by Engineer shall indicate only consent to the schedule of values as a basis for preparation of applications for progress payments, and shall not constitute an agreement as to the value of each indicated item.

3. SCHEDULE OF PAYMENTS. Within 30 days after award of contract, Contractor shall furnish to Engineer a schedule of estimated monthly payments. The schedule shall be revised and resubmitted each time an Application for Payment varies more than 10 percent from the estimated payment schedule.

4. SURVEY DATA. Not used.

5. LAYOUT DATA. Contractor shall keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Copies of such data shall be furnished to the Resident Project Representative for use in checking Contractor's layout as provided in the project requirements section. All such data considered of value to Owner will be transmitted to Owner by Engineer with other records upon completion of the Work.

End of Section

Section 01380

CONSTRUCTION PHOTOGRAPHS

Data Sheet

Para-graph	Description	Data	Units
	General		
	Party responsible for the production of construction photographs:	☑ CONTRACTOR ☐ OWNER	
	Contractor Photographs		
	When CONTRACTOR is required to provide photographs, indicate the type of project.	☑ Plant ☐ Pipeline ☐ Roadway ☐ Other	
	When "Other" is selected, indicate the type of project.		
	When plant photographs are required, indicate the number of photographs required at the beginning of the project.	50	
	If specific locations need to be photographed, indicate the locations and views.	Basement Pipe Gallery Filter Pipe Gallery Corridor to Chemical Feed Building Site east of existing Filter to Waste Basin.	
	When plant photographs are required, indicate the number of additional photographs required each month of the project.	25	
	If specific locations need to be photographed, indicate the locations and views.	Basement Pipe Gallery Filter Pipe Gallery Corridor to Chemical Feed Building Site east of existing Filter to Waste Basin.	
	When pipeline photographs are required, indicate the distance interval between photographs that are required at the beginning of the project.		ft [m]
	If specific locations need to be photographed, indicate the locations and views.		

	When roadway photographs are required, indicate the distance interval between photographs that are required at the beginning of the project.		ft [m]
	If specific locations need to be photographed, indicate the locations and views.		

Section 01380

CONSTRUCTION PHOTOGRAPHS

1. TERMINOLOGY. When the phrase "as required" is stated in this section, it shall mean "as required in the attached Data Sheet".

2. CONSTRUCTION PHOTOGRAPHS BY CONTRACTOR. CONTRACTOR shall be responsible for the production of construction photographs as provided herein. ENGINEER shall designate the subject of each photograph.

For plant projects, photographs of the entire site, or pertinent features thereof, shall be taken before the commencement of Work and promptly submitted to Engineer. The number of photographs shall be as required. The same views shall be rephotographed upon completion of all construction activities and submitted with Contractor's application for final payment. As required, additional photographs shall be made each month throughout the progress of the Work at such times as requested by Engineer, and submitted with Contractor's application for progress payment.

For pipeline projects, photographs shall be taken along the route of the pipeline before the commencement of Work, and promptly submitted to Engineer. The photographs shall be at intervals as required. The same views shall be rephotographed upon completion of construction activities on any section of the pipeline, and submitted with Contractor's Application for Payment for Work on that section.

All photographs shall be color digital, produced by a competent professional photographer. Contractorshall submit two copies of the photographs electronically and two copies of 4 by 5 inch prints. Digital images shall be compiled on CD and provided with a descriptive index of the images. Prints shall be mounted on linen with flap for binding or enclosed in clear plastic binders, and marked with the name and number of the Contract, name of Contractor, description and location of view, and date photographed.

Engineer will transmit the digital files and one copy of the prints to Owner.

3. CONSTRUCTION PHOTOGRAPHS BY OWNER. Owner shall be responsible for the production of all construction photographs.

End of Section

Section 01400

QUALITY CONTROL

1. TESTING SERVICES. Testing services shall be provided in accordance with Paragraph 13.03 of the General Conditions. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. 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 Provided by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

Concrete.

Concrete materials and design mixtures.

All other tests and engineering data required for Engineer's review of materials and equipment proposed to be used in the Work.

Contractor shall obtain Engineer's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.

1.02. Testing Services provided by Owner. Unless otherwise specified, Owner shall provide for tests made on the following materials and equipment:

Other materials and equipment at the discretion of Owner.

Testing, including sampling, will be performed by Engineer or the testing firm's laboratory personnel, in the general manner indicated in the Specifications. Engineer 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 Engineer or laboratory personnel, Contractor shall furnish personnel and facilities to assist in the activities.

1.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified in the Submittals section.

The laboratory retained by Owner will furnish four copies of a written report of each test. Two copies of each test report will be transmitted to the Resident Project Representative, one copy to Engineer, and one copy to Contractor, within 3 days after each test is completed.

2. SPECIAL INSPECTIONS. Not used.

3. OFFSITE INSPECTION. Not used.

4. MANUFACTURER'S FIELD SERVICES. Manufacturer's field services shall be as specified herein except as specifically specified in the respective equipment sections.

4.01. Services Furnished Under This Contract. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the respective equipment section or in the equipment schedule section shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

Each manufacturer's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

4.02. Services Furnished by Others. Not used

End of Section

Section 01500

TEMPORARY FACILITIES

1. OFFICE AT SITE OF WORK. During the performance of this Contract, Contractor shall maintain a suitable office at or near the Site which shall be the headquarters of its representative authorized to receive drawings, instructions, or other communication or articles. Any communication given to the said representative or delivered at Contractor's office at the Site in the representative's absence shall be deemed to have been delivered to Contractor.

Copies of the Drawings, Specifications, and other Contract Documents shall be kept at Contractor's office at the Site and available for use at all times.

2. WATER. All water required for and in connection with the Work to be performed will be furnished by Owner in the vicinity of the Site without charge to Contractor, provided:

a. Contractor shall procure such water in the location and in the manner designated by Engineer.

b. Contractor at its own expense shall make authorized connections and provide means for delivering the water to the Site.

c. Contractor shall provide adequately against waste and needless use of water.

3. POWER. Contractor shall provide all power for heating, lighting, operation of Contractor's plant or equipment, or for any other use by Contractor. Temporary heat and lighting shall be maintained until the Work is accepted.

4. 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.

5. 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. Contractor shall enforce the use of such sanitary facilities by all personnel at the Site.

6. MAINTENANCE OF TRAFFIC. Contractor shall conduct its 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.

7. 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.

8. 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. 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 locations.

9. DAMAGE TO EXISTING PROPERTY. Contractor will be held responsible for any damage to existing structures, Work, materials, or equipment because of his operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to, Owner.

Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.

Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which may be caused by transporting equipment, materials, or workers to or from the Work. Contractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

10. SECURITY. Contractor shall be responsible for protection of the Site, and all 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, watchman services, and other measures as required to protect the Site.

11. 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.

12. PARKING. Contractor shall provide and maintain suitable parking areas for the use of all 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.

13. 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 its operations to avoid unnecessary noise which might interfere with the activities of building occupants.

14. 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.

15. 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 and shall be approved and coordinated with the Sanitation District No. 1 Permit requirements.

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.

16. EROSION CONTROL. Contractor shall prevent erosion of soil on the Site and adjacent property resulting from its 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.

17. 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 shall be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance shall be permitted to enter sanitary sewers, and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

End of Section

Section 01605

GENERAL EQUIPMENT REQUIREMENTS

1. SCOPE. All equipment furnished and installed under this Contract shall conform to the general requirements set forth in this section, except as otherwise specified in other sections.

2. COORDINATION. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

3. MANUFACTURER'S EXPERIENCE. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

4. WORKMANSHIP AND MATERIALS. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick. When dissimilar metal components are used, consideration shall be given to prevention of galvanic corrosion.

5. PROGRAMMING SOFTWARE. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-

based operating system. A copy of the manufacturer's original operating logic program shall be provided with tag name descriptions and comments for use in maintaining and troubleshooting the equipment. Where multiple pieces of equipment, from the same or different vendors, use the same programming software, only one copy of the software need be provided.

End of Section

Section 01610

GENERAL EQUIPMENT STIPULATIONS

1. SCOPE. When an equipment specification section in this Contract references this section, the equipment shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.

2. COORDINATION. Coordination by Contractor shall be as specified in Section 01605 – General Equipment Requirements when included in the Contract Documents.

3. MANUFACTURER'S EXPERIENCE. Manufacturer's experience requirements shall be as specified in Section 01605 – General Equipment Requirements when included in the Contract Documents.

4. WORKMANSHIP AND MATERIALS. Workmanship and Materials shall be as specified in Section 01605 – General Equipment Requirements when included in the Contract Documents.

5. LUBRICATION. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

6. ELEVATION. The elevation of the site shall be as indicated in the respective equipment specification sections. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at the specified elevation.

7. ELECTRIC MOTORS. Unless otherwise specified, motors furnished with equipment shall meet the requirements specified in Section 16220 – General Purpose Induction Motors or specified in specific equipment sections.

8. DRIVE UNITS. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

8.01. Gearmotors. The use of gearmotors sharing an integral housing, or cut gears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.

8.02. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L_{10} bearing life shall be 200,000 hours.

The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L_{10} 200,000 hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the

manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

8.03. Adjustable Speed Drives. Each mechanical adjustable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower [kilowatts] of the drive motor. A spare belt shall be provided with each adjustable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

8.04. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor.

9. SAFETY GUARDS. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage thick or thicker galvanized, aluminum-clad sheet steel, or stainless sheet steel or from 1/2 inch mesh galvanized expanded metal, or poltrusion molded UV resistant materials. Each safety guard shall be reinforced or shaped to provide suitable strength to prevent vibration and deflection and shall comply with OSHA. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

10. ANCHOR BOLTS. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with Section 05550 – Anchorage in Concrete and Masonry and, unless otherwise specified, shall be at least 3/4 inch in diameter.

Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

11. EQUIPMENT BASES. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall

be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in Section 03600 – Grout.

12. SPECIAL TOOLS AND ACCESSORIES. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

13. SHOP PAINTING. All iron and steel surfaces of the equipment shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an epoxy or polyurethane enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of a universal primer.

Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

14. PREPARATION FOR SHIPMENT. Equipment shall be prepared for shipment as specified in Section 01612 – Shipping.

15. STORAGE. Handling and storage of equipment shall be as specified in Section 01614 – Handling and Storage.

16. INSTALLATION AND OPERATION. Installation and operation shall be as specified in respective equipment sections and Section 01650 – Startup Requirements.

17. OBSERVATION OF PERFORMANCE TESTS. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests.

18. PROGRAMMING SOFTWARE. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-based operating system. A copy of the manufacturer's original operating logic program shall be provided with tag name descriptions and comments for use in maintaining and troubleshooting the equipment. Where multiple pieces of equipment, from the same or different vendors, use the same programming software, only one copy of the software need be provided.

End of Section

Section 01612

SHIPPING

1. SCOPE. This section covers packaging and shipping of materials and equipment.

2. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Grease and lubricating oil shall be applied to all bearings and similar items.

3. SHIPPING. Before shipping each item of equipment 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.

End of Section

Section 01614

HANDLING AND STORAGE

1. SCOPE. This section covers delivery, storage, and handling of materials and equipment.

2. DELIVERY. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified in this Contract. These requirements also apply to any subsuppliers making direct shipments to the jobsite.

Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished under this Contract before and after receipt at the port of entry. Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.

All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

Delivery of portions of the equipment in several individual shipments shall be subject to review of Engineer before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy accumulation, and to facilitate eventual installation.

3. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60°F. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.

When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of Engineer, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

4. HANDLING. Stored items shall be laid out to facilitate their retrieval for use in the Work. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.

End of Section

Section 01620

EQUIPMENT SCHEDULE

1. SCOPE. This section consists of an equipment schedule for items for which a basic level of manufacturer's field services or operation and maintenance manuals are required, but not covered in other sections. When other sections indicate that manufacturer's field services and operation and maintenance manuals are required, the requirements shall be as specified in the other sections.

Specific requirements for manufacturer's field services are covered in the Quality Control section and the equipment specifications.

Specific requirements for operation and maintenance manuals are covered in the Submittals section.

2. SCHEDULE. Manufacturer's field services, including equipment installation checks and training, and operation and maintenance manuals shall be provided for the items of equipment indicated in the following schedule:

Spec Section	Type of Equipment	Spare Parts	Mfr's. Field Services	O&M Manual
13500	Instrumentation and Control System	X	X	X
13530	Programmable Logic Controllers	X	X	X
13560	Instrumentation General Requirements	X	X	X
13561	Panel Mounted Instruments	X	X	X
13570	Panels, Consoles, and Appurtenances	X	X	X
13700	UV Disinfection System	X	X	X
15101	AWWA Butterfly Valves	X	X	X
15180	Valve Actuators	X	X	X

End of Section

Section 01630

PIPELINE SCHEDULE

1. SCOPE. This section consists of a schedule of 4 inch and larger pipelines indicating the type of pipe to be used. Pipe materials, installation, testing, and disinfection, when specified, are covered in other sections.

Piping smaller than 4 inches is covered in the various miscellaneous piping sections. Piping for plumbing, heating and air conditioning systems is covered in other sections. Piping to be furnished with equipment is covered in the applicable equipment section.

2. ALTERNATIVE PIPE TYPES. Where more than one type of pipe is indicated in the schedule, the type of pipe material to be installed may be selected by Contractor. The details on the drawings cover only one type of pipe for each line. If a different material is selected by Contractor, all details of connections, jointing, wall fittings, support, anchorage, and harnesses shall be modified as necessary to produce an equivalent design acceptable to Engineer.

3. WALL FITTINGS. A wall pipe or sleeve will be required for all pipe passing through concrete or masonry block walls. Wall fittings and sleeves shall be as indicated on the drawings and as specified in the applicable piping section.

4. SCHEDULE INDEX. Pipe material abbreviations and their applicable specification section number are as indicated:

Abbreviation	Pipe Material	Section No.
BR	Brass	15060
CPVC	CPVC	15067
CS	Miscellaneous steel pipe	15065
CSG	Galvanized steel pipe	15065
CU	Copper tubing	15070
DIP	Ductile iron pipe	15061
HS	Hose	15060
PVC	PVC	15067

5. SCHEDULE. Pipe materials shall conform to Schedule 01630-S01. All pipelines indicated on the drawings and all pipelines required for proper operation of the equipment furnished shall be provided whether listed in the schedule or not.

End of Section

Schedule 01630-S01

Pipeline Schedule

1.000	**General**		
1.010	Specification Section 01630		
2.000	**Requirements**		
Size (in.)	Service	Location	Material
24	Combined Filter Effluent	Basement Pipe Gallery	DIP

End of Schedule

Section 01650

STARTUP REQUIREMENTS

1. SCOPE. This section covers startup requirements for all items of equipment and systems including mechanical equipment. Additional requirements may be specified in specific equipment specifications. The requirements of this section shall be satisfactorily completed prior to any field tests specified in the specific equipment sections.

2. GENERAL. Equipment shall not be operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results. All items of equipment and systems shall be tested for proper operation, efficiency, and capacity. All required adjustments, tests, operation checks, and other startup activity shall be provided by qualified personnel. Contractor shall be responsible for planning, supervising, and executing the installation of Work.

2.01. Coordination. Contractor shall coordinate all tests related to startup of equipment and systems and shall report the results to Engineer in accordance with the submittals section. Contractor shall accept the equipment and the test results related to starting of equipment and systems before Engineer will accept the equipment and the test results.

When equipment is ready for a witness test, Contractor shall give written notice to Engineer at least 14 days before any offsite witness testing is performed or any field witnessed performance testing, unless otherwise specified.

3. EQUIPMENT TESTS.

3.01. Factory Tests. When specified in the specific equipment sections, the equipment will be test run at the point of manufacture and the test results will be delivered to Engineer. Such equipment will not be shipped until Engineer has reviewed the test results and advised the Contractor, in writing, that the equipment is acceptable for shipment. Such acceptance, however, will not be considered as final acceptance, which will only be made on the basis of the test results of the equipment after installation.

3.02. Preliminary Field Tests. All items of mechanical equipment shall be given a preliminary field test by Contractor after installation for proper operation, efficiency, and capacity. The preliminary field test shall consist of the requirements listed herein, unless exceptions or additions are indicated in the specific equipment sections.

Contractor's test operation of each piece of mechanical equipment shall continue for not less than 8 hours without interruption. All moving parts of equipment and machinery shall be carefully tested for operation, and adjusted so all parts move freely and function to secure satisfactory operation. All equipment shall be tested continuously under actual or simulated operating conditions. All parts shall operate satisfactorily in all respects, under continuous full load and in accordance with the specified requirements, for the full duration of the 8 hour test period. If any part of a unit shows evidence of unsatisfactory or improper operation during the 8 hour test period, correction or repairs shall be made and the full 8 hour test operation, as specified, shall be completed after all parts operate satisfactorily.

Tests of all process and pumping equipment, drive motors, including auxiliaries shall be made in accordance with the appropriate and approved test codes such as the American Society of Mechanical Engineers, Hydraulic Institute Standards, and IEEE.

Tests shall be conducted after the Work is substantially complete so each item of equipment is ready for integrated operation with other equipment at the plant. Testing, measuring, and calibrating procedures shall be submitted to Engineer for review and acceptance prior to startup and testing of equipment.

The equipment shall be properly filled, by Contractor, with oil and grease, and Contractor shall furnish all power, personnel, water, chemicals, fuels, oil, grease, and auxiliaries necessary for conducting the testing of the equipment for proper operation, efficiency, and capacity.

The period of inspection, initial startup operation, and field adjustment shall be as needed to achieve satisfactory installation and operation of the items furnished. Any period required for instruction of Owner's personnel shall be as specified in the Contract Documents.

When the specific equipment sections indicate that an installation check is required by the equipment manufacturer, the manufacturer's representative will make all necessary field adjustments and correct defects in materials or workmanship during this test period.

All equipment installed under this Contract, including that furnished by others, shall be placed into successful operation according to the written instructions of the equipment manufacturer and the instructions of the manufacturer's field representative.

3.03. Field System Operation Test. After all equipment is installed and the entire plant or system is ready to operate, Contractor shall conduct a field system

operation test. The test shall consist of the requirements listed herein, unless exceptions or additions are indicated in the specific equipment sections.

The test period shall be at least 7 days, and each system shall operate under actual or simulated operating conditions before the certificate of partial completion of all construction Work is issued. All defects of material, workmanship, or equipment which appear during this test period shall be corrected by Contractor. After such corrections are made, the 7 day test shall be repeated before the certificate of partial completion of all construction Work is issued, unless waived by Engineer.

Contractor shall supply all power, water, oil, grease, auxiliaries, and operating personnel required for this operation test.

When necessary for certain items of equipment, the final adjustments and inspections will be made by factory trained service personnel (other than sales representatives), rather than by Contractor. The service personnel will also supervise the test operation. This requirement will be stated under the detailed specification for the particular piece or pieces of equipment. The manufacturer's service personnel will make adjustments and supervise testing by Contractor until such tests have been accepted by Engineer.

4. ACCEPTANCE. When no other field tests for acceptance are specified in the equipment sections, at the end of the field system operation testing, each system will be accepted if, in the opinion of Engineer, it has operated satisfactorily without excessive power use, wear, or need for lubrication, or requiring undue attention; and if all its rotating parts operate without excessive vibration or noise at any operating condition.

When other field tests for acceptance are specified in the equipment sections, acceptance shall be after all tests are satisfactorily conducted as specified in the appropriate equipment procurement specification.

When a field performance test for baseline is specified in the equipment sections, acceptance shall be after a completion of the baseline performance test that is conducted as specified in the pumping unit field testing - baseline performance section.

Acceptance of Work in connection with the installation of equipment furnished by others will be subject to approval of the manufacturer's field representative. Acceptance by Owner or approval of the manufacturer's field representative will not relieve Contractor of responsibility for defective Work.

End of Section

	When "Yes" is selected, indicate additional equipment		
	Programming Hardware and Software (PR 2-5 & 2-6)		
	Notebook computer required.	☐ Yes ☒ No	
	Copies of LOI programming licenses required including documentation and manuals.	☐ OWNER copy ☐ ENGINEER copy ☐ Other	
	When "Other" is selected, indicate alternative.		
	Software standard.	☐ Manufacturers standard ☐ Third party ☐ RS Logix ☐ Concept ☒ Other	
	When "Other" is selected, indicate alternative.	PanelBuilder 32	
	Languages.	☐ Relay ladder logic ☐ Function block ☐ Sequential function chart ☐ Structured text ☐ State logic ☐ IEC-1131	
	PLC emulation testing required.	☐ Yes ☒ No	
	Enclosures (PR 2-7)		
	PLC housed in.	☑ Shop-assembled ☑ Existing	
	Field Services (PR 3-1)		
	Refer to specification section indicated.	Section 13500 – Instrumentation and Control System.	
	Fiber Optic Cable testing required.	☐ Yes ☒ No	

Section 13530

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1-1. SCOPE. This section covers programmable logic controllers (PLCs) and Local Operator Interfaces (LOI) as designated and as required, including associated input/output hardware to control process equipment and serve as the interface to field devices. The System Supplier shall provide and install a discrete input module, a discrete output module, and a Ethernet Communication Module including all appurtenances to be installed in the Owner's existing Distribution System PLC enclosure.

The UV System Supplier will be providing complete PLC systems to control the respective UV systems. The UV System Supplier shall provide all programming of PLC and LOI to fully control and facilitate integration with the Owner's existing PLC based plant control system. The Owner will meet with the UV System Supplier prior to commencement of PLC programming to determine all programming and tag name conventions and data transfer requirements.

1-1.01. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".

1-1.02. Control System. Section 13500 – Instrumentation and Control System shall apply to all equipment furnished under this section. Additional PLC software requirements are indicated in Section 13550 – Software Control Block Descriptions.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Requirements. The General Equipment Requirements shall apply to all equipment provided under this section.

1-2.02. Drawings. Supplementing this section, the drawings indicate the number and sizes of PLCs, locations of PLCs, and provide diagrams and schematics regarding connection and interaction with other equipment. All hardware, including power supplies, special cables, and other appurtenant equipment, shall be provided to meet the functional requirements described herein and indicated

on the drawings.

1-2.03. I/O List. An input/output (I/O) field device signal listing is included as an appendix attached to this section.

1-3. SUBMITTALS. Submittals shall be as required in Section 13500 – Instrumentation and Control System.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as required in Section 13500 – Instrumentation and Control System.

1-5. SPARE PARTS. Spare processor modules, spare power supply modules, spare I/O cards, and spare communications modules shall be supplied in the numbers as required. This applies to the UV System Supplier only. Additional spare parts shall be provided as required.

PART 2 - PRODUCTS

2-1. GENERAL. All equipment furnished under this section shall be expressly selected by System Supplier for its superior quality for the intended purpose and shall comply with the following requirements.

2-1.01. Interchangeability. All programmable logic controller systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules such as coprocessors and ASCII modules shall be interchangeable among all I/O panels and systems. PLC modules and hardware by other manufacturers will be acceptable only if the PLC manufacturer does not offer suitable modules and hardware for the same functions.

2-1.02. Initial, Spare, and Future Memory (RAM). System Supplier shall provide 1756-L61/B or higher memory as required by the application.

2-1.03. Spare I/O. Each PLC input/output enclosure shall be provided with at least 20 percent spare inputs and outputs of each type. Spare I/O shall be installed, wired, and interfaced properly to the terminal strip. The spare I/O shall be in addition to any I/O installed and reserved for future process signals as may be indicated on the I/O list. In addition, each PLC input/output enclosure shall be capable of accommodating 25 percent of additional input/output capacity of each type as originally assembled, without the need for additional expansion racks, communication adapters, cables, or PLC power supplies.

2-1.04. Expandability. Each PLC processor and associated I/O shall have a future expandability of at least 50 percent of the provided system or as required, whichever is greater.

2-1.05. Acceptable Manufacturers. The PLCs shall be Allen-Bradley ControlLogix as detailed in table below, no exceptions to match Owner's existing equipment. The operator interface shall be as listed below, no exceptions to match owner's existing unit.

Allen Bradley ControlLogix		
Type	Allen Bradley Model No.	Description
CPU	1756-L61/B	PLC – ControlLogix Processor Module
PS	1756-PA75	ControlLogix Rack Power Supply
RACK	1756-A*	ControlLogix Rack sized for system provided
ENBT	1756-ENBT	ControlLogix Ethernet Communication Module
AI	1756-IF6I	ControlLogix Analog Input Module
AO	1756-OF6CI	ControlLogix Analog Output Module
DI	1756-IA16	ControlLogix 120 VAC Discrete Input Module to be provided in the UV System PLC Panel
DI	1756-IB16	ControlLogix 24 VDC Discrete Input Module to be provided in the Owner's Existing Distribution System PLC Panel
DO	1756-OA16	ControlLogix 120 VAC Discrete Output Module
LOI	2711-T10C20	PanelView 1000 Color with Ethernet Comm.

2-1.06. Signal Power Supplies. A regulated dc power supply for analog output and for analog input loops shall be provided for each I/O rack as required. Power supplies shall be suitable for an input voltage variation of ±10 percent, and the supply output shall be fused or protected against short-circuiting. Output voltage regulation shall be as required by the instrumentation equipment supplied under another section.

The loop power supply shall be separate from the power supply circuit for the processor and racks.

A separately fused 120 volts ac or 24 volts dc power source shall be provided for all digital inputs from field devices as required. Unless otherwise noted, all field devices will be provided with dry contacts that close to provide an input to the PLC.

2-1.07. I/O Circuit Power Supply. Outputs for motor driven equipment will typically be powered from the driven equipment. Discrete outputs for miscellaneous equipment shall be powered either from the controlled equipment or the PLC enclosure as indicated on the drawings or as coordinated with the

controlled equipment supplier. Outputs that control process equipment specified under other sections or provided under other contracts shall be fully isolated or shall operate either interposing relays or relay-type discrete output modules in the PLC cabinet.

2-1.07.01. Interposing Relays. Interposing relays shall be incorporated on all I/O circuits as shown on the PLC input/output listing, or as required by the application to isolate foreign power sources, and where the continuous output rating of the PLC relay discrete, or output module is not sufficient to power the connected device or equipment. Interposing relays shall be provided for any discrete output module output signal that leaves the PLC enclosure. Interposing relays shall be mounted in the PLC enclosure containing the output module that activates the relays.

2-1.08. Appurtenances. The PLC processor and I/O hardware shall be provided as complete systems, as shown on the block diagram drawings. The PLCs shall include all necessary hardware and software for a complete working system. All special rack or panel mounted power supplies, special interconnecting and programming cables, special grounding hardware, or isolation devices shall be furnished as required for proper operation of the equipment. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, intrinsically safe relays and current repeaters, surge suppression devices, and isolation devices shall be furnished and installed as required for proper operation of the equipment.

2-1.08. PLC Arrangement. The PLCs shall be distributed and arranged as summarized below.

2-1.08.01. Master Plant Control PLC. A master plant control PLC and enclosure shall be provided. The PLC shall be programmed to accumulate all plant monitoring data from all other PLCs, and will be the primary communications point for data exchange with the SCADA system over the radio communications link.

2-1.08.02. Each Major Treatment Building. A separate PLC and enclosure, installed and wired under this contract, shall be provided for each major treatment process building.

2-2. LARGE PLC PROCESSOR. Not used.

2-3. MINI PLC PROCESSOR. Not used.

2-4. COMMUNICATIONS. Each programmable controller system shall be furnished complete with communication hardware modules for local input/output hardware, remote input/output hardware, other programmable controllers, or for host computers as required.

Communication hardware shall be compatible with the cable, data highway, fiber optic, or radio communication media as required.

2-4.01. Addressability. Each programmable logic controller shall be individually addressable so that only the selected controller responds when queried. At least 30, or a larger number as required, distinct network addresses shall be available. Designation of a controller's network address may be either a software or hardware function.

2-4.02. Communications Hardware. System Supplier shall provide all necessary communications hardware. Hardware shall be included for, but not be limited to, remote I/O, data highway, host computer, fiber optics, Ethernet and radio.

2-4.02.01. PLC to PLC Communications Hardware. Each PLC shall communicate to other PLCs over an Ethernet communications network. System Supplier shall include and configure all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system. Some components of the network will be provided under an allowance. Refer to Section 13500 – Instrumentation and Control System for details on the allowance items to be provided.

The UV SYSTEM SUPPLIER shall provide a Phoenix Contact industrial DIN rail mount Ethernet Switch in each UV PLC panel.

2-4.02.02. PLC to Remote Communications Hardware. The master PLC shall communicate with the remote PLC rack over a remote I/O communications network. System Supplier shall include all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system.

2-4.02.03. PLC to Host Communications Hardware. Each PLC shall communicate to the host computer over an Ethernet communications network. System Supplier shall include all rack mounted, enclosure mounted, or desktop mounted communications modules required for a complete working system.

2-4.03. Communications Media. System Supplier shall provide all necessary cabling for the PLC communications network and PLC remote I/O communications network. Communications cables shall meet the requirements of the manufacturers of the PLCs and communications modules.

2-4.03.01. Cable. System Supplier shall provide all necessary cabling for the PLC system. Communications cables shall meet the requirements of the manufacturers of the PLCs and communications modules.

2-4.03.01.01. Data Highway Plus Cabling. Not used.

2-4.03.01.02. Modbus Plus Cabling. Not used.

2-4.03.01.03. Metallic LAN Cable. Cable shall be coaxial or shielded pair suitable for installation in conduit. Cable furnished shall meet the following minimum requirements.

Twisted, Shielded pair (STP)

Category 5E

Copper conductors

#24 AWG

Aluminum/polyester shield with drain

300 volt rated

Minimum 0.037 inch PVC jacket

Non-plenum rated

Metallic LAN cable shall be Belden 1534A 006 (BLULT).

2-4.03.01.04. Fiber Optic Cable. Not used.

2-4.03.02. Fiber Optic Communications Hardware. Not used.

2-4.03.03. Radio Communications Hardware. Not used.

2-5. PROGRAMMING DEVICE HARDWARE. Not used.

2-5.01. Special Devices. System Supplier shall provide two sets of any special devices (such as null modems, adapter cards, interface converters, etc.) required to establish an operational programming line between the programmable logic controllers and programming device.

2-6. PROGRAMMING SOFTWARE. Not used.

2-7. SYSTEM ENCLOSURES. Programmable logic controllers and input/output hardware shall be housed in shop-assembled panels as indicated on the drawings and as described in Section 13570 – Panels, Consoles and Appurtenances.

2-8. SYSTEM ENCLOSURES. Programmable logic controllers and input/output hardware shall be housed in existing panels or panels provided by others.

2-9. LOCAL OPERATOR INTERFACE. Local operator interfaces (LOIs) shall be furnished and installed in each UV System PLC panel to provide proper monitoring and control of specific plant and process areas. No LOI is required for the existing Distribution PLC panel. LOIs shall be industrial, flat-panel PCs designed specifically for panel mounting. Each LOI shall be powered from the power sources within its associated PLC enclosure. Any power supplies or converters needed for powering the LOI shall be provided. Each LOI housing shall be rated for NEMA Type 4X service. Refer to the itemized table located elsewhere for LOI manufacturer and model number.

LOIs shall have a touch screen interface, shall display graphics and alarms, and shall provide screen-level security.

One licensed copy of the LOI configuration software shall be provided. LOI configuration software shall be Allen-Bradley "PanelBuilder32".

Each LOI shall be interfaced with a local PLC in a stand-alone configuration. The LOI will connect to the PLC via an Ethernet communication.

LOIs shall be provided with all drivers, cables, and connectors required to properly interface with the PLC. Driver type shall be coordinated with the PLC processor type.

2-10. PLC Panel UPS. Each new UV System PLC panel shall be provided with an Uninterruptible Power Supply (UPS). The UPS shall be Cyberpower model CPS-525-SL.

PART 3 - EXECUTION

3-1. INSTALLATION REQUIREMENTS. PLCs installation requirements are specified in Section 13500 – Instrumentation and Control System except as described herein.

Field check, testing, and training shall be as specified in Section 13500 – Instrumentation and Control System.

3-2. CONFIGURATION.

3-2.01. PLC Programming and Configuration. Configuration services are specified in Section 13500 – Instrumentation and Control System.

3-2.02. Communications Configuration. The communications shall be fully configured and installed by System Supplier, and shall be operational before application software configuration by others. Communications shall be configured as shown on the block diagram drawing.

End of Section

					Analog Data			Discrete Data					
Item	Type	No.	Description	Field Device	Signal Type	Calibrated Range	Power	Signal Type	Closed State	Power Source	Interp Relay	Remarks	P&I Drawing
1	DI	1	UV-VBF-1 VALVE OPEN STATUS	UV-VBF-1	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
2	DI	2	UV-VBF-1 VALVE CLOSED STATUS	UV-VBF-1	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
3	DI	3	UV-VBF-1 IN-REMOTE	UV-VBF-1	N/A	N/A	N/A	24 VDC	IN-REMOTE	PLC	NO		P4
4	DI	4	UV-VBF-2 VALVE OPEN STATUS	UV-VBF-2	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
5	DI	5	UV-VBF-2 VALVE CLOSED STATUS	UV-VBF-2	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
6	DI	6	UV-VBF-2 IN-REMOTE	UV-VBF-2	N/A	N/A	N/A	24 VDC	IN-REMOTE	PLC	NO		P4
7	DI	7	UV-VBF-3 VALVE OPEN STATUS	UV-VBF-3	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
8	DI	8	UV-VBF-3 VALVE CLOSED STATUS	UV-VBF-3	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
9	DI	9	UV-VBF-3 IN-REMOTE	UV-VBF-3	N/A	N/A	N/A	24 VDC	IN-REMOTE	PLC	NO		P4
10	DI	10	UV-VBF-4 VALVE OPEN STATUS	UV-VBF-4	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
11	DI	11	UV-VBF-4 VALVE CLOSED STATUS	UV-VBF-4	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
12	DI	12	UV-VBF-4 IN-REMOTE	UV-VBF-4	N/A	N/A	N/A	24 VDC	IN-REMOTE	PLC	NO		P4
13	DI	13	TW-VBM-30 VALVE OPEN STATUS	TW-VBM-30	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
14	DI	14	TW-VBM-30 VALVE CLOSED STATUS	TW-VBM-30	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
15	DI	15	TW-VBM-31 VALVE OPEN STATUS	TW-VBM-31	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
16	DI	16	TW-VBM-31 VALVE CLOSED STATUS	TW-VBM-31	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
17	DI	17	NAOC-VBM-10 VALVE OPEN STATUS	NAOC-VBM-10	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
18	DI	18	NAOC-VBM-10 VALVE CLOSED STATUS	NAOC-VBM-10	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
19	DI	19	NAOC-VBM-20 VALVE OPEN STATUS	NAOC-VBM-20	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
20	DI	20	NAOC-VBM-20 VALVE CLOSED STATUS	NAOC-VBM-20	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
21	DI	21	NAOH-VBM-11 VALVE OPEN STATUS	NAOH-VBM-11	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4

					Analog Data			Discrete Data					
Item	Type	No.	Description	Field Device	Signal Type	Calibrated Range	Power	Signal Type	Closed State	Power Source	Interp Relay	Remarks	P&I Drawing
22	DI	22	NAOH-VBM-11 VALVE CLOSED STATUS	NAOH-VBM-11	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
23	DI	23	NAOH-VBM-21 VALVE OPEN STATUS	NAOH-VBM-21	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
24	DI	24	NAOH-VBM-21 VALVE CLOSED STATUS	NAOH-VBM-21	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
25	DI	25	CI-VBM-12 VALVE OPEN STATUS	CI-VBM-12	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
26	DI	26	CI-VBM-12 VALVE CLOSED STATUS	CI-VBM-12	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
27	DI	27	CI-VBM-22 VALVE OPEN STATUS	CI-VBM-22	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
28	DI	28	CI-VBM-22 VALVE CLOSED STATUS	CI-VBM-22	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
29	DI	29	HFS-VBM-13 VALVE OPEN STATUS	HFS-VBM-13	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
30	DI	30	HFS-VBM-13 VALVE CLOSED STATUS	HFS-VBM-13	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
31	DI	31	HFS-VBM-23 VALVE OPEN STATUS	HFS-VBM-23	N/A	N/A	N/A	24 VDC	OPEN STATUS	PLC	NO		P4
32	DI	32	HFS-VBM-23 VALVE CLOSED STATUS	HFS-VBM-23	N/A	N/A	N/A	24 VDC	CLOSED STATUS	PLC	NO		P4
33	DI	33	ZS-1010 ELECTRICAL VAULT INSTRUSION SWITCH	ZS-1010	N/A	N/A	N/A	24 VDC	NORMAL	PLC	NO		P4
34	DO	1	UV-VBF-1 VALVE OPEN COMMAND	UV-VBF-1	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
35	DO	2	UV-VBF-1 VALVE CLOSE COMMAND	UV-VBF-1	N/A	N/A	N/A	120 VAC	CLOSE COMMAND	VALVE	YES		P4
36	DO	3	UV-VBF-2 VALVE OPEN COMMAND	UV-VBF-2	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
37	DO	4	UV-VBF-3 VALVE OPEN COMMAND	UV-VBF-3	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
38	DO	5	UV-VBF-3 VALVE CLOSE COMMAND	UV-VBF-3	N/A	N/A	N/A	120 VAC	CLOSE COMMAND	VALVE	YES		P4
39	DO	6	UV-VBF-4 VALVE OPEN COMMAND	UV-VBF-4	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4

					Analog Data			Discrete Data					
Item	Type	No.	Description	Field Device	Signal Type	Calibrated Range	Power	Signal Type	Closed State	Power Source	Interp Relay	Remarks	P&I Drawing
40	DO	7	TW-VBM-30 VALVE OPEN COMMAND	TW-VBM-30	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
41	DO	8	TW-VBM-31 VALVE OPEN COMMAND	TW-VBM-31	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
42	DO	9	NAOC-VBM-10 VALVE OPEN COMMAND	NAOC-VBM-10	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
43	DO	10	NAOC-VBM-20 VALVE OPEN COMMAND	NAOC-VBM-20	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
44	DO	11	NAOH-VBM-11 VALVE OPEN COMMAND	NAOH-VBM-11	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
45	DO	12	NAOH-VBM-21 VALVE OPEN COMMAND	NAOH-VBM-21	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
46	DO	13	CI-VBM-12 VALVE OPEN COMMAND	CI-VBM-12	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
47	DO	14	CI-VBM-22 VALVE OPEN COMMAND	CI-VBM-22	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
48	DO	15	HFS-VBM-13 VALVE OPEN COMMAND	HFS-VBM-13	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4
49	DO	16	HFS-VBM-23 VALVE OPEN COMMAND	HFS-VBM-23	N/A	N/A	N/A	120 VAC	OPEN COMMAND	VALVE	YES		P4

Section 13550

SOFTWARE CONTROL BLOCK DESCRIPTIONS

Data Sheet

Para-graph	Description	Data	Units
	PLC Programming Functional Requirements		
	These descriptions are applicable to the software specified in these Sections.	☐ Section 13520 ☑ Section 13530 ☑ Other	
	When "Other" is selected, indicate other Sections.	13700 – UV Disinfection System	
3-1.02	Flow Value Totalization in PLCs	☒ Yes ☐ No	
3-1.11	Maintained/Momentary outputs required	☒ Yes ☐ No	
3-2.01	Database provided by Owner	☐ Yes ☒ No	
3-2.02	Number of real time trend displays required		
3-2.02	Number of historical trend displays required		
3-2.04	Number of historical facility reports required		

Section 13550

SOFTWARE CONTROL BLOCK DESCRIPTIONS

PART 1 - GENERAL

1-1. SCOPE. This section provides functional descriptions of the PLC and computer software requirements for the Instrumentation and Control System as indicated on the drawings and as required. These descriptions are intended to provide an overview of the operating concept of the plant process equipment rather than describing in detail every operating feature or interlock.

The UV System Supplier shall provide PLC and LOI programming for the UV system PLCs and LOIs. The UV System Supplier shall coordinate with the Owner for development of the Operator Workstation (HMI) programming. The Owner shall provide PLC programming of the existing PLC as shown on the drawings and the HMI programming. The UV System Supplier shall meet with the Owner prior to commencement of any programming to develop program and data structure to facilitate efficient HMI programming and communication.

1-1.01. Control System. Section 13500 – Instrumentation and Control System shall apply to all systems described in this section.

1-1.02. **Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".**

PART 2 – PRODUCTS

2-1. GENERAL. Operator workstation HMI software products shall be provided and programmed by the OWNER. PLC and LOI programming software is specified in Section 13530 – Programmable Logic Controllers. The UV System Supplier shall be responsible for programming the UV system PLC and LOI to match the Owner's standards. The UV System Supplier shall coordinate with the Owner in development of the operator workstation programming. The Owner's operator workstation software is Wonderware.

PART 3 - EXECUTION

3-1. PLC PROGRAMMING FUNCTIONAL REQUIREMENTS. The following paragraphs describe general configuration tasks that are required for the system PLC(s). These tasks shall be programmed in any applicable PLC. Each PLC

may have multiple instances of each of these tasks, or may have no instances of some or all of these tasks. The input/output lists (located in these documents as required in Section 13500 – Instrumentation and Control System) and detailed equipment control descriptions (included herein) should be referenced to determine the requirements for each PLC.

The following paragraphs cover functional requirements of the software, which are generic and may or may be not related to any specific control loop.

3-1.01. Available Process Values. All PLC-generated process alarm, equipment status, and process variable values shall be available at any operator workstation.

3-1.02. Flow Values. Flow values shall be integrated, totalized, and stored in the PLC registers so the values displayed on the HMI computers and on the field processor shall be identical. The flow values shall be to the Owner's Industrial Sequel Server.

3-1.03. System Failure. Failure of a PLC shall result in safe shutdown of associated process equipment. Interposing relays shall be provided where required to assure that equipment will revert to its fail-safe condition. Failure of any PLC or its communication shall be alarmed on the HMI computer.

3-1.04. HMI Computers. The HMI computers shall function as a monitoring system, not as a controller, for the process equipment. The computer shall download set points and other information to the PLCs, and the PLCs shall perform all control algorithms, so a temporary failure of the any HMI computer will not disrupt plant control.

3-1.05. Rack/Module Configuration. The rack and module definitions for each PLC, as well as the PLC communications configuration shall be completely configured to allow proper addressing of all field connected I/O points. This shall include configuration of any remote input/output (RIO) racks.

3-1.06. PLC Database Definition. The PLC database shall include both field I/O points and internally generated points required for programming. All field I/O points and internal programming points shall be fully defined according to database naming conventions approved by Owner. As a minimum, each database point shall be provided with a tag name, engineering unit, alarm parameters, and description.

3-1.07. Analog Scaling. Each analog input and output will be appropriately scaled for use in internal PLC programming, monitoring by the HMI computers, or transmission to other PLCs. Requirements for raw count values shall be coordinated with the operator interface software to ensure compatibility.

3-1.08. Equipment Runtimes. For each equipment item whose "run" status is monitored by a PLC, an internal equipment runtime shall be accumulated by the respective PLC. The runtime procedure will monitor the status of the equipment "run" contact and, when the equipment is running, increment a software timer that maintains equipment runtime to within a one-minute resolution. The timer shall stop incrementing, but not reset, when the "run" contact indicates that the equipment is not running. The timer value shall increment an hour counter that maintains an integer value representing the equipment run time in hours. The counter value shall be available for display on the HMI computer. A manual reset of the runtime value shall be available at the HMI computers for personnel at the supervisor level and above. The equipment runtime will be added to the Owner's Industrial Sequel Server.

3-1.09. Change-of-State Alarms. While equipment is controllable from the PLC ("in remote"), discrete output commands shall be compared to their respective process feedback status signal (where available) to verify proper execution. If the feedback status does not match the most recent output command (after an adjustable 2 to 300 second time delay), an alarm message shall be displayed on the HMI computer and the condition shall be logged as an alarm, requiring operator acknowledgment. The alarm shall remain energized until the proper discrete condition is sensed or until the operator resets the alarm through the HMI computer.

3-1.10. Equipment Availability. In general, equipment with PLC control has been provided with a local selector switch that transfers control to the PLC. The PLC shall monitor the position of this switch to determine if the equipment is available for PLC control. If the equipment is not available, the PLC program shall not attempt to implement remote manual or automatic status changes for the equipment. The PLC program may, however, need to implement special routines if equipment unavailability affects a sequence (as described in the detailed equipment descriptions).

3-1.11. Maintained/Momentary Outputs. The need for maintained or momentary control outputs shall be determined from the input/output listing and the electrical schematics. In general, equipment with only one control output indicated in the I/O list shall be programmed for a maintained control output. Equipment with two (or more) control outputs shall be programmed for momentary outputs. Provisions shall be made, in either case, to remove the active state (start, open, forward, initiate, etc.) control output when an equipment failure is sensed or when the equipment transitions from available to unavailable (local switch change).

3-1.12. Equipment Mode Changes. Unless otherwise indicated in the equipment control descriptions, equipment in automatic mode shall be transitioned to manual mode (and stopped) if the equipment fails or becomes unavailable or if the PLC processor resets.

3-1.13. Manual/Auto Bumpless Transfer. Unless otherwise indicated in the equipment control descriptions, equipment changes from automatic to manual control shall be bumpless. Equipment running or stopped in automatic mode shall remain running or stopped when manual mode is selected.

3-2. HMI FUNCTIONAL REQUIREMENTS (Reference Only). The following paragraphs describe general configuration tasks that are required for the HMI and related software.

3-2.01. Database. The system database, including field I/O and internal points shall be established according to the database point naming conventions approved by Owner. Database generation for field I/O shall include all required coordination with PLC level addresses. If no Owner database point naming conventions are available, the database names shall utilize an ISA or ISA-like tag name.

In the default scheme, the format of the tag name is WWWW-XXX-YYY-ZA.

WWWW is the plant name (TMTP)
XXX is the ISA function designation.
YYY-ZA is the unique loop designation defined by the P&IDs.

Where possible YYY-ZA will correspond to the loop numbers on the P&IDs. Otherwise, a unique number should be assigned. Z is a number (1, 2, 3) to designate similar loops associated with trains of equipment. A is a letter (A, B, C) to designate identical functions within the same loop. For instance, if there are two ferric sulfate metering pumps and the loop number chosen is 222, the remote status input for pump number one might be HS-222-1 and the remote status input for pump number two might be HS-222-2. If there is more than one switch input for either pump the tag name would be HS-222-1A and the second switch would be HS-222-1B.

Function designations currently defined are listed below:

AI's (Analog Inputs)

AIT - Analytical Input	PDIT - Differential Pressure Input (Headloss)
EIT - Voltage Input	PIT - Pressure Input
EIIT - VAR Input	ST - Speed or Rate Input
FIT - Flow Input	TIT- Temperature Input

IIT - Current Input

JIT - Power Input

LIT - Level Input

WIT - Weight Input

ZT - Position Input

AO's

AC - Residual Proportioning Control

FC - Flow Proportioning Control

SC - Speed or Rate Control

ZC - Position Control

DI's

AAH - Analytical Alarm High

AAL - Analytical Alarm Low

FSH - High Flow Status

FSL - Low Flow Status

HS - Hand Switch Status

JA - Electrical Alarm

LSH - High Level Status

LSHH - High Water Cutoff Alarm

LSL - Low Level Status

LSLL - Low Water Cutoff Alarm

PDSH - High Differential Status

PS - Pressure Alarm Hi/Lo or Unspecified

PSL - Low Pressure Status

PSLL - Low Pressure Cutoff Alarm

WAL - Low Weight Alarm

XA - General or Unspecified Alarm

YA - Equipment Overload Alarm (Failure)

YS - Equipment Run Status

ZSC - Position Closed Status

ZSO - Position Open Status

DO's

LC - PLC Generated LWCO Output

XC - General Control Output

YC - Equipment Start/Stop Command

ZCC - Equipment Close Command

ZCO - Equipment Open Command

Initially, the facility database shall be configured so all database points are defined as belonging to a specific area (as allowed by the graphical interface

software). The areas designated for the facility shall be coordinated with Owner. If Owner has no existing standards for area designations, all points can be placed in appropriate areas selected by System Supplier.

3-2.02. Trend Displays. Trend displays shall be developed to present real-time and historical process data in an X-Y graph format. Real-time trends shall utilize current process values to generate temporary graphs that do not retain data values. Historical trends shall utilize historically collected data and shall access the data files directly for use in the trend display. Historical trends shall allow paging forward and back to the limits of the collected data. The trending package shall be configured to automatically retrieve historical data from the proper data file to accommodate the paging functions. Content of the trends will be determined after meeting with Owner. The quantity of real-time trend displays and historical trend displays shall be as required.

3-2.03. Alarms. Complete system alarming shall be configured. This shall include configuration of graphical alarm displays, and configuration of audible alarms through the HMI speakers. All process or system alarms shall appear on an alarm summary screen and the alarm banner of each process graphic. Alarms and events shall be color coded on the alarm summary screen, with initial colors based on Owner conventions or the default colors associated with the graphics package. The colors may be adjusted after meeting with Owner. Alarm prioritizing and area assignments (if any) shall be coordinated with Owner at the first configuration meeting.

For LOW or LOW-LOW analog or discrete alarms which do not apply if associated equipment is not operating, provisions shall be made to prevent generation of the alarm unless the associated equipment is operating. This shall include alarms such as low amperage alarms for pumps that are not running. This may also include low flows or pressures when associated pumps are not operating (this will only apply if periodic operation of the equipment is considered normal).

All alarms/events shall be time stamped when displayed or printed. Unacknowledged alarms shall not automatically clear from the alarm summary if they return to normal before being acknowledged.

3-2.04. Reporting. System reporting shall be accomplished using the standard operator interface software-reporting package. All necessary report development, including macro development in spreadsheets, shall be supplied to access real-time and historical data for reporting. The quantity of historical, monthly facility reports shall be as required.

3-2.05. Historical Data Collection. System data shall be collected for historical archiving and for use in trending and reporting functions. Requirements for data collection shall be as needed to support the trends and reports developed.

3-2.06. Manual Entry of Data. The human machine interface (HMI) computers shall allow manual entry of laboratory data and other variables, which shall then be available for display and use in reports. Operator entered commands from any of the HMI computers shall be logged at all HMI computers.

3-3. EQUIPMENT CONTROL AND CONTROL MODE OVERVIEW. The following paragraphs explain the general format and control modes that are used in the detailed equipment descriptions. These paragraphs apply to the attached, project specific, equipment control descriptions included herein.

3-3.01. General. Appended to this section are the equipment control programming requirements, with requirements for both PLC programming and the minimum operator interface functions. The HMI requirements represent the anticipated display generation requirements and shall be adjusted if the PLC programming warrants adjustment.

3-3.02. Control Modes. There are two general control modes available for the process equipment: 1) remote manual, and 2) remote auto. Remote manual control provides a means for operators to adjust equipment status or setpoint, through the HMI, using manually initiated commands. Remote automatic control provides a means for automatically changing equipment status or setpoint based on measured process parameters, calculated values, or operator setpoints. Some equipment may have more than one remote auto mode.

Descriptions for local control are included in the detailed equipment control descriptions. These apply to Local Manual and Local Automatic from the UV Systems LOI.

3-4. DETAILED EQUIPMENT CONTROL DESCRIPTIONS. The following paragraphs describe specific function requirements for various software control blocks in the control system. These descriptions are intended to provide an overview of the operational concept for the facilities, rather than describing in detail every operating feature or interlock.

3-4.01. UV System

3-4.01.01. Loop Description Title
UV Reactor System

Associated Equipment
UV-UVL-1, UV-UVL-2

Associated PLC
UV Equipment PLCs

Associated P&ID(s)
P4

Local Manual Mode
Local manual control of the UV Reactor System shall be from each system's Local Operator Interface (LOI) located on each system's PLC panel. Start/stop, auto/manual selection, and intensity manual adjustment shall be initiated from the LOI. When Local and manual are selected from the LOI and start is selected from the LOI, the system shall start and operate at the lamp intensity manually set.

Local Auto Mode
Local automatic control of the UV Reactor System intensity shall be from each system's LOI located on each system's PLC panel. The intensity setpoint shall be entered at the LOI. The UV system shall pace based on the sum of the filter effluent flows. Start/stop shall remain operator initiated in the Local Automatic mode.

Remote Manual Mode
None

Remote Auto Mode
None

Alarms
The PLC shall generate a UV Start Fail alarm when the UV system does not report a run status or reach setpoint intensity within an adjustable time delay (0-30 sec, initially set at 5 sec).

Operator Interface and Operator Workstation Status Indications
The LOI and HMI shall indicate the following UV System status:
UV System in Auto/Manual, Running, Not Running, Individual Lamp Intensities, UV Transmittance, UV Dose Applied, UV Dose Setpoint, and the following Fail Statuses at a minimum:

- Low-low UV Intensity
- Low-low UV Transmittance
- Low-low Operational UV dose
- Lamp Failure
- Communication Failure
- High temperature for Individual Reactors
- Low Water Level
- Main Power Supply Failure
- Standby Power Supply Failure
- Ground Fault Low

- UV Intensity Warning
- Individual Lamp Failure
- Low Operational UV Dose
- Low UV Transmittance

PLC Power-up
On PLC power-up, control of the UV System shall be set to local manual mode.

Power Failure
Control of the UV System shall resume with the control mode established prior to the power failure.

Operator Workstation Requirements
The UV System shall be depicted on the Plant Overview display. The display layout shall be similar to the P&ID. The UV System symbol shall be a selectable target which retrieves the respective control overlay display. The overlay display shall contain control targets which allow selection of UV System operational adjustments and shall duplicate status indications as shown on the main display.

Calculations
Dosage, Transmittance, UV Intensity

3-4.01.02. Loop Description Title
UV System Isolation Valves

Associated Equipment
UV-VBF-1, UV-VBF-2, UV-VBF-3, UV-VBF-4

Associated PLC
PLC-1

Associated P&ID(s)
P4

Local Manual Mode
Local manual control of the UV System Isolation Valves shall be provided through the LOCAL-OFF-REMOTE (L-O-R) selector switch and the OPEN-STOP-CLOSE (O-S-C) push buttons located on the valve actuator. When the L-O-R switch is in LOCAL position and the OPEN push button is pressed, the valve shall open. When the STOP push button is pressed, the valve shall stop and hold position. When the CLOSE push button is pressed, the valve shall close.

Local Auto Mode
None

Remote Manual Mode
Remote manual control of the UV System Isolation Valves shall be provided through a SCADA system Operator Workstation or as also referred as a Human Machine Interface (HMI). When the L-O-R selector switch located on the valve actuator is in the REMOTE position and MANUAL is selected at the HMI, the valve shall be opened and closed from the PLC using manual operator commands at the HMI.

Remote Auto Mode
Remote automatic control of the UV System Isolation Valves shall be provided through a SCADA system Operator Workstation or as also referred as a Human Machine Interface (HMI). When the L-O-R selector switch located on the valve actuator is in the REMOTE position and AUTO is selected at the Operator Workstation, the valve shall be opened and closed from the PLC when the UV System is called to operate or stop.

Alarms
The PLC shall generate a Valve Fail alarm when the valve position switch indicates that the valve did not reach the commanded position within an adjustable (0-180 sec, initially set at 30 sec) time delay. The alarm shall be generated only when the valve is in remote mode.

Operator Workstation Status Indications
The HMI shall indicate the following valve status:
Valve in Local/Remote, Valve in Auto/Manual, Valve Open, Valve Closed, and Valve Fail to open or close.

PLC Power-up
N/A

PLC Power Failure
N/A

Operator Workstation Requirements
The UV System Isolation Valves shall be depicted on the UV System display. The display layout shall be similar to the P&ID. The valve symbol shall be a selectable target which retrieves the respective control overlay display.

Calculations
None

3-4.01.03. Loop Description Title
Clearwell Chemical Feed Isolation Valves

Associated Equipment
NAOC-VBM-10, NAOC-VBM-20, NAOH-VBM-11, NAOH-VBM-21, CI-VBM-12, CI-VBM-22, HFS-VBM-13, HFS-VBM-23,TW-VFM-30, TW-VBM-31

Associated PLC
PLC-1

Associated P&ID(s)
P4

Local Manual Mode
Local manual control of the Clearwell Chemical Feed Isolation Valves shall be provided through the OPEN-CLOSE-REMOTE (O-C-R) selector switch located on the valve's local control station. In the OPEN position, the valve shall open. In the CLOSE position, the valve shall close.

Local Auto Mode
None

Remote Manual Mode
Remote manual control of the Clearwell Chemical Feed Isolation Valves shall be provided through the HMI. When the O-C-R selector switch located on the valve's local control station is in the REMOTE position and MANUAL is selected at the HMI, the valve shall be opened and closed from the PLC using manual operator commands at the HMI.

Remote Auto Mode
Remote automatic control of the Clearwell Chemical Feed Isolation Valves shall be provided the HMI. When the O-C-R selector switch located on the valve's local control station is in the REMOTE position and AUTO is selected at the HMI, the valve shall be opened and closed from the PLC when the UV System is called to operate or stop.

Alarms
The PLC shall generate a Valve Fail alarm when the valve position switch indicates that the valve did not reach the commanded position within an adjustable (0-180 sec, initially set at 30 sec) time delay. The alarm shall be generated only when the valve is in remote mode.

Operator Workstation Status Indications
The HMI shall indicate the following valve status:
Valve in Auto/Manual, Valve Open, Valve Closed, and Valve Fail to open or close.

PLC Power-up
N/A

PLC Power Failure
N/A

Operator Workstation Requirements
The Clearwell Chemical Feed Isolation Valves shall be depicted on the UV System display. The display layout shall be similar to the P&ID. The valve symbol shall be a selectable target which retrieves the respective control overlay display.

Calculations
None

End of Section

Section 13560

INSTRUMENTATION GENERAL REQUIREMENTS

Data Sheet

Para-graph	Description	Data	Units
	General		
	Instruments and devices are indicated on	☑ P&ID drawings ☐ Instrument Device Schedule drawings ☐ 13560-SO Schedules ☑ Individual Device Specifications 13561 through 13565	
	Sheet Numbers of attached 13560-S0 Schedules		
	General Equipment Requirements	☒ Yes ☐ No	
	Range of elevation for project		ft [m]
	Ambient temperature range for indoor instrumentation		°F [°C]
	Ambient temperature range for outdoor instrumentation		°F [°C]
	Spare Parts	☐ Duplicate full set of lamps for annunicators ☐ Duplicate full set of lamps for indicating lights ☐ One year's supply of spare charts and ink for each recorder ☐ Other	
	When "Other" is selected, indicate parts.		
	Individual Device Specifications (PR 2-1)		
	See Section 13561 for Panel Mounted Instruments.	☒ Yes ☐ No	
	Quantity of Programming Devices required for Panel Mounted Instruments	1	
	Copies of Diagnostic/Interface Software required for Panel Mounted Instruments	1	

	See Section 13562 for Flow Instruments.	☐ Yes ☒ No	
	Quantity of Programming Devices required for Flow Instruments		
	Copies of Diagnostic/Interface Software required for Flow Instruments		
	See Section 13563 for Pressure and Level Instruments.	☐ Yes ☒ No	
	Quantity of Programming Devices required for Pressure and Level Instruments		
	Copies of Diagnostic/Interface Software required for Pressure and Level Instruments		
	See Section 13564 for Analytical Instruments.	☐ Yes ☒ No	
	Quantity of Programming Devices required for Analytical Instruments		
	Copies of Diagnostic/Interface Software required for Analytical Instruments		
	See Section 13565 for Miscellaneous Instruments.	☐ Yes ☒ No	
	Quantity of Programming Devices required for Miscellaneous Instruments		
	Copies of Diagnostic/Interface Software required for Miscellaneous Instruments		

Section 13560

INSTRUMENTATION GENERAL REQUIREMENTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of all instrumentation equipment required for the Instrumentation and Control System as indicated on the drawings and as required.

Principal components of the instrumentation systems shall be as indicated on the P&ID drawings; as indicated on the instrument device schedule drawings; as indicated on the instrument device schedules attached to this Section 13560 – Instrumentation General Requirements, or to Sections 13561 through 13565, as required.

1-1.01. Control System. Section 13500 – Instrumentation and Control System shall apply to all systems described in this section. All applicable requirements defined in Section 13500 – Instrumentation and Control System shall apply to equipment and services provided under Section 13560 – Instrumentation General Requirements.

1-1.02. **Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".**

1-2. GENERAL. System Supplier shall select the equipment furnished under this section for its superior quality and the intended performance. The System Supplier shall install all equipment in accordance with the manufacturer's instructions. Equipment and materials used shall be subject to review and shall comply with the following requirements.

1-2.01. General Equipment Requirements. As required, the General Equipment Requirements section shall apply to all equipment provided under this section.

1-2.02. Drawings. Supplementing this section, the drawings indicate locations and arrangement of instruments and enclosures, provide mounting details, and may show device schedules and other information regarding the connection and interaction with other equipment.

1-2.03. Governing Standards. Governing Standards for instruments shall be as indicated in Section 13500 – Instrumentation and Control System.

1-2.04. Corrosive Fluids. All parts, which are exposed to corrosive conditions, shall be made from corrosion resistant materials. System Supplier shall submit certification that the instrument manufacturer approves the selection of materials

of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.

1-2.05. Elevation and Temperature. All instruments shall be designed to operate within a range of elevation and temperature as required.

1-2.06. Power and Instrument Signals. Unless otherwise indicated, electric power supply to the instrumentation equipment will be unregulated 120 volts ac. Unless otherwise indicated, all transmitted electronic analog instrument signals shall be 4-20 mA dc and shall be linear with the measured variable.

1-2.07. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation devices shall be furnished as needed for proper performance of the equipment.

1-2.08. Interchangeability and Appearance. To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.

1-2.09. Programming Devices. A programming or system-configuring device shall be provided for systems that contain any equipment that requires such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete, newly purchased for this project, and shall be in like-new condition when turned over to Owner at completion of startup.

1-2.10. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with System Supplier's equipment drawings and shall be as close as practical to the tag numbers used on the project drawings and device schedules. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.

1-3. SUBMITTALS. Submittals shall be as required in Section 13500 – Instrumentation and Control System.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as required in Section 13500 – Instrumentation and Control System.

1-5. SPARE PARTS. Spare parts shall be provided as required.

PART 2 – PRODUCTS

2-1. INDIVIDUAL DEVICE SPECIFICATIONS. Individual instruments and related devices shall be provided as specified in one or more of the following sections, as required:

13561 Panel Mounted Instruments

2-2 INDUSTRIAL WIDE GAP MAGNETIC SWITCH. The hatch on the new electrical vault shall be equipped with an industrial wide gap magnetic switch contact to indicate when the hatch is open. The switches shall be Telemechanique R.B. Dennison Mag Switch – SGC series, no exceptions to match owner's existing units. Each switch shall be installed with an interposing relay, an individual surge protector, and an individual power supply.

PART 3 - EXECUTION

3-1. INSTRUMENTATION INSTALLATION REQUIREMENTS. Additional instrumentation installation requirements are specified in Section 13500 – Instrumentation and Control System. Instruments shall be installed and calibrated in accordance with the following requirements.

3-1.01. Field Calibration. After each instrument has been installed, a technical representative of System Supplier shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final settings. The adjustments of calibrated instruments shall be sealed or marked, insofar as possible, to discourage tampering. Instrument calibration shall be done before checkout of the system operation. A typical instrument calibration report is attached to the end of each section.

3-1.02. Systems Check. A technical representative of System Supplier shall participate in the checkout of instrumentation systems. Systems check requirements shall be as specified in Section 13500 – Instrumentation and Control System.

3-1.03. Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by System Supplier for the duration of the testing work and this test equipment will remain the property of System Supplier.

3-1.04. Mounting of Field Instruments. Instruments shall be mounted so that they can be easily read and serviced and so that all appurtenant devices can be easily operated. Installation details for some instruments are indicated on the drawings.

3-2. CUSTOMER TRAINING. Instrumentation training is covered in Section 13500 – Instrumentation and Control System.

End of Section

INSTRUMENT NAME & SERVICE:		
BRAND & MODEL NO.:		
TAG OR LOOP NO.:		
INPUT/OUTPUT RANGE:		
INPUT	ACTUAL OUTPUT	DESIRED OUTPUT
PROPORTIONAL BAND:		
RESET:		
POSITION OF SWITCHES, JUMPERS, ETC.		
COMMENTS:		
DATE OF CALIBRATION: CALIBRATED BY:		
Black & Veatch	INSTRUMENT CALIBRATION REPORT	Figure 1-13560

Section 13561

PANEL MOUNTED INSTRUMENTS

Data Sheet

Para-graph	Description	Data	Unit
	Annunciators		
2-2.01	Annunciator(s) required	☐ Yes ☒ No	
	Annunciator window size required.	☐ 1 by 3 1/4 inch [25 by 83] ☐ 1 1/2 by 3-1/4 inch [38 by 83 mm] ☐ 3 by 3 1/4 inch [77 by 83 mm]	
	Annunciator operating sequence required.	☐ ISA Sequence A ☐ ISA Sequence M (manual reset) ☐ ISA Sequence F2A (first out)	
	Audible alarm device and accessories required.	☐ Repeating chime ☐ Adjustable volume horn ☐ Auxiliary contacts for alarm condition ☐ Automatic acknowledge relay ☐ Resettable common alarm relay ☐ Other	
	When "Other" is selected, indicate alternative.		
	Annunciator point requiring isolated auxiliary contact outputs.	☐ Yes ☐ No	
	Adjustable time delay required.	☐ Yes ☐ No	
	Auxiliary relay required.	☐ Yes ☐ No	
	Totalizers		
2-2.02	Totalizer(s) Required	☒ Yes ☐ No	

	Resettable totalizer required.	☐ Yes ☐ No	
	Digital Panel Indicators		
2-2.03	Digital Panel Indicator(s) Required	☑ Yes ☐ No	
	Electronic Bar Graph Indicators		
2-2.04	Electronic Bar Graph Indicator(s) Required	☐ Yes ☑ No	
	Absolute alarm with set point required.	☐ Yes ☐ No	
	Edgewise Panel Indicators		
2-2.05	Edgewise Panel Indicator(s) Required	☐ Yes ☑ No	
	Manual Loading Stations		
2-2.06	Manual Loading Station(s) Required	☐ Yes ☑ No	
	Ratio Stations		
2-2.07	Ratio Station(s) Required	☐ Yes ☑ No	
	Electronic Indicating Control Stations		
2-2.08	Electronic Indicating Control Station(s) Required	☐ Yes ☑ No	
	¼ DIN Single-Loop Control Stations		
2-2.09	¼ DIN Single-Loop Control Station(s) Required	☐ Yes ☑ No	
	¼ DIN Manual/Auto Backup Stations		
2-2.10	¼ DIN Manual/Auto Backup Station(s) Required	☐ Yes ☑ No	
	Large Case Recorders		
2-2.11	Large Case Recorder(s) Required	☐ Yes ☑ No	
	Options required.	☐ 24 hours chart speed ☐ 7 day chart speed ☐ Integrator and totalizer ☐ Alarm relays ☐ Multiple instruments	

	Recorder requires microprocessor and six-digit totalizer.	☐ Yes ☐ No	
	Recorder requires two alarm relays for each channel	☐ Yes ☐ No	
	Strip Chart Recorders		
2-2.12	Strip Chart Recorder(s) Required	☐ Yes ☒ No	
	Options required.	☐ Integrator and totalizer ☐ Alarm relays ☐ Multiple instruments	
	Pressure Gauges		
2-2.13	Pressure Gauge(s) Required	☐ Yes ☒ No	
	Clocks		
2-2.14	Clock(s) Required	☐ Yes ☒ No	
	Clock type and options required.	☐ Circular panel clock ☐ Digital clock with 12 hour display ☐ Display clock with 24 hour display	

	Switches, Lights, and Push Buttons		
2-2.15.01 2-2.15.02 2-2.15.03	Devices Required	☑ Selector Switches ☑ Indicating Lights ☑ Push Buttons	
	Panel Interior Mounted Devices		
2-3.01 2-3.02 2-3.03 2-3.04 2-3.05 2-3.06 2-3.07 2-3.08 2-3.09 2-3.10 2-3.11	Devices required.	☐ Integrators ☑ Power supplies ☑ Relays ☑ Intrinsically safe relays ☑ Electronic signal booster/isolators ☐ Electronic signal selectors ☐ Electronic signal summers ☐ Fixed deadband signal monitors ☑ Adjustable deadband signal monitors ☑ Strip heaters ☑ Intrinsically safe barriers ☐ Other	
	When "Other" is selected indicate alternative.		
	Common power supply for all instruments in a filter system.	☐ Yes ◉ No	
	Other Panel Mounted Instruments	☐ Yes ☐ No	
	When "Yes" is selected, indicate other panel mounted instruments		

Section 13561

PANEL MOUNTED INSTRUMENTS

PART 1 - GENERAL.

1-1. SCOPE. This section covers the furnishing of all panel mounted instruments and accessories required for the Instrumentation and Control System as indicated on the drawings and as required.

Equipment and services provided under this section shall be subject to the Instrumentation General Requirements in Section 13500 – Instrumentation and Control System and Section 13560 – Instrumentation General Requirements. This section shall be used and referenced only in conjunction with Section 13560 – Instrumentation General Requirements. Supplementing Section 13560 – Instrumentation General Requirements, instrument data, special requirements, and options are indicated on the drawings or the Instrument Device Schedule, as required.

When multiple instruments of a particular type are indicated on the Data Sheet, and each requires different selectable features, the required features are described on the drawings or the Instrument Device Schedule.

1-1.01. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet ".

1-2. DESIGN CRITERIA. The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the drawings or the Instrument Device Schedule.

Where possible, each instrument shall be factory calibrated to the calibration ranges indicated on the drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart" devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the drawings and/or Instrument Device Schedule.

1-3. SUBMITTALS. Submittals shall be made in accordance with the requirements of Section 13500 – Instrumentation and Control System.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs describe minimum device requirements. The drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01 Programming Device. For systems that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility (quantity required shall be as indicated in the Section 13560 – Instrumentation General Requirements general data sheet). The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2-1.02 Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility (quantity required shall be as indicated in the Section 13560 – Instrumentation General Requirements general data sheet). Software shall be capable of running under Microsoft's Windows 98, Windows Me, Windows 2000, Windows NT 4.0, and Windows XP operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2-2. PANEL FRONT MOUNTED DEVICES.

2-2.01. Annunciators. Not Used.

2-2.02. Totalizers.Totalizers shall have miniature, rectangular, semi-flush counters, designed for use in conjunction with miniature indicators and recorders, and shall be of such a design that only the counter is flush-mounted and the associated integrating mechanism is located in the rear of the panel. The counter shall contain not less than seven digits, with a multiplier of a power of 10 plainly engraved on the face of the counter, or on a nameplate below the counter, so a full range of 9,999,999 is reached before repeating. Totalizers actuated by dc-powered coils shall be equipped with a reverse voltage protection device. Totalizers shall not reset upon power failure. Totalizers shall be as manufactured by Durant, Hecon, or Omron.

As required, each totalizer shall have a manually reset push button.

2-2.03. Digital Panel Indicators. Digital indicators shall be designed for semi-flush mounting in a panel. The indicator shall be a 3-1/2 digit LED, LCD, or gas discharge type display, with digits at least 0.5 inch high. The indicator shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 0 to 140°F. Accuracy shall be ±0.1 percent. The indicator shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The indicator shall have a selectable decimal point and shall provide over-range indication. Digital indicators shall be manufactured by Action Instruments, Crompton Instruments, Newport Electronics, Precision-Digital, or Red Lion.

2-2.04. Electronic Bar Graph Indicators. Not Used.

2-2.05. Edgewise Panel Indicators. Not Used.

2-2.06. Manual Loading Stations. Not Used.

2-2.07. Ratio Stations. Not Used.

2-2.08. Electronic Indicating Control Stations. Not Used.

2-2.09. 1/4 DIN Single-Loop Control Stations. Not Used.

2-2.10. 1/4 DIN Manual/Auto Backup Stations. Not Used.

2-2.11. Large Case Recorders. Not Used.

2-2.12. Strip Chart Recorders. Not Used.

2-2.13. Pressure Gauges. Not Used.

2-2.14. Digital and Panel Clocks. Not Used.

2-2.15. Switches, Lights, and Push Buttons.

2-2.15.01. Selector Switches. Selector switches shall be heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 V ac. Contact configuration shall be as indicated on the drawings or as required for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Cutler-Hammer "Type T", General Electric "CR", Micro Switch "Type PT", or Allen Bradley "800T".

2-2.15.02. Indicating Lights. Indicating lights shall be heavyduty, oil-tight type, with low voltage LEDs. A built-in transformer shall be used for ac service. Legends shall be engraved on the lens or on a legend faceplate. Lights shall be push-to-test type. Indicating lights shall be Cutler Hammer "Type T", General Electric "CR", Micro Switch "Type PT", or Allen Bradley "800T".

2-2.15.03. Push Buttons. Push buttons shall be heavy-duty, oil-tight type. Legends shall be engraved on the push-button faceplate. Contacts shall be rated 10 amperes continuous at 120 V ac. Push buttons shall be Cutler-Hammer "Type T", General Electric "CR", Micro Switch "Type PT", or Allen Bradley "800T".

2-3. PANEL INTERIOR MOUNTED DEVICES.

2-3.01. Integrators. Not Used.

2-3.02. Power Supplies. Regulated dc power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop or system. Power supplies shall be suitable for an input voltage variation of ±10 percent, and the supply output shall be fused or shortcircuit protected. Output voltage regulation shall be as required by the instrumentation equipment supplied. Multiloop or multisystem power supplies will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply systems shall be designed so either the primary or the backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation. Multiloop power supply connections shall be individually fused so a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Fuses shall be clearly labeled and shall be located for easy access. Multiloop supply systems shall be oversized for an additional 10 percent future load. Failure of a multiloop supply shall be indicated on the respective instrument panel or enclosure.

2-3.03. Relays. Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL recognized and shall have not less than double-pole, double-throw contacts. Control circuit relays shall have silver cadmium oxide contacts rated 10 amperes at 120 V ac. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low-level signals. Relays used for computer input, alarm input, or indicating light service shall have contacts rated at least 3 amperes. Time delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of ±2 percent of setting. Latching and special purpose relays shall be as required for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that

illuminates to indicate an energized condition. Relays shall be Eagle Signal "Series 22, 80"; IDEC "Series RR"; Potter & Brumfield "Series KRP, CB"; .

2-3.04. Intrinsically Safe Relays. Relays shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Relays shall be located in non-hazardous areas. Relays shall be Consolidated Electric or Gems "Safe-Pak".

2-3.05. Electronic Signal Booster/Isolators. Electronic signal boosters and isolators shall have all solid-state circuitry and complete electrical isolation between the power supply and the input and output signals. Accuracy shall be ±0.15 percent of span. Isolators shall be manufactured by Acromag, Moore, Phoenix Contact or R.I.S.

2-3.06. Electronic Signal Selectors. Not Used.

2-3.07. Electronic Signal Summers. Not Used.

2-3.08. Fixed Deadband Signal Monitors. Not Used.

2-3.09. Adjustable Deadband Signal Monitors. Signal monitors shall accept an electronic analog input signal and shall provide an electrically isolated contact output when the input exceeds a predetermined value. Circuitry shall be all solid-state. Set point shall be fully adjustable and shall have a resolution of 0.1 percent of span. Trip point repeatability shall be 0.1 percent of span. Deadband shall be adjustable from 1 to 99 percent by means of a potentiometer. Output relay contacts shall be single-pole, double-throw, and rated 5 amperes at 120 V ac. Where standard deadband is not adjustable up to 99 percent, a dual alarm unit wired to a seal-in relay may be used as an alternate. The dual alarm set points shall be clearly marked "On/Off" or "Upper/Lower" set point. Signal monitors shall be as manufactured by Acromag, Moore, Phoenix Contact or R.I.S.

2-3.10. Strip Heaters. Electric strip heaters shall be provided as indicated on the drawings, as specified, and as required for the application. Strip heaters shall be sized to prevent condensation within the enclosure and to maintain the equipment above its minimum operating temperature. Strip heaters shall be located to avoid overheating electronic hardware or producing large temperature fluctuations. Strip heaters shall be controlled by adjustable thermostats with adjustment ranges of 30° to 90°F. A circuit disconnect switch shall be provided within the enclosure.

2-3.11. Intrinsically Safe Barriers. Barriers shall be solid-state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe use in hazardous areas. Barriers shall be located in non-hazardous areas. Barriers shall be MTL, STAHL, Turck, or GEMS.

PART 3 – EXECUTION

3-1 FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in Section 13560 – Instrumentation General Requirements.

Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

Section 13570

PANELS, CONSOLES, AND APPURTENANCES

Data Sheet

Para-graph	Description	Data	Units
	General		
1-2.01	General Equipments Requirements (PR 1-2)	☒ Yes ☐ No	
	Spare parts (PR 1-5)		
	Freestanding Vertical Panels (PR 2-2)		
	Freestanding Vertical Panels required	☒ Yes ☐ No	
	Panel Front Door required	☒ Yes ☐ No	
	Mounted Instruments required	☒ Yes ☐ No	
	Instrument Arrangement Detailed	☒ Yes ☐ No	
	Open bottom for conduit entrance.	☐ Yes ☒ No	
	Top removable access plate(s) required.	☐ Yes ☒ No	
	Panel Arrangement Shown on Drawings	☐ Yes ☒ No	
	Filter Consoles (PR 2-3)		
2-3	Filter Consoles required	☐ Yes ☒ No	
	Construction	☐ Steel ☐ Fiberglass	
	Mounting	☐ Floor ☐ Raised curb	
	Height	☐ 54 inches [1.35 m] ☐ Other	

	When "Other" is selected, indicate alternative console height		
	Wall Mounted Cabinets (PR 2-4)		
2-4	Wall Mounted Cabinets required.	☐ Yes ☒ No	
	Wall or Floor Mounted Instrument Subpanels (PR 2-5)		
2-5	Wall or Floor Mounted Instrument Subpanels required	☒ Yes ☐ No	
	Control System Consoles and Enclosures (PR 2-6)		
2-6	Control System Console(s) required.	☐ Yes ☒ No	
2-6.09	Printer enclosures	☐ Yes ☐ No	
	Number of printer enclosures required		No.
2-6.10	Printer stands	☐ Yes ☐ No	
	Number of printer stands required		No.
	Provide additional wiring and receptacles for:	☐ CCTV ☐ Security system ☐ Intercom ☐ Radio	
	Provide mounting kits for:	☐ CCTV ☐ Security system ☐ Intercom ☐ Radio	
	CPU shelves	☐ Fixed ☐ Slideout	
	Exterior panels	☐ Oak veneer ☐ Plastic Laminate ☐ Metal	
	Work surface nosing	☐ Solid oak ☐ Soft urethane	
	Console front	☐ Oak veneer ☐ Plastic laminate ☐ Metal	
	Task lighting	☐ Continuous ☐ Retractable	

	Control System Furniture (PR 2-7)		
2-7	Control system furniture required	☐ Yes ☒ No	
2-7.05	Task lighting required	☐ Yes ☐ No	
2-7.06	CPU mounting required	☐ Yes ☐ No	
2-7.09	Printer stand required	☐ Yes ☐ No	
2-7.10	Cabinet required	☐ Yes ☐ No	

Section 13570

PANELS, CONSOLES, AND APPURTENANCES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of panels, consoles, and appurtenances, as required and as indicated on the drawings.

The UV System Supplier shall provide a free standing PLC/control panel for each UV system.

The System Supplier shall modify an existing PLC panel to add I/O for controlling and monitoring the valves and equipment as shown on the drawings and in the specifications.

1-1.01. Control System. Section 13500 – Instrumentation and Control System shall apply to all equipment furnished under this section.

1-1.02. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated and assembled in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Requirements. As required, the General Equipment Requirements section shall apply to all equipment provided under this section.

1-2.02. Drawings. General dimensions and arrangements are indicated on the drawings. System Supplier shall be responsible for coordinating the console and enclosure sizes and arrangements to accommodate the equipment provided.

1-3. SUBMITTALS. Submittals shall be as required in Section 13500 – Instrumentation and Control System.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as required in Section 13500 – Instrumentation and Control System.

1-5. SPARE PARTS. Spare parts shall be provided as required.

PART 2 - PRODUCTS.

2-1. PANEL DESIGN AND FABRICATION FEATURES. All panels furnished shall conform to the requirements of NEMA ICS-6-1993. Unless indicated otherwise on the drawings, the following paragraphs describe general fabrication requirements for the PLC cabinets, instrument panels, consoles, enclosures, and subpanels.

2-1.01. Piping. Pneumatic tubing shall be 1/4 inch OD, soft annealed copper with compression fittings. Tubing and fittings shall be as specified in Section 15060 – Miscellaneous Piping and Pipe Accesories.

2-1.01.01. Fittings. Compression type bulkhead fittings shall be provided near the bottom or the top of the panel for all field connections. Compression nuts and sleeves shall be provided for the field connections. Indicators, recorders, controllers, and other pneumatic devices shall be provided with plugged test connections and shutoff valves for isolation.

2-1.01.02. Valves. All devices shall have separate air supply shutoff valves. Valves and compression fittings shall be as manufactured by Nupro, Parker Hannifin, Swagelock, Tylok, or Whitey.

2-1.02. Instrument Wiring. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. Annunciator and indicating light circuits shall be minimum 16 AWG. Electronic analog circuits shall be 16 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits.

2-1.03. Power Entrance. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be of a nonfaulting and noninterrupting design, with a response time of not more than 5 nanoseconds. Surge protectors shall be Innovative Technology "PTX 080-1P101", Power Integrity Corporation "ZTAS-30", or Transtector "ACP 100 BW3".

2-1.04. Power Wiring. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on System Supplier's panel wiring diagrams. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture resistant and flame retardant covering rated for not less than 90°C.

2-1.05. Terminal Blocks. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance. Terminals shall be Phoenix Contact, nickel plated.

2-1.06. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the Instrument Device Schedule and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered labels or tape labels will not be permitted.

2-1.07. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends, as indicated on the drawings, and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified under the Device Tag Numbering System paragraph.

2-1.08. Painting. Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust inhibitive (universal) primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils. Color samples shall be submitted to Engineer for color selection. One quart of paint shall be furnished with the panels for future touchup painting.

2-1.09. Factory Test. Panels shall be factory tested electrically and pneumatically by the panel fabricator before shipment.

2-2. FREESTANDING VERTICAL PANELS. The following paragraphs describe specific requirements for the freestanding vertical panels:

2-2.01. Construction. Panel construction shall be an indoor, dusttight, completely enclosed cubicle formed from steel structural members and steel plates. The base shall be formed of steel channels, with flanges extending upwards. The base shall be provided with 1/2 inch diameter holes at 12 inch centers so that the base can be bolted to the concrete equipment base. Welds, seams, and edges on all exposed surfaces shall be ground smooth. Suitable lifting facilities shall be provided for handling and shipment.

2-2.02. Structure. Panel structure shall be suitably braced and of sufficient strength to support all equipment mounted on or within, to withstand handling and shipment, to remain in proper alignment, and to be rigid and freestanding. Top, sides, and back shall be fabricated from USS 10 gage or heavier steel sheets, with stationary back suitable for back to wall installation, or designed for rear access with hinged back doors as required. Doors shall not be greater than 24 inches wide or spaced not greater than 36 inches center to center as required. Rear access doors shall be fabricated from USS 14 gage or heavier steel.

2-2.03. Panel Front. As required, the front shall be a hinged door, or doors, with mounted instruments and control devices, fabricated from USS 10 gage steel sheet and suitably braced and supported to maintain alignment. Panels with hinged fronts shall be of sufficient width to permit door opening without interference with rear projection of flush mounted instruments.

2-2.04. Doors. Doors shall be essentially full height, having turned back edges and additional bracing to ensure rigidity and prevent sagging. Doors shall be mounted with strong, continuous, piano type hinges. Positive latches, acting from a common door handle, shall hold doors securely compressed at top, side, and bottom against rubber gaskets.

2-2.05. Mounted Instruments. As required, the front shall be stationary, with mounted instruments and control devices, fabricated from 3/16 inch [5 mm] steel plate. Panel fronts shall be suitably reinforced between mounting cutouts and drilling to support instruments and devices without deformation and shall be free from waves and other imperfections. As required, panel fronts shall be recessed at the base. Adjoining panel sections shall be accurately shop fitted to assure satisfactory assembly in the field.

2-2.05.01. Instrument Arrangement. Panel instruments and control devices shall be arranged in a logical configuration for the plant operators. The centerline of recorders shall be within 3 feet and 5 feet 9 inches above the base of the panel for convenient reading and chart replacement. Control switches shall be within 6 feet and 2 feet and 6 inches above the base of the panel. Indicators may be located within 2 feet and 6 inches and 6 feet and 6 inches above the base of the panels. Annunciators and clocks may be mounted near the top of the panels.

2-2.06. Conduit Entrance. Not used.

2-2.07. Size and Arrangement. Not used.

2-2.08. Interior Lighting. Illumination of panel interiors shall be provided by ceiling mounted lamp fixtures spaced at approximately 2 feet and 6 inches and near the door. Fixtures shall be 100 watt, incandescent or fluorescent tube type, with a common "On-Off" switch near each end door. Duplex-grounded receptacles shall be provided for service and maintenance tools at spacing not greater than 5 feet throughout the length of a panel. The lighting and receptacle circuit shall be fused separately from the instrumentation systems.

2-3. FILTER CONSOLES. Not used.

2-4. WALL-MOUNTED CABINETS. Not used.

2-5. WALL OR FLOOR MOUNTED INSTRUMENT SUBPANELS. Instrument subpanels shall be constructed from 1/8 inch thick stainless steel and shall be reinforced and braced as required to form a rigid assembly. Panels designed for wall mounting shall have 1 inch turned back edges and a minimum 2 inch air space between the panel and the wall surface. All components shall be mounted so as to be easily removable without requiring rear access to the subpanel. Refer to the drawings for additional details.

2-6. CONTROL SYSTEM CONSOLES AND ENCLOSURES. Not used.

2-7. CONTROL SYSTEM FURNITURE. Not used.

PART 3 - EXECUTION

3-1. GENERAL INSTALLATION REQUIREMENTS. Installation requirements are specified in Section 13500 – Instrumentation and Control System. In addition, equipment furnished under this section shall conform to the following manufacturing requirements.

3-1.01. Piping. All tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipment. Flexible polyethylene tubing shall be used to connect devices mounted on hinged doors.

3-1.02. Wiring. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and bound by nylon cable ties or shall be routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be

provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

3-1.03. More Than One Panel. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.

End of Section

Section 13700

UV DISINFECTION SYSTEM
DATA SHEET

Description	Data	Units
General		
Location of equipment	UV Reactors	
Tag number	UV-UVL-1, UV-UVL-2	
UV lamp power supply	480V, 60 Hz, 3 ph, 3 wire	
Power enclosure type	NEMA 4	
Approximate site elevation above mean sea level	511.00	feet
Operation and Maintenance manuals required	☒ Yes ☐ No	
Operating Conditions		
Peak hourly flow	12	mgd
Average daily flow	6	mgd
Flow per reactor		
Minimum	4	mgd
Average daily	6	mgd
Design	12	mgd
Design UV transmittance (at 253.7 nm through 1 cm path length)	89	%
Operational UV transmittance range (at 253.7 nm through 1 cm path length)	85 to 98	%
Design germicidal UV dose (biodosimetry equivalent), at design conditions, at the end of lamp life (70%)	40	mJ/cm^2
Operational germicidal UV dose range (biodosimetry equivalent)	10 to 40	mJ/cm^2
Guaranteed maximum headloss through reactor	8	inches of water column
Maximum hardness concentration	310	mg/L as $CaCO_3$
Maximum iron concentration	0.05	mg/L as Fe
Maximum manganese concentration	0.258	mg/L
Total organic carbon concentration range	1.05 to 3.03	mg/L
Maximum color	5	Pt/Cu
Water temperature range	2.8 to 29.4	°C
Operating pressure above center line	6	feet of water
Validated reactor required.	☒ Yes ☐ No	
Hydraulic calculations/modeling results to verify headloss requirements at listed production rates	☒ Yes ☐ No	

Description	Data	Units
UPS required for UV system	☒ Yes ☐ No	
Flow metering per reactor, provided by others	☒ Yes ☐ No	
UV intensity monitor per lamp, medium pressure only	☒ Yes ☐ No	
Online UV transmittance monitor	☒ Yes ☐ No	
Operational dose per reactor	☒ Yes ☐ No	
Items Submitted with Bid		
Product data sheet	☒ Yes ☐ No	
CAD drawing of proposed unit	☒ Yes ☐ No	
Upstream and downstream hydraulic requirements	☒ Yes ☐ No	
Power requirements	☒ Yes ☐ No	
Spare parts included in Bid	☒ Yes ☐ No	
Service and Maintenance Contract	☒ Yes ☐ No	
Field services included in Bid	☒ Yes ☐ No	
Power requirements at listed production rates	☒ Yes ☐ No	
Guaranteed Present Worth Table	☒ Yes ☐ No	
Guaranteed unit cost for replacement parts including mechanisms to adjust cost for 20 year life	☒ Yes ☐ No	
Warranty/guarantee (equipment, lamps, and performance)	☒ Yes ☐ No	

Section 13700

UV DISINFECTION SYSTEM – GENERAL

PART 1 - GENERAL

1-1. SCOPE. This section covers the general requirements for the design, fabrication, and testing of the Ultraviolet (UV) disinfection system. Reactors for the UV System shall be medium pressure UV reactors per Section 13702 – Medium Pressure UV Reactors. The UV system performance shall be in accordance with Section 13703 – UV System Performance Testing.

The UV system shall include the following principal components:

a. Two medium pressure UV reactors with quartz sleeves.

b. UV intensity sensors.

c. Reactor air relief vent valve.

d. Semiautomatic/automatic cleaning system.

e. Online UV transmittance monitors.

f. System instrumentation and controls.

g. Accessories.

h. Spare parts.

i. Special tools required for a complete system, whether or not specified in this section.

The UV system shall be capable of disinfecting filter effluent to meet the water quality standards specified in this section.

The manufacturer shall supply all accessories and appurtenances required for satisfactory operation of the integrated UV disinfection system.

The UV System shall be furnished by a single qualified Ultraviolet System Supplier who shall provide all services, equipment, and appurtenances required for a complete, fully integrated and operational system that meets all the design conditions, testing requirements, performance guarantees, and warranties specified herein.

1-1.01. Terminology. When the phrase "as required" is stated in this section, it shall mean "as required in the attached Data Sheet".

1-1.02. Definitions. The following terms are used in this section:

a. UV Dose – The total radiant energy incident from all directions onto an infinitesimally small sphere of area dA, divided by dA, for a given contact time in seconds. The unit of UV dose shall be milliJoules per square centimeter (mJ/cm^2) and shall be calculated as follows:

$$D = I \cdot t$$

Where: D = UV Dose, $mW\text{-}s/cm^2$ (mJ/cm^2)
I = average intensity or irradiance, mW/cm^2
t = average exposure time, s

b. UV Transmittance (UVT) – The transmittance of ultraviolet light at a wavelength of 254 nm through the water across a pathlength of 1 cm. UV transmittance shall be calculated from UV absorbance (A) at 254 nm by the following equation:

$$\text{Percent transmittance} = 100 \times 10^{-A}$$

c. Intensity or Irradiance – The total radiant power incident from all directions onto a infinitesimally small sphere of cross-sectional area dA, divided by dA. The units of intensity shall be milliwatts per square centimeter (mW/cm^2).

d. Validated Reactor – A reactor that has been validated under the following conditions.

i. The validated flow range contains the design flow range per reactor as required.
ii. The validated UVT range contains the operational UV transmittance range as required.
iii. The validated dose range contains the operational germicidal UV dose range as required.

The validation protocol shall be submitted to the Owner and Engineer one week before the Bid date. The Owner shall have final approval of the validation procedure.

e. Equivalent Dose – The maximum dose necessary for a full-scale UV system to achieve a level of inactivation of a specific organism equivalent to the level of inactivation for the same organism achieved in a laboratory using a collimated beam apparatus with a low pressure lamp producing

UV energy at a wavelength of 254 nm to test a water sample collected at the same time.

f. Medium Pressure (MP) Lamp – A lamp with the input power converted to UV light at 200 – 400 nm with a pressure of approximately 20 psi.

g. Guaranteed Life – The manufacturer's warranted life of the lamp, sleeve, ballast, and sensor as submitted by Ultraviolet System Supplier at the time of Bid and acceptable to Owner and Engineer.

h. Expected Lamp Life – The manufacturer's estimated life of the lamp based on the operating conditions listed in the Guaranteed Present Worth Table in the Bid Form.

i. Prorated Start Time – The time beginning after a minimum of 20 percent of the guaranteed life has lapsed.

j. Guaranteed Maximum Total System Energy Use – A calculated present worth value based on Ultraviolet System Supplier data entered in the Bid Documents reflecting energy use in kilowatt-hours per year.

k. Guaranteed Maximum Head Loss – The head loss in inches of water column allowed through the UV reactor between the inlet flange and the outlet flange at peak production rate.

1-2. GENERAL. Equipment furnished and installed under this section and Section 13702 – Medium Pressure UV Reactors, shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

The entire ultraviolet disinfection system shall be factory assembled and tested before shipment by operating all lamps, monitoring equipment, and controls. The manufacturer shall submit to Engineer written certification following factory testing. Systems that are not factory assembled and tested or that require extensive field assembly are not acceptable.

1-2.01. General Equipment Requirements. The General Equipment Requirements shall apply to all equipment furnished under this section and Section 13702 – Medium Pressure UV Reactors.

1-2.02. Power Supply. Power supply to the UV power distribution equipment shall be 480 volts, 60 Hz, 3 phase, 3 wire. The system control panel shall include control power transformers to provide lower voltages be as required by the system. Any modifications required for the power supply shall be the responsibility of the Ultraviolet System Supplier.

1-2.03. Anchor Bolts. All anchor bolts, nuts, and washers shall be stainless steel as specified in Section 05550 – Anchorage in Concrete and Masonry. Tie rod connections will not be acceptable.

Anchor bolts shall be accurately located as required for the equipment furnished.

1-2.04. Fasteners. All bolts, nuts, washers, and other fasteners that will be submerged or subject to contact with liquid shall be Type 316 stainless steel.

1-2.05. Edge Grinding. Sharp corners of cut or sheared edges shall be dulled by at least one pass of a power grinder.

1-2.06. Surface Preparation. All ferrous metal surfaces, except stainless steel, shall be shop cleaned by sandblasting or equivalent, as recommended by the coating manufacturer. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

1-2.07. Shop Painting. All ferrous metal surfaces, except stainless steel, shall be shop painted in accordance with the General Equipment Requirements.

1-2.08. Stainless Steel Cleaning. All stainless steel shall be pickled at the mill in accordance with ASTM A380 before being shipped. Pickling shall produce a modest etch and shall remove all embedded iron and heat tint. After fabrication, pickled surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect any residual embedded iron. All pickled surfaces damaged during fabrication, including welded areas, shall be repickled or passivated in accordance with ASTM A380, as needed, to remove all traces of iron contamination. All stainless steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination by iron or carbon steel objects or surfaces.

1-2.09. Baffles. Flow distribution baffles shall be provided to achieve equal distribution of flow and velocity to each lamp, if required and if used during validation testing. The baffle shall be integral to the vessel, shall be designed to prevent any dead zones in the vessel, and shall require no maintenance.

1-2.10. Spare Parts. The Ultraviolet System Supplier shall provide a complete set of spare lamps for one reactor, and shall also include a spare parts allowance as required.

Spare parts shall be suitably packaged in accordance with the General Equipment Requirements, with labels listing the contents of each package. Spare parts shall be delivered to Owner as directed.

1-3. INFORMATION REQUIRED TO BE SUBMITTED WITH THE BID. The following data shall be submitted with the bid:

a. Complete biodosimetry report prepared by an independent testing laboratory or by field testing for validated reactors. The report shall verify the maximum flow rate per reactor that will result in the delivered design UV dose. The required dose shall be demonstrated on a full-size prototype unit at the design UVT, with the lamp output reduced to 80 percent of its initial level (end of lamp life) and with no fouling on the lamp sleeves. The bench-scale dose-response calibration curve and flow-through biodosimetry test shall be based on a UV-resistant organism, such as MS2 coliphage, to ensure that the delivered dose can be accurately interpreted from the calibration curve.

b. A list of three references who are users of similar systems which are designed, assembled, and furnished by the Ultraviolet System Supplier and that disinfect at the design flow as required or a higher rate. The list shall include contact names, phone numbers, addresses, and brief project descriptions of the installation.

c. The number of lamps and the power consumption required to achieve disinfection based on the flow rates stated in the Bid Documents.

d. Calculations showing power draw from UV system at average and design flow conditions.

e. Guaranteed operating life of lamps, in hours.

f. Guaranteed operating life of ballasts, in years.

g. Guaranteed useful life of quartz sleeves, in years.

h. Guaranteed useful life of intensity sensors, in years.

i. Recommended spare parts list, including pricing.

j. Schedules of recommended routine and preventive maintenance.

k. Step-by-step procedure for cleaning the lamps, sensors, and reactors, including the volume of cleaning chemical required to clean one reactor and expected cleaning frequency given the water quality constituents.

l. Description of calibration procedure for UV intensity monitors and the recommended time interval for calibration.

m. Installation list for drinking water systems, indicating whether pilot-scale or full-scale installation; groundwater or surface water; and including location, size of system, number of units, reference and contact information, date installed, validation and certification procedures, other design criteria, and photographs (where applicable).

n. Completed Guaranteed Present Worth Table from Bid Documents.

o. Description and fee for the Service and Maintenance Agreement.

1-3.01. Present Worth of UV Operating System. The Ultraviolet System Suppler shall calculate the present worth of the UV operating system using the Guaranteed Present Worth Table in the Bid Form. Each Bidder is required to include with its bid a completed copy of Guaranteed Present Worth Table

The values listed in the table for energy use, guaranteed lamp life, estimated lamp life, sleeve life, ballast life, and sensor life shall be in accordance with the specification sections applicable to the construction and operation of the UV system, including, but shall not be limited to, Sections 13700, 13702, and 13703. The values pertaining to energy consumption shall take into account the energy required at the end of lamp life.

Ultraviolet System Supplier shall complete the Guaranteed Present Worth Table using the values for operating the UV system at the indicated production rates, including the equipment listed in this section and under the operating conditions described in that and other applicable sections. The maximum specific energy and maximum total energy use per day shall be guaranteed by Ultraviolet System Supplier and shall be used when evaluating the system during Performance Tests. Ultraviolet System Supplier shall guarantee that the UV system, including all equipment specified herein and all ancillary equipment, will perform under the conditions listed in the Guaranteed Present Worth Table without exceeding the total power consumption determined and stated for each flow rate.

Since power consumption is measured at the switchboards, motor control centers, and local panel boards, feeder line losses will be included in the total power consumption. The Ultraviolet System Supplier shall take this into account in estimating the total system power consumption and shall factor it into the final guaranteed power consumption rate submitted.

1-4. SUBMITTALS. Ultraviolet System Supplier shall submit for review in accordance with Section 01300 – Submittals, engineering data, including the quantities listed for headloss, power consumption, and disinfection capability. These quantities shall be verified during the performance testing of the equipment and before acceptance of the equipment by the Owner. Any

exceptions or deviations from this specification shall be listed and fully described in the submittal.

1-4.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering the materials, parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section.

Drawings and data shall include, but shall not be limited to, the following:

a. Drawings for the UV disinfection equipment and accessory equipment, including principal dimensions and locations of fittings, electrical connections, and remote monitoring facilities.

b. Fabrication, assembly, and installation drawings, schematics, and wiring diagrams, together with specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished.

c. Certification that the cost of replacement lamps, ballasts, sleeves, and sensors is guaranteed for a minimum of 15 years from the date of acceptance after performance testing. During these 15 years, the price shall be adjusted annually by the Producer Price Index – Industrial Commodities (where the base is 1982 = 100) published by the United States Department of Labor, Bureau of Labor Statistics, applicable on the anniversary of the date of the UV system acceptance.

d. Dimensions and installation requirements.

e. Descriptive information, including catalog cuts and manufacturers' specifications for major components.

f. Controls information as required in Section 13500, article 1-4.

g. Hydraulic calculations demonstrating compliance with the specified hydraulic characteristics.

h. Total headloss curves for minimum flow, maximum flow, and at least three intermediate points.

i. The power consumption per lamp (including ballast loss) and the system peak power consumption (including ballast loss) for new lamps, burn-in (100 hours), and end of lamp life.

j. Lamp output certification consisting of complete UV lamp and ballast output report prepared by an independent testing laboratory within the

past 12 months, which shall verify the output of the lamp and ballast at various operating conditions.

k. Detailed narrative description of how the UV control system will operate.

l. Performance documentation from plants of similar size.

m. Electrical equipment ratings and data sheets for all devices.

n. List of recommended spare parts along with prices and ordering information.

o. Complete instrumentation and control schematics in conformance with ISA Bulletin S5.1, latest edition.

p. UV system control system interface signals to the plant control system, including point-to-point interconnection diagrams.

q. Wire numbers and/or color coding.

r. Terminal numbers.

s. Operation, installation, and troubleshooting instructions.

t. Complete external electrical interconnection diagrams for control panels and field junction boxes, including number, sizes, and type of cables or wire required between panel, junction boxes, and equipment components.

u. Scaled drawings of cabinet assembly and layout, including interior and exterior views.

v. Control panel front elevation showing all face-mounted instruments; control panel interior layout drawing showing locations of major components, motor controls, control power transformers, fuses, and circuit breakers; and point-to-point wiring drawings.

w. Detailed bill of materials for all components, including manufacturer's name, description, and catalog number.

x. Fabrication and painting specifications.

y. Spare parts list.

Software documentation shall be submitted in accordance with Section 13500 – Instrumentation and Control System.

In the event it is not possible to conform with certain specified details, all nonconforming aspects shall be completely described as part of the Bid.

1-4.02. Operation and Maintenance Data and Materials. Operation and maintenance manuals shall be submitted in accordance with Section 01300 – Submittals. Equipment designations used shall correspond to those indicated on the drawings.

Operation and maintenance manuals shall include but not be limited to the following:

a. Equipment function, normal operating characteristics, and limiting conditions.

b. Assembly, installation, alignment, adjustment, and checking instructions.

c. Operating instructions for startup, routine and normal operation, regulation and control shutdown, and emergency conditions.

d. Maintenance instructions.

e. Guide to troubleshooting.

f. Parts lists and predicted life of parts subject to wear.

g. Outline, cross-section, and assembly drawings, engineering data, and wiring diagrams.

h. Test data and performance curves, where applicable.

i. Control Panel Information as stipulated in Section 13500

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4.03. PLC Programs. Provide electronic non-password protected electronic versions of PLC and LOI programs.

1-5. SYSTEM DESCRIPTION. All equipment shall be designed for a site elevation as specified.

The UV system shall be designed to treat water within the specified flow range and at the specified dosage. The UV system shall be designed based on a UVT as required.

The UV system shall be located between the existing filters and the clearwell as indicated on the drawings.

Access for the UV system maintenance shall be provided from the side of the UV system.

The power supply units and control panels for the UV units will be located as indicated on the drawings.

The operator shall locally select the desired UV dose for each individual reactor. The calculated UV dose for each reactor shall take into account the flow to the reactor, the status of the UV lamps, actual irradiance levels measured by the UV sensors, and transmittance of the filtered water. The calculation model shall take into account hydrodynamics of the UV reactor at the flow level being used and shall be verified with validation test results.

The UV system shall include, but shall not be limited to, the following equipment:

a. Two UV reactors.

b. Medium pressure UV lamps.

c. UV intensity monitors (one per lamp).

d. One online transmittance monitor per train that shall measure transmittance at 254 nm with a 1-cm path length.

e. Existing flowmeters located on filter effluent piping.

f. Isolation valves (two automatic per reactor) to be provided by others.

g. Pressure differential gauge (one for each reactor) to be provided by others.

h. Reference sensors for intensity monitors.

i. Temperature sensor (one for each reactor).

j. All controls and control panels as specified herein and as recommend by the equipment manufacturers to ensure a complete operating UV system.

k. All safety equipment, including face shields and warning signs.

1-6. WARRANTY. The equipment shall be free from defects in materials and workmanship, including damage that may occur during shipping, for a period of 2 years from the date of acceptance after performance testing.

The Ultraviolet System Supplier shall guarantee that the "Adjusted Total Power with LF", as determined by the testing procedures specified, will not exceed the values provided in the Guaranteed Present Worth Table in the Bid Form.

Engineering services shall be furnished during the 2 year warranty period. The engineering services shall include two plant visits of at least 1 day's duration each by an Ultraviolet System Supplier factory representative (two visits per year, not including emergency visits, on a date agreed upon by the Owner) to check, furnish technical assistance, and provide calibration services for the equipment. The factory representative must be familiar with the UV equipment and the control system instrumentation. Otherwise, an additional field service engineer who is familiar with the equipment must be present during these visits.

1-7. INSTALLATION AND OPERATION. Equipment shall be installed by the construction contractor with the guidance of qualified personnel from the Ultraviolet System Supplier. Equipment shall be operated only by qualified personnel from the Ultraviolet System Supplier having the knowledge and experience necessary to obtain proper results.

The Ultraviolet System Supplier shall provide services of qualified field representatives as required to perform all manufacturer's field services. The manufacturers' field representatives shall observe, instruct, guide, and direct the installation procedure, or shall perform an installation check, as required, and shall revisit the site as often as necessary to attain installation satisfactory to Owner and Engineer.

All equipment furnished under this Contract shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activities shall be provided. Prior to operation, the UV equipment shall be disinfected according to Kentucky Division of Water regulations.

1-8. REFERENCE STANDARDS. The UV system design shall conform to the latest editions or revisions in effect at the time of the bid opening of the following applicable codes and standards, and regulations generally available from the association, society, governing body, or regulatory agency named in the title:

American National Standards Institute (ANSI)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

American Water Works Association (AWWA)

American Welding Society (AWS)

Institute of Electrical and Electronics Engineers (IEEE)

Instrument Society of America (ISA)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

National Fire Protection Association (NFPA)

National Water Research Institute (NWRI)

1-9. RELATED WORK. General Equipment Stipulations are specified in Section 01610.

Medium pressure UV systems shall be as specified in Section 13702.

Performance testing shall be as specified in Section 13703.

Instrumentation work included as part of the UV system equipment shall be as specified in Division 13.

1.10. QUALITY ASSURANCE. The UV disinfection system shall be furnished by a single manufacturer who shall assume full responsibility for providing a complete, operating system designed for long life with a minimum of required maintenance meeting the requirements specified herein and as indicated on the drawings.

The equipment shall be subject to the specified testing requirements after installation and startup.

The Ultraviolet System Supplier shall be responsible for the entire UV system and shall be the manufacturer of the UV reactors, as specified in Section 13702 – Medium Pressure UV Reactors.

1-11. PATENT ROYALTIES AND FEES. US patent 6,129,893 – Method for Preventing Replication in *Cryptosporidium parvum* Using Ultraviolet Light, published on October 10, 2000 and US patent 6,565,803 – Method for the Inactivation of *Cryptosporidium parvum* using Ultraviolet Light, published on May 20, 2003 both describe the use of ultraviolet radiation in water treatment. The Ultraviolet System Supplier shall state their contractual limitations with regard to this patent in the Bid submittal. The Ultraviolet System Supplier shall indemnify the Owner against all other patent and/or royalty fees deemed applicable.

1-12. DELIVERY, STORAGE, AND HANDLING. All equipment shall be crated, delivered, and uncrated in a manner to protect against damage.

All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and is equipment is ready for operation.

Finished iron or steel surfaces that are not painted shall be properly protected to prevent rust and corrosion.

The finished surfaces of all exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted in place.

Factory assembled parts and components shall not be dismantled for shipment unless written permission is received from the Engineer.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS. The UV equipment shall be designed to meet the specified performance requirements as required. The design layout is based on dimensions from Trojan Technologies, Inc. Modifications may be necessary to accommodate a different manufacturer. Any additional costs for such modifications shall be included in the Contract Price.

2-2. EQUIPMENT CONSTRUCTION. The UV system design shall allow complete maintenance of the system without shutdown or bypassing. The reactors shall be removable without the use of special tools or equipment. All wetted parts shall be fabricated of Type 316 stainless steel, quartz glass, Teflon, or plastics that are not susceptible to degradation by UV light or chemicals, including oxidants.

All metal components shall be Type 316 stainless steel. All wiring exposed to UV light shall be Teflon coated. All other material exposed to UV light shall be Type 316 stainless steel, Type 214 quartz, Teflon, or other suitable material approved by Engineer.

The UV disinfection system shall include, but shall not be limited to, UV lamps, UV reactor, online UV transmittance monitor, main power/ballast enclosure(s), system control center, automatic chemical and/or physical cleaning system, stainless steel support legs, spare parts and other equipment as required for the complete installation and operation of the system.

2-3. ACCESSORIES. The following accessory items shall be provided.

2-3.01. Permanent Nameplates. The equipment shall be provided with permanent engraved stainless steel nameplates inscribed as directed by the Engineer and located in a conspicuous place acceptable to the Owner and Engineer. The lettering on the nameplates shall be at least 3/4 inch high and shall be painted black after fabrication. Each reactor shall also be labeled with a permanent engraved stainless steel number plate bearing the unit's serial number.

2-3.02. Manufacturer's Nameplate. Each item of major equipment shall be provided with a securely fixed nameplate bearing the manufacturer's name, address, and model/catalog number. The nameplate of the distributing agent only shall not be acceptable.

2-3.03. Lifting Eyes/Lugs. All equipment weighing more than 100 pounds shall be provided with lifting eyes or lugs. Where a special lifting sling or jack is required, it shall be furnished.

2-3.04. Safety Equipment. Safety equipment consisting of six pairs of personnel goggles for protection against UV wavelengths between 200 and 400 nm and four UV area warning signs shall be provided.

2-4. ELECTRICAL SYSTEM.

2-4.01. Power Distribution. The power supply to the main power/ballast enclosure shall be as required. The external power supply wiring from the Plants power system shall be furnished and installed as specified in Section 16050 - Electrical.

The main power/ballast enclosure shall be rated NEMA Type 4. All wiring to external devices shall terminate on numbered, pressure type terminal blocks as detailed in Section 13570 – Panels, Consoles and Appurtenances.

Enclosure cooling provided shall be rated NEMA Type 4. The UV System Supplier shall be responsible for heat load calculations needed to properly size the enclosure cooling system.

The enclosure shall have a circuit breaker type main disconnect with an externally operated handle and the padlock provisions. Provide a mechanical interlock between the main disconnect and the panel front with a defeat. Circuit breakers shall have a 25,000 A short circuit rating at 480 volts.

Control power for the pilot devices, relays, timers and UV system auxiliaries shall be 120 volts, single phase and shall be derived from control power transformers located in the UV enclosure(s). Control power transformers shall have both primary leads fused and shall have one secondary lead fused, the other grounded, and shall have capacity for all simultaneous loads.

Refer to Specification Section 13561 – Panel Mounted Instruments and Section 13570 – Panels, Consoles, and Appurtenances for detailed requirements for panel components and fabrication.

2-4.02. Wiring and Connections. All wiring and electrical connections shall be protected against moisture to prevent electrical shorts or failure. UV System Supplier shall be responsible for all electrical components, installation, wiring, and controls on or within the UV disinfection system and shall be in accordance with the current edition of the NEC and with all other applicable state and electrical codes.

The UV reactors shall be completely wired, requiring only an external connection for external power and control wiring. External wiring to and from the power/ballast control panel and the UV reactors shall be furnished by the Ultraviolet System Supplier and installed as specified in Section 16050 – Electrical. Wiring within the UV enclosure for power distribution to the ballasts, and from the ballasts to the lamps, shall be as specified in this section.

2-5. INSTRUMENTATION AND CONTROL.

2-5.01. System Control Center. The UV system shall be provided with a programmable logic controller (PLC) for each UV reactor. Each PLC shall be capable of controlling UV lamps based on the sum of the flow from the existing flowmeters located on each filter's effluent piping and will be transmitted to the UV system PLC, via Ethernet communication. The PLC system will adhere to the requirements detailed in sections 13500, 13530, and 13550. The PLC-based system shall also include operator interface displays through a graphic display screen and a message keypad. Hardwired panel devices and meters are not acceptable. The keypad shall be covered with a sealed membrane overlay covering all function keys and numerical keys. The operator interface displays shall be graphical and menu driven, with fault message windows appearing upon alarm conditions. The UV System Supplier shall provide a list of alarms and operational statuses to the Owner for programming of the plant control system Operator Workstations. The UV System Supplier shall coordinate with the Owner regarding tag names and communication addressing. In addition, the UV System Supplier shall attend three programming coordination meetings with the Owner. The meetings shall be held at the following milestones: one prior to commencement of any programming; one at approximately 30% completion of programming; and one at approximately 70% programming. Each UV reactor control system shall include at least the following features:

a. Hand, Off, Auto selection.

b. Elapsed time of each row and each lamp recorded and displayed on the display screen when prompted.

2-5.01.01. Minor Alarms. Minor alarms shall be provided to indicate the need for maintenance, and shall include at a minimum the following conditions:

a. Low UV intensity warning shall be preset at the factory for 80 percent of the intensity after 100 hours. Alarm set point shall be field adjustable from the local operator interface (LOI).

b. Individual lamp failure (if a single lamp is less than 5 percent of the total number of lamps in a reactor) indicated by the address system specified below.

c. Low operational UV dose alarm shall occur when the operational UV dose drops below the predetermined set point. The set point shall be field adjustable from the LOI.

d. Low UV transmittance alarm shall occur when the influent UV transmittance drops below a predetermined set point. The set point shall be field adjustable from the LOI.

2-5.01.02. Major Alarms. Major alarms shall be provided to indicate an extreme alarm condition in which the UV disinfection performance may be jeopardized and shall include at a minimum the following conditions:

a. Low-low UV intensity alarm shall be preset at the factory for 70 percent of the intensity after 100 hours burn-in of the lamps. The alarm set point shall be field adjustable from the LOI.

b. Low-low UV transmittance alarm shall occur when the transmittance drops below a predetermined set point. The alarm set point shall be field adjustable from the LOI.

c. Low-low operational UV dose alarm shall occur when the operational UV dose drops below the predetermined set point. Set point shall be field adjustable from the LOI.

d. Multiple lamp failure when more than 5 percent of the lamps in a reactor fail indicated by the address system specified below. This condition shall instigate a default routine in the PLC control to turn on all available UV lamps to ensure that disinfection will be achieved, if physically possible. Personnel and plant safety must be maintained at all times.

e. Failure of an instrument or a communications link resulting in loss of a control signal. Alarm shall indicate which instrument or communication link failed. This condition shall instigate a default routine in the PLC control to turn on all available UV lamps to ensure that disinfection will be

achieved, if physically possible. Personnel and plant safety must be maintained at all times.

f. High temperature alarms for each individual reactor.

g. Low water level alarm shall occur when the water level in the UV reactor falls below a predetermined level.

h. Main power supply failure. Failure of power supply from transformer.

i. UV system power failure. Failure of main power supply to the UV system.

j. Ground fault interruption alarm.

Major and minor alarms shall identify the affected lamps by an address system. The 20 most recent alarms shall be recorded in an alarm history register and displayed when prompted. All minor alarms shall energize one common alarm for each reactor for transmittal to the plant control system. Additionally, all major alarms shall energize one common alarm for each reactor for transmittal to the plant control system. Alarm contacts shall be rated 120 volts ac, 5 amperes.

Each control system panel shall be as required and shall adhere to sections 13500, 13530, 13550, 13560, 13561, and 13570. All alarms and operational statuses shall be transmitted to the plant control system by Ethernet communication.

2-5.02. Control Logic. The system shall be capable of being placed in either Hand, Off, or Auto mode. The Auto mode shall be transmitted to the plant control system by Ethernet communication. When the system is in the Auto mode, the controller shall operate the system based on Ethernet communicated flow value determined from the summing the individual filter flows which are measured upstream from the UV reactor.

2-5.03. Dose Pacing. A dose pacing system shall be supplied to run the UV system at the UV dosage set point in relationship to a 4-20 mA signal from the individual flow monitors, a 4-20 mA signal from the UVT monitor, and the intensity signals from the UV intensity sensors. If applicable, logic and time delay relays shall be provided to regulate the UV lamp ON/OFF cycles as well as intensity.

2-5.04. Online Transmittance Monitor. An online UV transmittance (UVT) monitor shall be provided which will automatically track the transmittance of the UV reactor influent at the 254 nm germicidal wavelength. The monitoring shall be continuous. To ensure valid results, an automatic calibration sequence shall be utilized. The UVT shall measure from 0 to 100 percent, with an accuracy of at least 1 percent. A 4-20 mA analog output from the UVT shall interface the UVT

monitor with the plant control system, which will re-transmit the signal to each UV reactor PLC. The UV transmittance signal from the plant control system shall be used by the UV reactor control system to create a UV demand feedback loop. The system control center shall vary power in response to the influent UV reactor's UVT. The UVT analyzer shall be located not more than 100 feet from the influent pipe being monitored.

2-6. CONTROL ENCLOSURE. The control panel enclosure shall be rated NEMA Type 4. All wiring to external devices shall terminate on numbered, pressure type terminal blocks as detailed in Section 13570 – Panels, Consoles and Appurtenances.

The control panel shall be factory wired to receive power from the main power/ballast enclosure.

All selector switches and pilot lights shall be heavy-duty, oiltight type. Pilot lights shall be of the transformer or LED type. All relays shall have contacts rated 10 amperes at 120 volts ac.

Enclosure cooling provided shall be rated NEMA Type 4. The UV System Supplier shall be responsible for heat load calculations needed to properly size the enclosure cooling system.

Refer to Specification Section 13561 – Panel Mounted Instruments and Section 13570 – Panels, Consoles, and Appurtenances for detailed requirements for panel components and fabrication.

2-7. SPARE PARTS. In addition to the spare parts listed above, any special tools required to facilitate maintenance of any component of the UV system shall also be furnished. All spare parts shall be in waterproof packages suitable for export service, labeled with the part description and numbers. Each item or set of parts expected to be installed at one time shall be in an individual package.

In addition, provide spare parts as required in specification sections 13530, 13560, and 13561.

Any spare parts that are used during the installation process shall be replaced by the manufacturer at no cost to the Owner.

2-8. SHOP TESTS. Before shipment to the jobsite, the UV units shall be operated to check for leaks, faulty controls, proper wiring, and other defects. The UV intensity monitor and UVT monitor shall be calibrated to the manufacturer's specifications. Defective equipment and controls revealed by such tests shall be replaced and the equipment package shall be placed in satisfactory operating condition before shipping.

PART 3 - EXECUTION

3-1. MANUFACTURER'S INSTALLATION AND STARTUP SERVICES. The Ultraviolet System Supplier shall furnish the services of a competent, qualified field representative and any necessary assistance to perform the manufacturer's field services, including equipment installation, certification, startup, adjustment, and instructing Owner's personnel in the operation and maintenance of the equipment furnished. Training shall be provided by the Ultraviolet System Supplier in accordance with Section 01020 – Training.

3-1.01. Manufacturer's Field Representative. The field representative shall report to the site at the time designated by Owner and Engineer, provided that the Ultraviolet System Supplier is notified at least 14 days in advance. The site visit time shall be adequate for equipment installation, modification, certification, startup, and instruction of Owner's personnel. These requirements are in addition to the manufacturer's responsibilities during performance testing specified above. Additional services and associated travel expenses needed to correct defective installation, materials, or equipment shall be the responsibility of the Ultraviolet System Supplier.

3-1.02. Duties of the Field Representative. Duties of the field representative during installation shall include the following:

a. Instructing and guiding Contractor in the use of proper methods and procedures for all technical phases of the UV equipment installation.

b. Inspecting and indicating approval or disapproval of the installation as it progresses.

c. Reporting observations in writing to Contractor, with copies to Engineer.

d. Performing operational checks.

e. Determining when equipment is ready for startup.

f. Provide control system testing as required in Section 13500 – Instrumentation and Control System.

g. Conduct training in accordance with Section 01020 – Training.

Unless otherwise agreed, all startup adjustments and testing of equipment shall be performed in the presence of Owner, Engineer and the manufacturer's field representative, and in accordance with the manufacturer's instructions. No startup or testing shall be undertaken without the manufacturer's approval.

During the UV system installation, startup, testing and at any other times as may be required, the manufacturer's field representative shall instruct designated Owner's personnel in the proper operation and maintenance of the equipment. Such installation shall continue until both the field representative and the Owner are satisfied that the personnel are properly instructed.

The Ultraviolet System Supplier shall furnish to Engineer, a written report certifying that the equipment (1) has been properly installed, (2) is in accurate alignment, and (3) is free from any undue stress imposed by anchor bolts. This report shall be submitted to the Engineer before the performance testing is completed.

3-2. PERFORMANCE TEST. The Ultraviolet System Supplier shall guarantee that the UV system, including all equipment as specified herein and all ancillary equipment, must be capable of achieving inactivation equivalent to the design germicidal UV dose without exceeding the Guaranteed Present Worth Energy Cost and the Guaranteed Maximum Headloss for the entire UV system. Performance tests shall be conducted based on conditions for flow, UV transmittance, and dose as specified in the Bid Documents, and the performance tests shall consider degradation such as equipment aging and wear, fouling, and cleaning efficiency. The performance test shall be conducted according to Section 13703 – Performance Testing.

3-3. REMEDIES/PENALTIES. In the event that any part of the UV System fails to meet the guaranteed or otherwise specified performance requirements, Ultraviolet System Supplier shall, at its sole expense, exercise one or both of the following options:

a. Provide all necessary materials and personnel to modify the system to meet the specified performance requirements and repeat the performance tests.

b. Remove that part(s) of the system that is not operating properly and replace it with equipment that meets the necessary performance criteria.

In the event that, after exercising options a. and b., any part of the UV system still fails to meet specified performance requirements, the Ultraviolet System Supplier is required to install additional equipment or replace the installed equipment with units capable of meeting the specified performance requirements, and shall repeat the performance tests. All costs associated with additional or replacement equipment, including the cost of any required modifications to any building, piping system, or electrical system shall be borne entirely by the Ultraviolet System Supplier.

If the UV system fails to meet the specified performance requirements after these modifications, the Ultraviolet System Supplier shall continue to modify or replace equipment until full compliance is achieved.

If after modification the system fails to meet the Maximum Total System Energy Use, the Ultraviolet System Supplier shall pay a penalty proportional to the estimated present worth difference in energy cost between the Guaranteed Maximum Total System Energy Use and the Adjust Measured Total System Energy Use as calculated below:

Power penalty at given flow rate = (A-B)*C*D*E, where:

A = Measured Present Worth Energy Cost, as determined during performance testing

B = Guaranteed Present Worth Energy Cost, as specified by the Ultraviolet System Supplier in the Bid Documents

C = Present Worth factor, 20 years at 6.0 discount rate = 11.47

D = Power Cost = $0.07/kWh

E = Multiplier = 2.0

3-4. GUARANTEED PRESENT WORTH TABLE. The Ultraviolet System Supplier shall fill in all blanks in the table and submit with the Bid. The following formulas are to be used to calculate the numbers:

Number in Row 20 = [Number in Row 3 x Number in Row 5] / LF

Row 21 = Row 20 x AO x EC

Row 22 = [Row 3 x AO x Row 7 x Row 15] / Row 11

Row 23 = [Row 3 x Row 8 x Row 16] / Row 12

Row 24 = [Row 3 x Row 9 x Row 17] / Row 13

Row 25 = [Row 3 x Row 10 x Row 18] / Row 14

Where:

AO = Annual Operations, hours

EC = Energy Costs, $/kWh

LF = Lamp Factor

3-5. UV SYSTEM SERVICE AND MAINTENANCE CONTRACT. On the Date of acceptance after performance testing the Ultraviolet System Supplier shall provide a one year, renewable at the option of the Owner, service and maintenance contract. The contract price shall be renewable for up to an

additional four (4) years at the option of the Owner. The service and maintenance contract scope shall be outlined in a proposal submitted by the Ultraviolet System Supplier and shall include, as a minimum, the following items listed herein for the price indicated on the Bid Form:

a. Annual equipment maintenance check on all instrumentation devices, monitors, local programmable controllers, local instrument loops, and electrical equipment of the ultraviolet disinfection system equipment components furnished.

b. Replacements parts, including but not limited to lamps, sleeves and ballasts, will be provided by the Ultraviolet System Supplier on an as-needed basis. Replacement parts will be provided free of charge to the Owner during the first year but will be paid for by Owner at Ultraviolet System Supplier's actual cost after the first year during any extensions of the service and maintenance contract. The Owner will inform the Ultraviolet System Supplier when minor alarms of the UV Disinfection System occur in order to have the replacement parts on site in a timely manner. The Owner will also maintain spare parts for one reactor which shall be replenished by the Ultraviolet System Supplier when used.

c. Twenty-four hour per day availability to provide verbal direction and response to troubleshooting inquiries regarding equipment furnished.

d. Annual tuning of the ultraviolet disinfection system to optimize system performance and inspection of each reactor to determine the need for cleaning. If cleaning is required, the Ultraviolet System Supplier shall supervise the cleaning operations performed by Owner's personnel.

e. Annual training of Owner's supervisory, operating, and maintenance personnel covering the operation and maintenance of the UV Disinfection System. The training shall be as indicated in Section 01020 – Training.

End of Section

Section 13702

MEDIUM PRESSURE UV REACTORS

PART 1 - GENERAL

1-1. SCOPE. This section covers medium pressure ultraviolet (UV) reactors. The UV system shall comply with the general requirements specified in Section 13700 – UV Disinfection System.

The Ultraviolet System Supplier shall supply all accessories and appurtenances required for satisfactory operation of the integrated UV disinfection system.

The equipment furnished under this section shall be manufactured by Trojan Technologies Inc. or equal.

1-2. WARRANTY. The following requirements are in addition to those specified in Section 13700 – UV Disinfection System.

1-2.01. Lamp Life. Lamps shall be warranted for a minimum of 5,000 hours of operation, regardless of delivered dose. The Prorated Start Time shall be at least 20 percent of the warranted lamp life or 20 percent of the expected lamp life, whichever is longer. If 20 percent of the lamps installed fail before the end of the warranty period, the Ultraviolet System Supplier shall replace all lamps within 30 days after written notification from the Owner, at no additional cost to the Owner.

1-2.02. Sleeve Life. Sleeves shall be warranted for a minimum of 6 years, regardless of the power output and operating hours. The Prorated Start Time shall be a minimum of 20 percent of the guaranteed life. If 20 percent of the sleeves fail during the warranty period, the Ultraviolet System Supplier shall replace all sleeves within 30 days after written notification from the Owner, at no additional cost to the Owner.

1-2.03. Ballast Life. Ballasts shall be warranted for a minimum of 5 years regardless of the power output and operating hours. The Prorated Start Time shall be a minimum of 20 percent of the guaranteed life. If 20 percent of the ballasts fail during the warranty period, the Ultraviolet System Supplier shall replace all ballasts within 30 days after written notification from the Owner, at no additional cost to the Owner.

1-2.04. Sensor Life. Sensors shall be warranted for a minimum of 3 years regardless of the power output and operating hours. The Prorated Start Time shall be a minimum of 20 percent of the guaranteed life. If 20 percent of the sensors fail during the warranty period, the Ultraviolet System Supplier shall

replace all sensors within 30 days after written notification from the Owner, at no additional cost to the Owner.

1-2.05. Replacement Cost Calculation. Replacement cost for the lamps, sleeves, ballasts, and sensors shall be calculated according to the following schedule:

Time of Failure	Replacement Cost to Owner
Less than Prorated Start Time	None
Between Prorated Start Time and Guaranteed Life	$\frac{TF - PST}{GL - PST} \times \text{Guaranteed Price}$
After Guaranteed Life	Full Guaranteed Price

Where:

TF = Time of Failure
PST = Prorated Start Time
GL = Guaranteed Life

Guaranteed Price shall be as indicated in Guaranteed Present Worth Table in the Bid Form.

PART 2 - PRODUCTS

2-1. CONSTRUCTION.

2-1.01. UV Reactors. Reactors shall be fabricated of Type 316 stainless steel. Each UV lamp shall be enclosed in an individual quartz sleeve which shall not come into contact with any steel component of the reactor. All lamp power cables and control wiring shall be furnished by the Ultraviolet System Supplier and shall terminate in a junction box located on the reactor vessel. Cables connecting the lamps and control devices from the reactor junction box shall be enclosed inside the frame of the UV reactor and shall not be exposed to the water. The UV reactors shall be so designed that operating personnel can change the lamps and the quartz sleeves without removing the reactor from the piping. Systems whose lamp assemblies have to be returned to the factory for lamp replacement are not acceptable.

The ballast enclosure shall contain the ballasts and addressable lamp status monitoring systems.

The reactor shall be designed for a fouling factor of 0.8 to account for fouling of the quartz sleeves. The UV system shall be capable of meeting the performance guarantee with this factor.

2-1.02. UV Lamps. The UV system shall utilize medium pressure lamps capable of variable control of power output from 40 to 100 percent. Each lamp shall be protected from contact with the water by a quartz sleeve. Filaments shall be sufficiently rugged to withstand shock and vibration. Lamp bases shall be resistant to UV light, ozone, chlorine, and chloramines. The UV lamps shall not require a long cool-down period prior to restarting after a short-period power interruption.

The UV output shall be verified at maximum lamp operating temperature which shall not be exceeded under full-scale, full power operating conditions for this project.

The Ultraviolet System Supplier shall ensure disposal of the returned lamps (old/used) at no cost to the Owner upon receipt of the returned lamps at a location designated by the Ultraviolet System Supplier. The lamp output shall not fluctuate by more than 3 percent as a result of variations in water temperature between 40°F and 100°F.

2-1.03. Lamp End Seal and Lamp Holder. The open end of each quartz sleeve shall be sealed with an O-ring sealed end plug. The electrical connections at the end of the quartz sleeve shall be sealed. The quartz sleeve retainers shall remain in place to protect the quartz sleeve ends against damage, without impeding the removal and replacement of the UV lamp.

Lamps shall be removable while the quartz sleeve remains in place. All electrical connections to the lamp assembly shall be Ultraviolet System Supplier standard pin machined connectors.

The lamp assembly design and UV reactor mounting shall enable the operator to easily accomplish the following:

a. Disconnecting of lamp power cable only, without removing the UV lamp or the lamp assembly from the reactor.

b. Disconnecting of lamp power cable and removing only the UV lamp from the reactor.

c. Disconnecting of the lamp power cable and removing the entire lamp assembly without removing the lamp from the assembly.

2-1.04. UV Lamp Sleeves. A lamp sleeve shall be provided around each UV lamp to prevent the lamps and electrical connections from contact with the water.

The minimum UV_{254} transmittance of the quartz sleeves shall be rated for 88 percent at the start of its life.

2-1.05. Intensity Monitor. Each UV lamp shall be provided with a UV intensity monitor, mounted in the center of a representative UV reactor and connected to a central control panel. The peak response for the UV monitor shall be between 255 and 280 nm; and less than 10 percent of the sensor response shall be above 300 nm. The sensor shall not degrade after prolonged exposure to UV light. Sensor readings shall be displayed on the control screen and shall be accurately calibrated to produce a current that is proportional to the UV light intensity.

A portable hand-held reference sensor meeting the same requirements as the permanent sensors shall be provided for routine checking.

The sensor shall be cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and hence spurious alarms indicating low intensity.

In the event that the UV intensity from any reactor drops below a set point, a common alarm contact shall open in the control unit for remote alarm to the plant control system. The alarm contact shall be rated 4 amperes at 120 volts and shall be electrically isolated. The set point for activation of the alarm shall be adjustable over the entire range of 0 to 100 percent of maximum intensity. The intensity monitor in any UV unit which has been turned off because of low flow operation shall also be turned off to prevent the annunciator alarm on the main control panel from being activated. An adjustable time delay (variable from 0 to 20 minutes) to bypass the alarm on start and warmup of the lamps and the UV system shall be provided to avoid nuisance alarms.

2-1.06. Lamp Running Time Meters. Each reactor shall be provided with a running time meter to indicate the duration between cleaning cycles, etc. This information shall be displayed on the operator interface.

2-2. ELECTRICAL SYSTEM. Each ballast shall drive a maximum of two lamps with independent control and monitoring circuits, and shall provide individual lamp status information to the PLC. Ballasts shall be located in the main power/ballast enclosure and ballast cooling shall be provided within the enclosure using cooling fans/forced air.

The ballasts shall be either electronic or electromagnetic design specifically designed for medium pressure high intensity lamps. The minimum operating power factor for all ballasts shall be 0.90. The ballast shall be capable of varying the lamp power between 40 and 100 percent proportional to a 4-20 mA control signal. In case of control signal failure, the ballasts shall automatically power the lamps to 100 percent.

The ballast shall detect lamp failure and shall initiate a re-strike sequence independently from any external influence. The ballast shall attempt two re-starts before shutting off. The ballast shall incorporate a filament pre-heat circuit to minimize lamp failure on startup. The ballast shall include automatic overload protection with automatic reset, or slow blow fuses.

The ballast shall include standard non-proprietary plug-in connectors for ease of troubleshooting and replacement of individual ballasts. Designs that require removal of multiple ballasts for service shall not be acceptable..

The ballast shall be held in a standby mode when not in operation to reduce startup time and minimize stresses on electronic components induced when the reactors are powered.

2-3. CLEANING SYSTEM. Each UV reactor shall be equipped with an automatic cleaning system for mechanical and/or chemical cleaning of the lamp sleeves, and mechanical cleaning of the UV sensor. Manual control of the cleaning system shall be available through the operator interface. All cleaning reagents and solutions used shall be NSF 60 approved.

PART 3 – EXECUTION

3-1. INSPECTION. Onsite testing procedures shall be coordinated as detailed in Section 13703 – Performance Testing. Water used for the tests shall be provided by the Contractor.

3-2. MANUFACTURERS' REPRESENTATIVES REQUIREMENTS. A Ultraviolet System Supplier representative shall inspect the final installation, supervise the testing of equipment, and provide training to Owner's personnel, as specified in Section 13700 – UV Disinfection System.

End of Section

Section 13703

UV SYSTEM PERFORMANCE TESTING

1. SCOPE. Performance testing shall be conducted on all UV reactors. The Ultraviolet System Supplier is responsible for performing and coordinating the performance testing and associated laboratory efforts.

The Ultraviolet System Supplier shall guarantee that the UV system, including all equipment as specified herein and all ancillary equipment, is capable of achieving inactivation of microorganisms equivalent to that achieved using a germicidal UV design dose without exceeding the Guaranteed Present Worth Energy Cost as stated by the Ultraviolet System Supplier in the Bid Documents. Performance tests shall be conducted based on conditions for flow, UV transmittance, and dose as specified, and considering degradation such as equipment aging and wear, fouling, and cleaning efficiency.

Offsite validation shall be completed before the Bid Opening. Performance testing shall be conducted on-site by the Ultraviolet System Supplier in the presence of the Owner and Engineer. The Ultraviolet System Supplier's representative shall have previous satisfactory experience in conducting tests of this type. Five copies of the test report shall be submitted to Engineer.

2. TESTING PROTOCOLS. The Ultraviolet System Supplier shall submit to the ENGINEER the following documentation: (1) testing protocols describing all procedures to be used 30 days before testing; (2). calibration data for all instruments 14 days before testing; and (3) test reports within 15 days after completion of testing.

The performance testing protocol shall be done using the test organism MS2 coliphage. Performance testing shall be done using a single reactor to be selected by the ENGINEER.

3. PERFORMANCE TESTING PROTOCOL. The performance test shall be conducted to verify the Guaranteed Present Worth Energy Cost and the Guaranteed Maximum Headloss at the flow rate, dose, and UV transmittance (UVT) indicated on the Data Sheet in Section 13700 – UV Disinfection System. Power consumption and on-line sensor readings shall be recorded for the performance tests. Microbiological testing will not be required for the performance testing.

The power use shall be compared with the Guaranteed Present Worth Energy Cost, as stated by the Ultraviolet System Supplier in the Bid Documents.

4. TEST PROCEDURES. The following procedure shall be used for all tests.

   a. Flow used for testing shall be within ±3 percent of the target flow.

   b. Transmittance shall not exceed the design value, as stated on the Data Sheet in Section 13700 – UV Disinfection System.

   c. UV lamps shall have undergone 100 hours of burn-in prior to testing.

   d. UV lamps shall be operated at 80 percent power to simulate conditions at the end of lamp life.

   e. Before testing is initiated, the Ultraviolet System Supplier shall submit calibration data for all instruments used during testing.

End of Section

Section 15010

VALVE INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of new valves and actuators purchased by Contractor as part of this Work.

Cleaning, disinfection, pressure and leakage testing, insulation, and pipe supports are covered in other sections.

The following specification sections are applicable to valves to be installed:

Section	Title
15091	Miscellaneous Ball Valves
15093	Check Valves
15101	AWWA Butterfly Valves

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. Coordination. When manufacturer's field services or installation check services are provided by the valve manufacturer, Contractor shall coordinate the services with the valve manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services.

Flanged connections to valves including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Section 01614 – Handling and Storage and the manufacturer's instructions until installed in the Work. Stored equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment dry at all times.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3-1. INSPECTION. All valves and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. INSTALLATION.

3-2.01. General. Valves shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the valve for in-place maintenance. Installation shall be in accordance with the valve manufacturer's recommendations.

Unless otherwise indicated on the drawings, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of piping having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as reviewed by Engineer.

3-2.02. Installation Checks. When specified in the valve sections, installation checks will be provided by a manufacturer's representative. The specified services shall be furnished at no charge to the Contractor. Any additional services in connection with the installation of the equipment which are required by reason of Contractor's progress shall be paid for by Contractor.

Contractor shall perform no Work related to the installation or operation of materials or equipment furnished by others without direct observation and guidance of the field representative, unless Engineer and manufacturer furnishing such materials concur otherwise.

3-2.03. AWWA Butterfly Valves. Butterfly valves shall be installed with the shaft horizontal unless otherwise necessary for proper operation or as acceptable to Engineer.

Whenever an actuator must be removed to permit installation of a valve, the actuator shall be promptly reinstalled and shall be inspected and readjusted by a representative of the valve manufacturer.

3-2.04. Check Valves.

3-2.04.01. Lift Check Valves. Horizontal lift checks shall be installed in a level horizontal position so that the internal parts rise and fall vertically, unless the valve is spring loaded. Angle pattern lift checks shall be installed in vertical pipe with flow upward from beneath the disc.

3-2.04.02. Swing Check Valves. Install valves oriented for the correct flow direction. Only valves designed for vertical installation shall be installed in vertical piping.

3-2.04.03. Low Pressure Air Service Check Valves. Dual disc wafer check valves installed in the discharge piping of centrifugal blowers shall be positioned with the valve hinge perpendicular to the impeller shaft of the blower.

3-2.05. Eccentric Plug Valves. Not Used.

3-2.06. Resilient Seated Gate Valves. Not Used.

3-2.07. Double Disc Gate Valves. Not Used.

3-2.08. Air Release and Combination Air Valves. Not Used.

3-2.09. Valve Boxes. Not used.

3-2.10. Yard Hydrants. Not Used.

3-2.11. Fire Hydrants. Not Used.

3-3. VALVE ACTUATORS. Valve actuators and accessories shall be installed in accordance with the equipment manufacturer's recommendations.

3-4. FIELD QUALITY CONTROL.

3.4.01. Field Testing. After installation, all valves shall be tested in conjunction with Section 02704 – Pipeline Pressure and Leakage Testing.

3-4.01.01. Pressure Tests. Pressure testing shall be in accordance with Section 02704 – Pipeline Pressure and Leakage Testing.

3-4.01.02. Leakage Tests. All valves shall be free from leaks. Each leak that is discovered within the correction period stipulated in the General Conditions shall

be repaired by and at the expense of Contractor. This requirement applies whether pressure testing is required or not.

3-5. ADJUSTING. After installation, the opening and closing time shall be adjusted as needed for each pneumatic, hydraulic and electric actuated valve.

End of Section

Section 15020

MISCELLANEOUS PIPING AND ACCESSORIES INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of piping and accessories as indicated on the drawings for the following piping sections:

Section	Description
15060	Miscellaneous Piping and Accessories
15065	Miscellaneous Steel Pipe, Tubing, and Accessories
15067	Miscellaneous Plastic Pipe, Tubing, and Accessories
15070	Copper Tubing and Accessories

Contractor shall furnish all necessary jointing materials, coatings, and accessories that are specified herein.

Pipe supports and anchors shall be furnished by Contractor, and are covered in Section 15140 – Pipe Supports.

1-2. GENERAL.

1-2.01. Coordination. Materials installed under this section shall be installed in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by Engineer.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with Section 01300 – Submittals. Items requiring submittals shall include, but not be limited to, the following:

Watertight/dusttight pipe sleeves.

Materials as specified herein.

1-3.02. Welder Certification. Not Used.

1-3.03. Spool Drawings. Not Used.

1-4. QUALITY ASSURANCE.

1-4.01. Welding and Brazing Qualifications. Not Used.

1-4.02. Tolerances. These tolerances apply to in-line items and connections for other lines.

The general dimension, such as face-to-face, face or end-to-end, face- or end-to center, and center-to-center shall be 1/8 inch.

The inclination of flange face from true in any direction shall not exceed 3/64 inch per foot.

Rotation of flange bolt holes shall not exceed 1/16 inch.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

Plastic pipe, tubing, and fittings shall be stored between 40°F and 90°F.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Pipe, tubing, and fittings covered herein shall be installed in the services indicated in the various pipe sections.

2-2. MATERIALS.

Threaded Fittings

Anti-Seize Thread Lubricant	Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize".
Teflon Thread Sealer	Paste type; Hercules "Real-tuff", John Crane "JC-30", or Permatex "Thread Sealant with Teflon".
Teflon Thread Tape	Hercules "Tape Dope" or John Crane "Thread-Tape".

Solvent Welded Fittings	
Solvent cement for PVC Systems	ASTM D2564.
Solvent cement for CPVC Systems	ASTM F493.
Sodium Hypochlorite, Sodium Hydroxide, and Sodium Bisulfite Service	IPS Corporation "Weld-On 724"
Primer for PVC Systems	ASTM F656.
Solder or Brazed Fittings	
Solder	Solid wire, ASTM B32, ANSI/NSF 61 certified, Alloy Grade Sb5, (95-5).
Soldering Flux	Paste type, ASTM B813.
Brazing Filler Metal	AWS A5.8, BCuP-5; Engelhard "Silvaloy 15", Goldsmith "GB-15", or Handy & Harman "Sil-Fos".
Brazing Flux	Paste type, Fed Spec O-F-499, Type B.
Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. "Clearflow Fittings".
Flanged	Epco "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".
Pipe Insulation	See Mechanical Insulation section.
Watertight/Dusttight Pipe Sleeves	O-Z Electrical Manufacturing "Thruwall" and "Floor Seals", or Thunderline "Link-Seals"; with modular rubber sealing elements, nonmetallic pressure plates, and galvanized bolts.
Pipe Sleeve Sealant	Polysulfide or urethane, as specified in the Caulking section or as indicated on the drawings.

Protective Coatings	
Tape Wrap	ANSI/AWWA C209, except single ply tape thickness shall not be less than 30 mils; Protecto Wrap "200" or Tapecoat "CT".
Primer	As recommended by the tape manufacturer.
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".

PART 3 - EXECUTION

3-1. INSPECTION. All piping components shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. PREPARATION.

3-2.01. Field Measurement. Pipe shall be cut to measurements taken at the site, not from the drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3-3. INSTALLATION.

3-3.01. General. All instruments and specialty items shall be installed according to the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance.

Flat faced wrenches and vises shall be used for copper tubing systems. Pipe wrenches and vises with toothed jaws will damage copper materials and shall not be used. Bends in soft temper tubing shall be shaped with bending tools.

3-3.02. Pipe Sleeves. Piping passing through concrete or masonry shall be installed through sleeves that have been installed before the concrete is placed

or when masonry is laid. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates. Unless otherwise indicated on the drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 1 inch nor more than 2 inches above the floor surface, with the projections uniform within each area. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

Unless otherwise indicated on the drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

3-3.03. Pipe Joints. Pipe joints shall be carefully and neatly made in accordance with the indicated requirements.

3-3.03.01. Threaded. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs. Unless otherwise indicated, threaded joints shall be made up with teflon thread tape, thread sealer, or a suitable joint compound.

Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads. Threaded joints in steel piping for chlorine service shall be made up with teflon thread tape or litharge and glycerine paste applied to all male threads.

3-3.03.02. Compression. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past fingertight, or as recommended by the fitting manufacturer, to produce a leaktight, torque-free connection.

3-3.03.03. Flared. Ends of annealed copper tubing shall be cut square, and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as needed to produce leaktight connections.

3-3.03.04. Soldered and Brazed. Where solder fittings are specified for lines smaller than 2 inches, joints may be soldered or brazed at the option of Contractor. Joints in 2 inch and larger copper tubing shall be brazed. Brazing alloy shall contain no tin. Joints in copper chlorine tubing and refrigerant piping shall be brazed; solder will not be acceptable.

Surfaces to be joined shall be thoroughly cleaned with flint paper and coated with a thin film of flux. At each joint, tubing shall enter to the full depth of the fitting socket.

Care shall be taken to avoid overheating the metal or flux. Each joint shall be uniformly heated to the extent that filler metal will melt on contact. While the joint is still hot, surplus filler metal and flux shall be removed with a rag or brush.

3-3.03.05. Solvent Welded. Solvent welded connections shall only be used for PVC or CPVC pipe. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations and ASTM D2855. Pipe ends shall be beveled or chamfered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the setting time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, as set forth in Table X2.1 of ASTM D2855, has elapsed. Solvent welding shall be performed by bonding operators who have met the requirements of ASME B31.3 and A328.

3-3.03.06. Epoxy and Adhesive Bonded. Not Used.

3-3.03.07. Heat Fusion Bonded. Not Used.

3-3.03.08. Flanged. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but shall not be torqued less than the minimum value required by the gasket manufacturer. Flange bolts shall not be so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

Flange bolt holes shall be oriented as follows, unless otherwise indicated on the spool drawings:

Vertical flange face:	Bolt holes to straddle the vertical centerlines.
Horizontal flange face:	Bolt holes to straddle plant north-south centerlines.

Pipe sealants, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by Engineer.

Welds at orifice flanges shall have internal surfaces ground smooth to the pipe wall.

Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1/16 to 1/8 inch between the edge of the fillet weld and the face of the flange. The seal weld shall be applied so that the flange face shall be free of weld spatter and does not require refacing.

Flat-faced flanges shall be used when mating to Class 125 flanges. Full-face gaskets shall be used with flat-faced flanges and ring gaskets shall be used with raised faced flanges.

Weld neck flanges shall be used with butt-weld fittings. The bore of weld neck flanges shall match the pipe wall thickness.

Insulating joints connecting submerged (buried) piping to exposed piping shall be installed above the maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged (buried) metallic piping shall be isolated from the concrete reinforcement. Insulating flanges shall be tested for electrical isolation after installation and bolt-up but prior to introduction of conducting fluid.

3-3.03.09. Welded. Not Used.

3-3.03.10. Grooved Couplings. Not Used.

3-3.03.11. Push-on. Not Used.

3-3.03.12. Rubber-Gasketed. Not Used.

3-3.03.13. Other Pipe Joints. Not Used.

3-3.04. Pipe. Pipe shall be installed as specified, as indicated on the drawings, or, in the absence of detail piping arrangement, in a manner acceptable to Engineer.

Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe, valves, or connecting equipment.

Piping shall be supported in conformance with the Pipe Supports section.

Piping shall be connected to equipment by flanges or unions as specified in the various piping sections. Piping connecting to equipment shall be supported by a pipe support and not by the equipment.

Water, gas, and air supply piping shall be provided with a shutoff valve and union at each fixture or unit of equipment, whether or not indicated on the drawings, to permit isolation and disconnection of each item without disturbing the remainder of the system. Air supply piping shall be provided with sectionalizing valves and valved air inlet connections as needed for isolation of portions of the system for periodic testing. Gas supply lines to buildings shall be provided with a shutoff valve and union located above grade immediately outside the building. A capped drip leg shall be provided at the bottom of the vertical riser of gas supply piping adjacent to gas-fired appliances.

A union shall be provided within 2 feet of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the drawings or the specifications.

Water supply piping within structures shall be arranged, and facilities provided, for complete drainage. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated and complete venting is provided.

In all piping except air and gas piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe, tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

Branch connections in horizontal runs of steam, air, and gas piping shall be made from the top of the pipe.

Buried PVC piping shall be "snaked" in the trench and shall be kept as cool as possible during installation. PVC pipe shall be kept shaded and shall be covered with backfill immediately after installation.

All chemical piping shall be installed so that lines are readily accessible for cleaning. Tees shall be provided at regular intervals in all chemical piping except chlorine piping, with extra openings plugged, to facilitate cleaning. Teflon thread tape or teflon thread sealer shall be applied to the threads of the plugs so that they can be easily removed. At each point where hose or reinforced plastic tubing is connected to rigid piping, a quick-disconnect coupling shall be provided.

Piping adjacent to flow sensors shall be installed in accordance with the requirements of the manufacturer of the flow sensor and commonly accepted design practices of the appropriate straight pipe runs both upstream and downstream.

Drains required for operation are shown on the drawings. However, vents at all high points and drains at all low points in the piping that are required for complete draining for pressure test may not be shown on these drawings. Contractor shall add such items as found to be necessary during detail piping design and/or piping installation.

3-3.05. Reducers. Eccentric reducers shall be installed flat on the bottom for steam, condensate return and digester gas services.

3-3.06. Valves. Isolation valves provided with equipment and instruments shall be located in a manner which will allow ease of access and removal of the items to be isolated. Prior to soldering or brazing valves, teflon and elastomer seats and seals shall be removed to prevent damage.

3-4. PIPING ASSEMBLY.

3-4.01. General. Contractor shall only use labor that has been qualified by training and experience to capably perform the specified activities required to accomplish the work in a satisfactory manner

If there is a conflict between the mechanical drawings and piping and instrumentation drawings (P&IDs), the P&ID shall take precedence. Any deviations from the Specifications or piping locations shown on the drawings require prior review and approval by Engineer.

3-4.02. Buttwelded Piping. Not Used.

3-5. PROTECTIVE COATING. Standard weight steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating.

Where specified in the Miscellaneous Steel Pipe, Tubing, and Accessories section, extra strong steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating or a shop applied tape wrap. Where not specified to be shop coated or wrapped in the Miscellaneous Steel Pipe, Tubing and Accessories section, a tape wrap shall be field applied. The exterior surfaces of all fittings, couplings, specials, and other portions of buried piping not protected with plastic coating shall be tape-wrapped in the field.

All surfaces to be tape-wrapped shall be thoroughly cleaned and primed in accordance with the tape manufacturer's recommendations immediately before wrapping. The tape shall be applied by two-ply (half-lap) wrapping or as needed to provide a total installed tape thickness of at least 60 mils. Joints in plastic-coated pipe shall be cleaned, primed, and tape-wrapped after installation.

Joints in galvanized steel piping in underground locations shall be field painted with two coats of coal tar epoxy coating.

3-5.01. Inspection. All shop-applied plastic coatings and tape wrap on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fitting on the job and immediately before installation. All field-applied tape wrap on pipe, joints, fittings, and valves shall be inspected for holidays and other defects following completion of wrapping. Inspection of plastic coatings after installation of the pipe or fitting in the trench shall be made where, in the opinion of Engineer, the coating may have been damaged during installation. Holidays and defects disclosed by inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.

The inspection shall be made using an electrical holiday detector. The detector and inspection procedures shall conform to the requirements of Section 4.4 of ANSI/AWWA C209.

3-6. PRESSURE AND LEAKAGE TESTING. All specified tests shall be made by and at the expense of Contractor in the presence, and to the satisfaction of Engineer. Each piping system shall be tested for at least 1 hour with no loss of pressure. The Contractor shall coordinate this section with Section 02704 – Pipeline Pressure and Leakage Testing. Piping shall be tested at the indicated pressures:

Service	Test Pressure	Test Medium
Water supply	1-1/2 times working pressure but not less than 120 psi	Water
Gas supply	1-1/2 times working pressure but not less than 60 psi	Compressed air
Air supply and signal (See paragraph 3-6.01)	1-1/2 times working pressure but not less than 50 psi	Compressed air with 100 percent of all oil 0.025 micron and larger removed
Other piping	1-1/2 times working pressure but not less than 50 psi	Suitable fluid or gas; for distilled water piping, distilled water or filtered oil-free compressed air may be used

Compressed air or pressurized gas shall not be used for testing plastic piping unless specifically recommended by the pipe manufacturer.

Leakage may be determined by loss-of-pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to Engineer. All fixtures, devices, or accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped as needed during the testing.

After completion of the specified pressure tests, all anhydrous ammonia, chlorine and sulfur dioxide gas piping shall be tested for leakage using the appropriate gas chemical at operating pressures. Piping shall be thoroughly cleaned and dried before admitting gas chemical into the system. Gas chemical shall be slowly admitted to the piping system.

For chlorine gas piping, leakage shall be checked by waving a swab soaked in aqua ammonia solution near each fitting. Ammonia solution shall not be applied directly to the fittings. Formation of white fumes will indicate the presence of leaks. All chlorine gas shall be purged from the line before leaks are repaired.

Unless otherwise required by the applicable codes, drainage and venting systems shall be water or air tested, as required. For water testing, the drainage and venting system shall be filled with water to the level of the highest vent stack. For air testing, the system shall be charged with air to a minimum pressure of 5 psig. Openings shall be plugged as necessary for either type of test. To be

considered free of leaks, the system shall hold the water or air for 30 minutes without any drop in the water level or air pressure.

All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of Contractor and at the time directed by Engineer.

All joints in piping shall be tight and free of leaks. All joints which are found to leak, by observation or during any specified test, shall be repaired, and the tests repeated.

3-6.01. Air Pressure Tests. Pressure tests shall be performed on all air piping systems as specified herein.

Air piping shall be pressure tested in 3 steps. The first step shall be to pressurize the air piping to approximately 1/3 of the final test pressure and held for one hour. Then the pressure in the piping shall be increased to 2/3 of the final test pressure and held for one hour. Finally, piping shall be pressurized to the final test pressure, as specified herein, and again held for one hour. Piping shall hold pressure with minimal leakage to the satisfaction of Engineer before going to the next step.

Contractor shall be responsible for ensuring that all air piping is free of leaks. All joints which are found to be leaking shall be repaired and the test repeated.

3-7. CLEANING. The interior of all pipe, valves, and fittings shall be smooth, clean, and free of blisters, loose mill scale, sand, dirt, and other foreign matter when installed. Before being placed in service, the interior of all lines shall be thoroughly cleaned, to the satisfaction of Engineer.

Metal anhydrous ammonia, chlorine and sulfur dioxide piping shall be cleaned as recommended by the gas chemical feed system supplier. All surfaces which may come into contact with gas chemical shall be thoroughly dry and free of oil or grease before being placed in service. The recommended cleaning procedures shall be submitted for review in accordance with the Submittals section.

Tin-lined copper tubing for distribution of distilled water shall be flushed and cleaned with distilled water in accordance with the tubing manufacturer's recommendations.

3-8. ACCEPTANCE. Owner reserves the right to have any section of the piping system which he suspects may be faulty cut out of the system by Contractor for inspection and testing. Should the joint prove to be sound, Owner will reimburse Contractor on a time-and-material basis as specified in the Contract. Should the joint prove to be faulty, the destructive test will continue joint by joint in all

directions until sound joints are found. Costs for replacement of faulty work and/or materials shall be the responsibility of Contractor.

End of Section

Section 15060

MISCELLANEOUS PIPING AND PIPE ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of miscellaneous piping and pipe accessories. Miscellaneous piping shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with Section 01300 – Submittals. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

Name of Manufacturer
Type and model
Construction materials, thickness, and finishes
Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section – Handling and Storage. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 - PRODUCTS

2-1. MATERIALS. Miscellaneous piping materials shall be as specified herein.

2-1.01. Material Classification BR-1.

BR-1 – Regular Weight Brass Pipe Gauge piping for hot/cold water. Gauge piping for seal water. Gauge piping for compressed air.	Pipe Fittings	ASTM B43, red brass, seamless, regular weight. ANSI/ASME B16.15, Class 125.

2-1.02. Material Classification BR-2. Not used.

2-1.03. Material Classification HS-1. Not used.

2-1.04. Material Classification HS-2.

HS-2 – Hose with Quick Disconnect Couplings Flexible connections in chemical piping. Overflow lines from chlorine feeders and residual analyzers. Lime slurry. Chemical transfer. Lime slurry at slakers and slurry pumps. Lime slurry in pump discharge.	Hose Couplings	ID not smaller than nominal size. Boston "Crosslinked Polyethylene Hose" or Gates "Renegade", "Mustang 45 HW" or "Stallion" acid-chemical hose. To be selected for resistance to the service chemical. Cam-lock type quick connect/disconnect couplers and adapters as manufactured by OPW or PT

2-1.05. Material Classification TG-1. Not used.

2-1.06. Material Classification CRP-1. Not used.

2-1.07. Accessories. Accessories for the miscellaneous piping systems shall be as indicated.

Unions for brass pipe — Fed Spec A-A-59617, Class 125.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Section 015020 – Miscellaneous Piping and Accessories Installation.

End of Section

Section 15061

DUCTILE IRON PIPE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of ductile iron pipe. Ductile iron pipe shall be furnished complete with all fittings, jointing materials, pipe hangers and supports, anchors, blocking, encasement, and appurtenances. Piping shall be furnished by Contractor.

Piping furnished hereunder shall be complete with all joint gaskets, bolts, and nuts required for installation of any valves and equipment furnished by others for installation under this contract.

Pipe hangers and supports, pressure and leakage testing, cleaning, disinfection, and cathodic protection are covered in other sections. Cast iron soil pipe is covered in Section 15060 – Miscellaneous Piping and Pipe Accessories. Pipe trenching, embedment, and backfill are covered in Section 02202 – Trenching and Backfilling.

1-1.01. Pipe Manufacturer's Experience and Field Services. All ductile iron pipe, fittings, and specials shall be fabricated, lined, and coated by the pipe manufacturer. Minimum required experience qualifications shall include manufacture of a pipeline at least 1 mile in length, of a diameter equal to or larger than the pipe to be provided, with joints, lining, and coating suitable for the same or a higher pressure rating, which has performed satisfactorily for the past 5 years.

All ductile iron pipe shall be installed in accordance with the pipe manufacturer's recommendations.

1-2. SUBMITTALS. Drawings, details, specifications, and installation schedules covering all ductile iron pipe and accessories shall be submitted in accordance with Section 01300 – Submittals. The drawings and data shall include, but shall not be limited to, the following:

Certification by manufacturer for each item furnished in accordance with the ANSI/AWWA Standards.

Certification of gaskets, certifying that gasket material is suitable for services intended.

Certification of proof-of-design tests for joints.

Certification of proof-of-design tests for welded-on outlets.

Laying schedule complete with an explanation of all abbreviations used in the schedule.

Two samples of the polyethylene encasement, each sample clearly identified as required by the Governing Standards and test results from an independent third party laboratory of the requirements specified in ANSI/AWWA C105/A21.5.

Submittal data shall clearly indicate the country of origin of pipe, fittings, flanges, restraining devices, and accessories. Certified copies of physical and chemical test results as outlined in ANSI/AWWA C151/A21.51 shall be submitted for the materials to be provided.

Contractor shall submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-2.01. Emergency Repair Manual. Contractor shall submit an emergency repair manual prepared and furnished by the pipe manufacturer. The manual shall include procedures for handling emergency calls and repairs; a list of stock replacement pipe sections, closures, and other parts needed for emergency repairs; names and emergency telephone numbers of pipe manufacturer's engineering staff and factory-trained field service representatives who can be contacted day or night during an emergency; response and delivery times; and installation instructions for the materials and methods used in making repairs. The pipe manufacturer shall provide emergency assistance that may be required at no additional cost to Owner.

1-3. SHIPPING, HANDLING, AND STORAGE. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage, and as specified herein.

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Unpadded hooks, wire brushes or other abrasive tools shall not be permitted to come into contact with polyethylene lining if such lining is specified.

Contractor-furnished pipe and fittings in which the lining has been damaged shall be replaced by and at the expense of Contractor. With the concurrence of Engineer, small and readily accessible damaged areas may be repaired.

If the lining of Owner-furnished pipe or fittings is damaged by Contractor during unloading or handling, the damaged pipe or fittings shall be replaced by and at the expense of Contractor. Where the damaged areas are small and readily accessible, Contractor may be permitted to repair the lining.

Contractor shall repair any damage to pipe coatings before the pipe is installed.

PART 2 - PRODUCTS

2-1. PIPE CLASS. The class of ductile iron pipe shall be as indicated on the drawings. The specified class includes service allowance and casting allowance.

Pipe wall thickness for grooved and threaded end pipe shall be increased if necessary to comply with the following minimum thickness:

Pipe Size		Minimum Class	
inches	mm	Threaded Ends (1)	Grooved Ends (2)
4-16	100-400	53	53
18	450	53	54
20	500	53	55
24	600	53	56
30-54	750-1400	53	--
60 & 64	1500-1600	350	--

(1) Complies with ANSI/AWWA C115/A21.15 for minimum pipe wall thickness for threaded flanges.

(2) Complies with ANSI/AWWA C606 for grooved and shouldered joint ductile iron pipe.

2-2. MATERIALS.

Pipe	Ductile iron, ANSI/AWWA C151/A21.51, Table 1 or Table 3.
Gaskets – All Joint Types	Synthetic rubber; natural rubber will not be acceptable. Gaskets for potable water service shall be certified as suitable for chlorinated and chloraminated potable water; a certificate of gasket suitability shall be submitted. Gaskets shall be furnished by the pipe manufacturer.
Fittings	ANSI/AWWA C110/A21.10 (except shorter laying lengths will be acceptable for U.S. Pipe), or ANSI/AWWA C153/A21.53, minimum working pressure rating as follows, unless indicated otherwise on the drawings.

Fitting Size in.	Material	Type	Min. Working Pressure Rating, psi
4 to 2	DI	Mechanical and Push-on joints	350
4 to 24	DI	Flanged joints	250
30 to 48	DI	All joints	250
54 to 64	DI	All joints	150

All fittings shall be ductile iron and suitable for a factory test pressure of 1.5 times rated working pressure without leakage or damage.

Push-on Joints	ANSI/AWWA C111/A21.11.
Restrained Push-on Joints, gaskets with stainless steel gripping segments, (4 inch through 12 inch)	American "Fast Grip" or "Field Lok 350 Gasket" manufactured by U.S. Pipe and furnished to licensed Tyton® joint manufacturer.
Restrained Push-on Joints, locking wedge type, (4 inch through 20 inch)	EBAA Iron "Megalug" Series 1700; Tyton "TR Flex Gripper Ring"; or American "Field Flex Ring", without exception.

Restrained Push-on Joints, positive locking segments and/or rings, (4 inch through 64 inch)	American "Flex-Ring," or "Lok-Ring"; Clow "Super-Lock"; U.S. Pipe "TR Flex"; or Griffin "Snap-Lok."
Flanged Joints	ANSI/AWWA C115/A21.15.
Flanges	
Class 250 (where identified)	Ductile iron, flat faced, with ANSI/ASME B16.1, Class 250 diameter and drilling.
All Others	Ductile iron, Class 125, ANSI/AWWA C115/A21.15.
Flanges	All flanges shall be suitable for test pressure of 1.5 times rated pressure without leakage or damage.
Bolts	ASTM A307, chamfered or rounded ends projecting 1/4 to 1/2 inch beyond outer face of nut.
Nuts	ASTM A307, hexagonal, ANSI/ASME B18.2.2, heavy semifinished pattern.
Gaskets	ASTM D1330, Grade I rubber, full face type, 1/8 inch [3 mm] thick. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.
Insulated Flanges	
Flanges	As specified herein, except bolt holes shall be enlarged as needed to accept bolt insulating sleeves.
Insulation Kits	As manufactured by Central Plastics or PSI Industries.

Insulating Gaskets	Type E, NEMA G-10 glass reinforced epoxy, 1/8 inch thick, with Buna-N sealing element for water and air service. For wastewater service use Viton sealing element. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.
Bolt Insulating Sleeves	Mylar, 1/32 inch thick.
Insulating Washers	Phenolic laminate, 1/8 inch thick, two for each flange bolt.
Backing Washers	Steel, 1/8 inch thick, two for each flange bolt.
Mechanical Joints	ANSI/AWWA C111/A21.11.
Restrained Mechanical Joints (factory prepared spigot), (4 inch through 48 inch)	American "MJ coupled Joints", or Griffin "Bolt-Lok" or "Mech-Lok".
Restrained Mechanical Joints, (field cut spigot), (4 inch through 20 inch)	EBAA Iron "Megalug" Series 1100, without exception.
Wall Castings	Mechanical joint with water stop and tapped holes; single casting or fabricated ductile iron; holes sized in accordance with the details on the drawings and provided with removable plugs.
Mechanical Joints with Tie Rods	As indicated on the drawings.
Tie Rods	ASTM A307.
Steel Pipe	ASTM A53, Schedule 40 or 80 as indicated on the drawings.
Washers	ANSI/ASME B18.22.1, plain steel.

Threaded Connections	ANSI/ASME B1.20.1, NPT; with boss or tapping saddle wherever wall thickness minus the foundry tolerance at the tapped connection is less than that required for 4-thread engagement as set forth in Table A.1, Appendix A, of ANSI/AWWA C151/A21.51.
Mechanical Couplings	
Couplings	Dresser "Style 38"; Smith-Blair "441 or 411 Flexible Coupling"; or Romac "Style 501"; without pipe stop.
Gaskets	Oil-resistant synthetic rubber. Gaskets shall be furnished by the pipe manufacturer. Gaskets for potable water service shall be certified as suitable for chlorinated potable water; a certificate of gasket suitability shall be submitted.
Grooved-End Joints	AWWA C606.
Pipe Ends (rigid joints)	Grooved, with dimensions conforming to AWWA C606, Table 3.
Pipe Ends (flexible joints)	Not used. Shouldered, with dimensions conforming to AWWA C606, Table 4.
Couplings (non-shouldered pipe)	Grinnell "Figure 7001," Gustin-Bacon "No. 500 Gruvajoint," or Victaulic "Style 31."
Couplings (shouldered pipe)	Victaulic "Style 41" or "Style 44".
Flanged Coupling Adapters	
Restrained (4 inch through 12 inch)	Smith-Blair "Type 912" or Romac "Style FCA501", with anchor studs.
Restrained (14 inch through 84 inch - Dismantling Joint)	Romac "DJ400" or Viking Johnson.
Unrestrained (14 inch and larger)	Smith-Blair "Type 913" or Romac "Style FC400", 14 inches and larger.

Unless otherwise indicated on the drawings, flanged coupling adapters shall be restrained.

Tapping Saddles	Ductile iron, with steel straps and rubber sealing gasket, 250 psi pressure rating.
Watertight/Dusttight Pipe Sleeves	Thunderline Corporation "Link-Seal", insulating type with modular rubber sealing elements, nonmetallic pressure plates, and stainless steel bolts and nuts.
Shop Coating and Lining	
Cement Mortar Lining with Seal Coat	ANSI/AWWA C104/A21.4.
Composite Polyethylene Lining	American Cast Iron Pipe Co. "PolybondPlus®".
Ceramic Epoxy Lining	Induron "Protecto 401 Ceramic Epoxy".
Calcium Aluminate Lining	La Farge "SewperCoat".
Glass Lining	Two-coat system applied over blast-cleaned surface; ground and finish coats separately fired; finished lining thickness at least 8 mils, Mohs' Hardness 5 to 6 density as determined by ASTM D792; Waterworks "MEH 32" or Victo "SG-14 Glass Lined Pipe."
Universal Primer	Manufacturer's standard.
Asphaltic Coating	Manufacturer's standard.
Coal Tar Epoxy	Manufacturer's standard.
Liquid Epoxy	ANSI/AWWA C210.
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol."
Polyethylene Encasement	Seamless, ANSI/AWWA C105/A21.5; LLDPE - 8 mil or HDCLPE - 4 mil.

2-3. SHOP COATING AND LINING. The interior of all pipe and fittings, unless noted otherwise, shall be cement mortar lined. The interior of all air piping shall be unlined and uncoated.

The exterior surfaces of all pipe and fittings which will be exposed in interior locations shall be shop primed. Flange faces shall be coated with a suitable rust-

preventive compound. Exterior surfaces of all other pipe and fittings shall be coated with asphaltic coating.

PART 3 - EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site.

3-2. PREPARATION. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign matter prior to installation. Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed.

Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other objects shall not be placed in or allowed to enter the pipe.

3-3. CUTTING PIPE. Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a file or a power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled.

All field cutting of existing gray cast iron pipe shall be done with mechanical pipe cutters, except where the use of mechanical cutters would be difficult or impracticable.

Contractor shall use factory prepared pipe ends unless a field cut is required for connections.

Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be acceptable. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be acceptable.

3-4. ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated in Table 3 or Table 4 of AWWA C600, unless specially designed bells and spigots are provided.

Either shorter pipe sections or fittings shall be installed where needed to conform to the alignment or grade indicated on the drawings.

3-5. LAYING PIPE. Buried pipe shall be protected from lateral displacement by placing the specified pipe embedment material. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions.

Whenever pipe laying is stopped, the open end of the pipe shall be sealed with a watertight plug, which will prevent trench water from entering the pipe.

Pipe shall be laid with the bell ends facing the direction of laying, except where reverse laying is specifically acceptable by Engineer.

3-6. FIELD JOINTS. Joints in buried locations shall be mechanical or push-on type unless otherwise indicated on the drawings. Bells on wall castings and wall sleeves shall be mechanical joint type, with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the drawings.

Certification of joint design shall be provided in accordance with ANSI/AWWA C111/A21.11, Section 4.5, Performance Requirements, as modified herein. The joint test pressure shall be not less than 2 times the working pressure or 1-1/2 times the test pressure of the pipeline, whichever is higher. The same certification and testing shall also be provided for restrained joints. For restrained joints, the piping shall not be blocked to prevent separation and the joint shall not leak or show evidence of failure. It is not necessary that such tests be made on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design.

Restrained joints shall be extended after they are assembled to minimize further takeup.

Field closure pieces shall be located away from the bends beyond the length over which joints are to be restrained.

3-7. MECHANICAL JOINTS. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Overtightening of bolts to compensate for poor installation practice will not be acceptable.

The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the

mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3-8. PUSH-ON JOINTS. Not used.

3-9. FLANGED JOINTS. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate, to ensure uniform compression of the gasket.

Special care shall be taken when connecting piping to any pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported to obtain accurate matching of bolt holes and uniform contact over the entire surface of flanges before any bolts are installed in the flanges. Pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened. Each pump shall be leveled, aligned, and wedged into position which will fit the connecting piping, but shall not be grouted until the initial fitting and alignment of the pipe, so that the pump may be shifted on its foundation if necessary to properly install the connecting piping. Each pump shall, however, be grouted before final bolting of the connecting piping. After final alignment and bolting, the pump connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as needed and then the flanges bolted back together. The flange bolts shall then be loosened and the process repeated until no movement is observed.

3-10. FLANGED COUPLING ADAPTERS. Flanged coupling adapters shall be installed in strict accordance with the coupling manufacturer's recommendations. After the pipe is in place and bolted tight, the proper locations of holes for the anchor studs shall be determined and the pipe shall be field-drilled. Holes for anchor studs shall be drilled completely through the pipe wall. Hole diameter shall be not more than 1/8 inch larger than the diameter of the stud projection.

The inner surfaces of couplings shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be coated with liquid

epoxy in accordance with ANSI/AWWA C210. The remaining surfaces, except flange mating surfaces, shall be cleaned and shop primed with universal primer.

3-11. MECHANICAL COUPLINGS. Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. A space of at least 1/4 inch, but not more than 1 inch, shall be left between the pipe ends. Pipe and coupling surfaces in contact with gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks, and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of Engineer.

The interior surfaces of the middle rings shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining components shall be cleaned and shop primed with universal primer.

3-12. GROOVED-END JOINTS. Not used.

3-13. POLYETHYLENE ENCASEMENT. Not used.

3-14. OUTLETS. Not used.

3-15. WALL CASTINGS. Wall castings shall be provided where ductile iron pipes pass through concrete walls, unless otherwise indicated on the drawings.

Where a flange and mechanical joint piece is to connect to a mechanical joint wall casting, the bolt holes in the bell of the wall casting shall straddle the top (or the side for vertical piping) centerline of the casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall casting at the foundry.

3-16. REDUCERS. Not used.

3-17. CONNECTIONS WITH EXISTING PIPING. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by Owner. Facilities shall be provided for proper dewatering and for disposal of all water removed from dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water,

mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then all potable water pipe, fittings, and valves shall be swabbed with, or dipped in, a 200 mg/L chlorine solution.

3-18. INSULATED FLANGED JOINTS. Not used.Insulated flanged joints shall be installed where indicated on the drawings. In addition to one full-faced insulated gasket, each flange insulating assembly shall consist of one full-length sleeve, two insulating washers, and two backing washers for each flange bolt. The insulating gasket ID shall be 1/8 inch less than the ID of the flange in which it is installed. The insulated flanged joint accessories shall be installed in accordance with the instructions and recommendations of the manufacturer.

3-19. CONCRETE ENCASEMENT. Not used.

3-20. REACTION ANCHORAGE AND BLOCKING. Not used.

3-21. PRESSURE AND LEAKAGE TESTS. Pipe and fittings shall be subjected to a pressure test and a leakage test in accordance with Section 02704 – Pipeline Pressure and Leakage Testing.Pipe and fittings shall be subjected to a pressure test and a leakage test. The Contractor shall provide all necessary pumping equipment; piping connections between the piping and the nearest available source of test water; pressure gauges; and other equipment, materials, and facilities necessary for the tests.

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with new and acceptable materials, and the affected portion of the piping shall be retested by and at the expense of Contractor.

All joints shall be watertight and free from visible leaks. Any visible leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3-22. CLEANING. The interior of all pipe and fittings shall be kept clean of any foreign matter until the work has been accepted.

End of Section

Section 15065

MISCELLANEOUS STEEL PIPE, TUBING, AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of miscellaneous steel pipe, tubing and accessories that for pipe diameters less than 24 inches. Pipe and tubing shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

Steel pipe for potable and non-potable water conveyance are covered in the Steel Pipe section.

1-2. GENERAL.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with Section 01300 – Submittals. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

Name of Manufacturer
Type and model
Construction materials, thickness, and finishes
Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with the Section 01614 – Handling and Storage. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

1-4.01. Coated Pipe. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide, padded skids. Plastic coated pipe shall be covered or otherwise protected from exposure to sunlight.

PART 2 - PRODUCTS

2-1. GALVANIZED STEEL PIPE. Not used.
Galvanized steel pipe materials and service shall be as specified herein.

2-1.01. Material Classification CSG-1. Not used.

2-1.02. Material Classification CSG-2.

CSG-2 – Standard Weight Galvanized Steel with Threaded Fittings Grease piping – pumping units. Sump pump discharge piping in interior locations except where buried. Filtrate piping. Drain piping from equipment.	Pipe Fittings	ASTM A53, Type E, standard weight, Grade A or B; or ASTM A106, of equivalent thickness, galvanized. Malleable iron threaded, galvanized. Fittings shall conform to ANSI/ASME B16.3, Class 150, or Fed Spec WW-P-521, Type II.

2-1.03. Material Classification CSG-3.

CSG-3 – Standard Weight Galvanized Steel with Flanged Fittings. Sump pump discharge piping in interior locations except where buried.	Pipe Fittings	ASTM A53, Type E, standard weight, Grade A or B; or ASTM A106, of equivalent thickness, galvanized. Cast iron flanged, galvanized. Fittings shall conform to ANSI/ASME B16.1, Class 125.

2-1.02. Accessory Materials. Accessory materials for galvanized steel pipe shall be as indicated in the Steel Pipe section of the specification.

2-2. STEEL PIPE. Steel pipe materials and service shall be as specified herein.

2-2.01. Material Classification CS-1. Not used.

2-2.02. Material Classification CS-2. Not used.

2-2.03. Material Classification CS-3.

CS-3 – Standard Weight Steel with Buttwelded Fittings. Natural or LP gas piping, buried or interior locations. Steam and condensate piping. Sodium hydroxide solution piping, interior locations or outdoors above grade. Sodium hydroxide solution piping, interior locations or outdoors above grade. Compressed air supply piping up to 250 psig Fuel oil or diesel fuel piping in interior locations or outdoors above grade. Heating water system piping. Chilled water system piping. Methanol piping. 2-1/2 inch and larger.	Pipe	ASTM A53, Type S, standard weight Grade B; or ASTM A106, of equivalent thickness. Bevel ends.
	Fittings	Buttwelded. Fitting shall conform to ANSI/ASME B16.9, standard weight.

2-2.04. Material Classification CS-4. Not used.

2-2.05. Material Classification CS-5. Not used.

2-2.06. Material Classification CS-6. Not used.

2-2.07. Material Classification CS-7. Not used.

2-2.08. Material Classification CS-8. Not used.

2-2.09. Material Classification CS-9. Not used.

2-2.10. Material Classification CS-10. Not used.

2-2.11. Material Classification CS-11. Not used.

2-2.12. Material Classification CS-12. Not used.

2-2.13. Material Classification CS-13. Not used.

2-2.14. Material Classification CS-14. Not used.

2-2.15. Accessory Materials. Accessory materials for the miscellaneous steel pipe and tubing systems shall be as indicated.

Nipples	ASTM A733, seamless, extra strong (Schedule 80); "close" nipples will be permitted only by special authorization in each case.
Unions (Malleable Iron)	Fed Spec WW-U-53l, Class 2; Type B (galvanized) for galvanized pipe or Type A (black) for ungalvanized pipe.
Flanges	
Standard Weight Pipe	ANSI/ASME B16.5, Class 150, flat faced when connected to flat faced flanges; otherwise, raised face.
Extra Strong Pipe	
Other services	ANSI/ASME B16.5, Class 300, raised face.
Flange Bolts and Nuts	ASTM A193, Grade B7 with ASTM A194 Grade 2H nuts. Length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut.
Flange Gaskets	
For Water Service	ASTM D1330, Grade I, red rubber, ring type, 1/8 inch thick.
For Chemical Service	Suitable for chemical.
For Other Services	
Flat Faced Flanges	Non-asbestos filler with neoprene or nitrile binder; dimensions to suit flange contact face; 1/16 inch minimum thickness for plain finished surfaces, 3/32 inch minimum thickness for serrated surfaces.
Raised Face Flanges	Continuous stainless steel ribbon wound into a spiral with non-asbestos filler between adjacent coils with a carbon steel gauge ring. Compressed gasket thickness shall be 0.095 inch ±0.005 inch.

Grooved Couplings

Rigid	AWWA C606; Gustin-Bacon "No. 120 Rigid" or Victaulic "07 Zero-Flex".
Standard	AWWA C606; Gustin-Bacon "No. 100 Standard" or Victaulic "Style 77".

Expansion Joints

Heating water, chilled water, and other services not specified.	Flexonics "Model H Expansion Compensators" for 3 inch or smaller; Flexonics "Mid-Corr, Series MCB" with flanged ends and stainless steel bellows for 4 inch or larger. Expansion joints shall be suitable for working pressures up to 150 psig.

2-1.03. Coatings. Standard weight steel pipe in buried locations shall have exterior surfaces protected with a shop applied plastic coating.

Shop applied coatings shall be as follows:

External Coatings

Plastic	Chevron Chemical Co. "Plexco Plexguard Coating" or Encoat/Lukens "Encoat Extruded Coating". The products of other manufacturers will not be acceptable.
Tape Wrap	ANSI/AWWA C209, except single ply tape thickness shall not be less than 30 mils; Protecto Wrap "200" or Tapecoat "CT".

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Section 15020 – Miscellaneous Piping and Accessories Installation.

End of Section

Section 15067

MISCELLANEOUS PLASTIC PIPE, TUBING, AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of miscellaneous plastic pipe, tubing, and accessories. Pipe and tubing shall be furnished complete with all fittings, flanges, unions, jointing materials and other necessary appurtenances.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with Section 01300 – Submittals. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

Name of Manufacturer
Type and model
Construction materials, thickness, and finishes
Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

Pipe, tubing, and fittings shall be stored between 40°F and 90°F.

PART 2 - PRODUCTS

2-1. FRP PIPE. Not used.

2-2. PVC PIPE MATERIALS. PVC pipe materials and services shall be as specified herein.

2-2.01. Material Classification PVC-1.

PVC-1 – Schedule 40 PVC Pipe with Solvent Welded Joints. Equipment drains. Irrigation system supply mains. Lateral piping.	Pipe Fittings	ASTM D1785, Cell Classification 12454, bearing NSF seal, Schedule 40. ASTM D2466, Cell Classification 12454, bearing NSF seal.

2-2.02. Material Classification PVC-2. Not used.

PVC-2 – Schedule 80 PVC Pipe with Solvent Welded Joints. Aluminum sulfate (alum) solution piping Chlorine feeder and residual analyzer overflow Chlorine and sulfur dioxide solution piping. Corrosion inhibitor piping. Ferric chloride solution piping. Ferric sulfate solution piping. Ferrous chloride solution piping. Ferrous sulfate solution piping. Hydrochloric acid piping. Hydrofluosilicic acid (fluoride) solution piping. Polyaluminum chloride piping Polyphosphate solution piping. Potassium permanganate solution piping. Sample lines. Sleeves for copper tubing. Sump pump discharge in buried locations (water). Zinc orthophosphate solution piping.	Pipe Fittings	ASTM D1785, Cell Classification 12454, bearing NSF seal, Schedule 80. ASTM D2467, Cell Classification 12454, bearing NSF seal. Flanges or unions shall be provided where needed to facilitate disassembly of equipment or valves. Flanges or unions shall be joined to the pipe by a solvent weld. When acceptable to Engineer, threaded joints may be used instead of solvent welded joints in exposed interior locations for the purpose of facilitating assembly. The use of threaded joints in this system shall be held to a minimum.

2-2.03. Material Classification PVC-3. Not used.

2-2.04. Material Classification PVC-4. Not used.

2-2.05. Material Classification PVC-5. Not used.

2-2.06. Material Classification PVC-6. Not used.

2-2.07. Material Classification PVC-7. Not used.

2-2.08. Material Classification PVC-8. Not used.

2-2.09. Accessory Materials. Accessory materials for the PVC Pipe systems shall be as indicated.

Flanges	Diameter and drilling shall conform to ANSI/ASME B16.5, Class 150. Schedule 80 for DWV systems.
Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut. Stainless steel for DWV and chemical feed systems, galvanized steel for all other systems.
Flat Washers	ANSI B18.22.1, plain. Same material as bolts and nuts.
Flange Gaskets	Full face, 1/8 inch thick, chemical-resistant elastomeric material suitable for the specified service.
Expansion Joints	Edlon "Thermo-molded TFE" or Resistoflex "Style R6905" molded expansion joint.

2-3. CPVC PIPE. Not used.

2-4. PE PIPE. Not used.

2-5. POLYPROPYLENE PIPE. Not used.

2-6. PVDF PIPE. Not used.

2-7. REINFORCED PLASTIC TUBING. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Section 15020 – Miscellaneous Piping and Accessories Installation.

End of Section

Section 15069

CAST IRON SOIL PIPE AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of cast iron soil pipe and accessories for the service conditions as specified herein. Cast iron soil pipe shall be furnished complete with all fittings and other accessories .

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with the Submittals section. Items requiring submittals shall include, but shall not be limited to, the following:

Pipe, Gaskets, and Couplings.
Name of Manufacturer.
Type and Model.
Construction materials, thickness, and finishes.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and Storage shall be in accordance with Section 01614 – Handling and Storage section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 - PRODUCTS

2-1. MATERIALS.

2-1.01. Material Classification CI-1. Not Used.

CI-1 – Bell and Spigot Building sanitary drain, waste, and vent piping, all locations. Building storm drain piping, all locations. Clear water waste piping, all locations	Pipe and Fittings Jointing Material	ASTM A74 Rubber gaskets, ASTM C564.

2-1.02. Material Classification CI-2. Not Used.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Section 15020 – Miscellaneous Piping and Accessories Installation section.

End of Section

Section 15070

COPPER TUBING AND ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of copper tubing and accessories. Copper tubing shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with Section 01300 – Submittals. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

Name of Manufacturer
Type and model
Construction materials, thickness, and finishes
Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 - PRODUCTS

2-1. MATERIALS. Copper tubing materials and service shall be as specified herein.

2-1.01. Material Classification CU-1.

CU-1 – Water Tubing with Flared Fittings Buried water supply, 2 inch and smaller. Differential pressure lines from flow elements to transmitters. All instrument tubing not otherwise specified.	Tubing Fittings	Soft annealed copper tubing, ASTM B88, Type K. Flared, material to match tubing. Fittings shall conform to ANSI/ASME B16.26.

2-1.02. Material Classification CU-2. Not used.

2-1.03. Material Classification CU-3.

CU-3 – Water Tubing with Solder and Brazed Joints Potable, non-potable, and plant effluent water supply, 3 inch and smaller. Differential pressure lines for flow transmitters. Compressed air, in-plant and exposed.	Tubing Fittings Flanges	Hard drawn copper tubing, ASTM B88, Type L. Solder joint (smaller than 2 inch), Brazed joint (2 inch and larger), material to match tubing. Fittings shall conform to ANSI B16.18, or ANSI/ASME B16.22. Where required for connection to equipment, valves, and accessories, ANSI B16.24, class 150, cast bronze, brazed joint.

2-1.04. Material Classification CU-4. Not used.

2-1.05. Material Classification CU-5. Not used.

2-1.06. Material Classification CU-6.

CU-6 – Instrument Tubing with Compression Fittings Panel mounted compressed air piping, 3/4 inch and smaller. Instrument air piping 3/4 inch and smaller.	Tubing Fittings	Soft annealed copper tubing, ASTM B280. Dimensions shall be in accordance with ASTM B280. Compression type, brass, Crawford "Swagelok" or Parker Hannifin "CPI".

2-1.07. Material Classification CU-7. Not used.

2-1.08. Material Classification CU-8. Not used.

2-1.09. Accessory Materials. Accessory materials for the copper tubing systems shall be as indicated.

Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch [3 to 10 mm] beyond outer face of the nut.
Flange Gaskets	ASTM D1330, Grade I, red rubber, ring type, 1/8 inch [3 mm] thick.
Expansion Joints	Tempflex "Model HB Expansion Compensators" with copper tube ends.
Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, poly-propylene lined, zinc plated; Perfection Corp. "Clearflow Fittings".
Flanged	Epco "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Section 15020 – Miscellaneous Piping and Accessories Installation.

End of Section

Section 15091

MISCELLANEOUS BALL VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of manually operated or remote activated two position (open-close) ball valves as specified herein.

Miscellaneous ball valves shall be provided where AWWA type ball valves are not required.

Piping, pipe supports, insulation, and accessories that are not an integral part of the valves or are not specified herein are covered in other sections.

1-2. GENERAL.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If the requirements in this section are different from those in the General Equipment Stipulations, the requirements in the section shall take precedence.

1-2.02. Permanent Number Plates. All miscellaneous ball valves, except buried or submerged valves, that have been assigned a number on the drawings, shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be acceptable to Engineer. Numerals shall be at least 1 inch high and shall be black baked enamel on anodized aluminum plate.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with Section 01300 -- Submittals. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft. Submittal drawings shall clearly indicate the country of origin of all cast gray iron and ductile iron valve components.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

PART 2 - PRODUCTS

2-1. CONSTRUCTION. Ball valves shown on the drawing, but not specified herein, shall be selected to match piping material they are installed in.

2-1.01. Valves Type VB-1.

VB-1 Instrument air, heating water, chilled water, and condenser water systems with copper pipe, ball valves indicated on the plumbing drawings for water service in metallic piping systems. 2 inch and smaller	Rating	500 psi nonshock cold WOG MSS SP-110
	Code	In-line, two piece, end entry, full port
	Type	ASTM B584--C84400 bronze
	Body/Bonnet	
	Trim	Reinforced Teflon
	Seat	Brass, or chrome plated brass
	Ball	Brass or bronze
	Stem	Reinforced Teflon
	Thrust Washer	Teflon or Viton
	Stem Seal	Threaded End
	End Connection	-20 to 400°F
	Temp. Limitations	Lever
	Valve Operator	Conbraco Industries "Apollo 77-100 Series"; Powell "Fig 4210T"
	Manufacturers	

2-1.02. Valves Type VB-2. Not used.

2-1.03. Valves Type VB-3. Not used.

2-1.04. Valves Type VB-4. Not used.

2-1.05. Valves Type VB-5. Not used.

2-1.06. Valves Type VB-6. Not used.

2-1.07. Valves Type VB-7. Not used.

2-1.08. Valves Type VB-8. Not used.

2-1.09. Valves Type VB-9. Not used.

2-1.10. Valves Type VB-10.

VB-10 Service as specified in Section 15067 – Miscellaneous Plastic Pipe, Tubing, and Accessories 4 inch and smaller Socket	Rating	150 psig nonshock cold WOG
	Type	In-line, true union, full port (Schedule 80)
	Body/Bonnet	PVC or CPVC to match piping system
	Trim	Teflon
	Seat	PVC or CPVC to match piping system
	Ball	PVC or CPVC to match piping system
	Stem	Teflon
	Thrust Washer	Viton O-ring
	Stem Seal	Viton O-rings
	Body Seals	
	End Connection	Socket
	Temp. Limitations	0 to 140°F Lever
	Valve Operator	Hayward Plastic Products "True Union Ball Valve"; Nibco "Chemtrol TU Series Tru-Bloc Ball Valve"; Spears Manufacturing Co "True Union 2000 Standard Series 3600 Ball Valve"
	Manufacturers	

2-1.11. Valves Type VB-11. Not used.

2-1.12. Valves Type VB-12. Not used.

2-1.13. Valves Type VB-13. Not used.

2-1.14. Valves Type VB-14. Not used.

2-1.15. Valves Type VB-15. Not used.

2-1.16. Valves Type VB-16. Not used.

2-1.17. Valves Type VB-17. Not used.

2-1.18. Length Tolerance. Unless otherwise specified, the actual length of valves shall be within plus or minus 1/16 inch of the specified or theoretical length.

2-1.19. Shop Coatings. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop coated for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating.

Coating Materials	
Asphalt Varnish	Fed Spec TT-C-494.
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy Enamel (for liquid service; NSF certified systems)	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", or Tnemec "Series N140 Pota-Pox Plus".
Rust-Preventive Compound	As recommended by the manufacturer.

Surfaces To Be Coated	
Unfinished Surfaces	
Interior Surfaces	
Liquid Service	Epoxy enamel (NSF certified).
Exterior Surfaces of Valves To Be Buried, Submerged, or Installed in Manholes or Valve Vaults	Asphalt varnish or coal tar epoxy.
Exterior Surfaces of all other valves	Universal primer.

2-2. VALVE ACTUATORS. Ball valve, except those which are equipped with power actuators or are designed for automatic operation, shall be provided with manual actuators. Unless otherwise specified or indicated on the drawings, each manual actuator shall be equipped with a lever operator. Ball valves with center lines more than 7'-6" above the floor shall be provided with chain levers.

Valves indicated to be electric motor operated on the drawings shall have reversible electric motor operators designed for 120 volt ac, single phase operation. Actuators shall include integral thermal overload protection and a declutchable manual override. Actuators shall be equipped with adjustable motor

operation limit switches and two additional adjustable single-pole, double-throw limit switches for auxiliary open and closed indication. An internal heater and thermostat shall be provided in each actuator housing to prevent condensation. Actuators in Class I, Division 1 and Division 2, Group D hazardous areas indicated on the drawings shall have NEMA Type 7 housings. Actuators in other areas shall have NEMA Type 4X housings.

2-3. ACCESSORIES. If the drawings indicate the need for extension stems, stem guides; position indicator; floor boxes; valve boxes; or operating stands, refer to Section 15180 – Valve and Gate Actuator.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section shall be installed in accordance with Section 15010 – Valve Installation.

End of Section

Section 15093

CHECK VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of check valves as specified herein.

Piping, pipe supports, insulation, and accessories that are not an integral part of the valves or are not specified herein are covered in other sections.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Temporary Number Plates. Each check valve with an identifying number listed in the Check Valve Schedule, shall be tagged or marked in the factory with the identifying number.

1-2.03. Permanent Number Plates. All check valves, except buried or submerged valves, that have been assigned a number on the drawings or in the Check Valve Schedule, shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be acceptable to Engineer. Numerals shall be at least 1 inch high and shall be black baked enamel on anodized aluminum plate.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with Section 01300 – Submittals. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft. Submittal drawings shall clearly indicate the country of origin of all cast gray iron and ductile iron valve components.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

PART 2 - PRODUCTS

2-1. CONSTRUCTION.

2-1.01. Valves VC-1.

VC-1	Type	Poppet
	Body	Stainless steel
Air or	Trim	
vacuum	Poppet	Stainless steel
service	O-ring	Viton
	Spring	Stainless steel
1-1/2 inch	End Connection	Threaded
or smaller	Temp. Limitations	-20 to 375°F
pipe	Manufacturers	Circle Seal "Series 200" or Swagelok "Series C"

2-1.02. Valves VC-2. Not used.

2-1.03. Valves VC-3. Not used.

2-1.04. Valves VC-4. Not used.

2-1.05. Valves VC-5. Not used.

2-1.06. Valves VC-6. Not used.

2-1.07. Valves VC-7. Not used.

2-1.08. Valves VC-8. Not used.

2-1.09. Valves VC-9. Not used.

2-1.10. Valves VC-10. Not used.

2-1.11. Valves VC-11. Not used.

2-1.12. Valves VC-12. Not used.

2-1.13. Valves VC-13.

VC-13 Service as specified in Section 15067 – Miscellaneous Plastic Pipe, Tubing, and Accessories Socket ends 3 inch and smaller PVC or CPVC pipe	Rating Type Body Trim Ball Seat Seals End Connection Temp. Limitations Manufacturers	150 psig nonshock Ball check, true union PVC or CPVC, material shall match pipe material PVC or CPVC, material shall match pipe material Viton or EPDM Viton or EPDM Socket 0 to 140°F Hayward Plastics Products "Ball Check Valve", Nibco "Chemtrol True Union Ball Check Valve", Sears Manufacturing Co. "True Union 2000 Industrial Series 4500 Ball Check Valves"

2-1.14. Valves VC-14. Not used.

2-1.15. Valves VC-15. Not used.

2-1.16. Valves VC-16. Not used.

2-1.17. Valves VC-17. Not used.

2-1.18. Valves VC-18. Not used.

2-1.19. Valves VC-19. Not used.

2-1.20. Shop Coatings. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop coated for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating.

Coating Materials

Asphalt Varnish	Fed Spec TT-C-494.
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Epoxy Enamel (for liquid service)	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard°891", or Tnemec "Series N140 Pota-Pox Plus".
Rust-Preventive Compound	As recommended by the manufacturer.

Surfaces To Be Coated

Unfinished Surfaces	
Interior Surfaces	
Liquid Service	Epoxy enamel.
Exterior Surfaces of Valves To Be Buried, Submerged, or Installed in Manholes or Valve Vaults	Asphalt varnish or coal tar epoxy.
Exterior Surfaces of All Other Valves	Universal primer.
Polished or Machined Surfaces	Rust-preventive compound.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with Section 15010 – Valve Installation.

End of Section

Section 15101

AWWA BUTTERFLY VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing AWWA butterfly valves for cold water service as indicated in the AWWA Butterfly Valve Schedule.

AWWA butterfly valves shall be furnished complete with actuators and accessories as specified herein, as indicated in the schedule, and as specified in Section 15180 – Valve and Gate Actuators.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all butterfly valves and manual actuators shall conform to the applicable requirements of ANSI/AWWA C504.

1-2.03. Marking. Supplementing the requirements of Section 6.1 of the governing standard, the country of origin of all castings and an identifying serial number shall be stamped on a corrosion-resistant plate attached to the valve body.

1-2.04. Temporary Number Plates. Each butterfly valve shall be tagged or marked in the factory with the identifying number listed in the AWWA Butterfly Valve Schedule.

1-2.05. Permanent Number Plates. All AWWA butterfly valves, except buried or submerged valves, that have been assigned a number on the drawings or in the AWWA Butterfly Valve Schedule, shall be provided with a permanent number plate. The location of number plates and the method of fastening shall be

acceptable to Engineer. Numerals shall be at least 1 inch high and shall be black baked enamel on anodized aluminum plate.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with Section 01300 – Submittals. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft. Submittal drawings shall clearly indicate the country of origin of all cast gray iron and ductile iron valve components.

Drawings shall include separate wiring diagrams for each electrically operated or controlled valve and the electrical control equipment. Each drawing shall be identified with the valve number or name as specified in this section.

Certified copies of test results as required by Section 5 of ANSI/AWWA C504, with an affidavit of compliance as indicated in Section 6.3 of C504, shall be submitted to Engineer before the valves are shipped.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Butterfly valves shall be limited to the manufacturers listed below. Sizes and styles for the manufacturers shall be as indicated, without exception:

Manufacturer	Acceptable Sizes and Styles
DeZurik	24-inch
Pratt (Mueller)	24-inch
Milliken	24-inch

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of butterfly valves shall conform to the requirements of ANSI/AWWA C504.

Acceptable shop coatings are listed in the following table.

Epoxy	
For Liquid Service other than in potable water facilities	Ameron "Amercoat 385 Epoxy", Carboline "Carboguard 890", or Tnemec "Series N69 Hi-Build Epoxoline II".
For Raw or Treated Water Service in potable water facilities (NSF certified)	Ameron "Amercoat 400 High Solids Epoxy", Carboline "Carboguard 891", or Tnemec "Series N140 Pota-Pox Plus".
Rust-Preventive Compound	As recommended by manufacturer.

2-3. VALVE CONSTRUCTION.

2-3.01. Valve Bodies. Valves shall be short-body type unless otherwise specified in the AWWA Butterfly Valve Schedule. The use of a stop or lug cast integrally with or mechanically secured to the body for the purpose of limiting disc travel by means of direct contact or interference with the valve disc (in either the open or closed position) will not be acceptable.

2-3.02. Flanges. Flanges shall be finished to true plane surfaces within a tolerance limit of 0.005 inch. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot (0.017 percent) of flange diameter.

2-3.03. Mechanical Joint Ends. Mechanical joint ends shall be either mechanical joint or push-on ends conforming to ANSI/AWWA C111/A21.11.

2-3.04. Valve Shafts. Valve shafts shall be fabricated of AISI Type 304 or 316 stainless steel. The use of shafts having a hexagonal cross section will not be acceptable. The connection between shaft and disc shall be in accordance with ANSI/AWWA C504.

The connection between the shaft and the disc shall be mechanically secured by means of solid, smooth sided, stainless steel or monel taper pins or dowel pins. Each taper pin or dowel pin shall extend through or shall wedge against the side of the shaft and shall be mechanically secured in place. The use of set screws, knurled or fluted dowel pins, expansion pins, roll pins, tension pins, spring pins, or other devices instead of the pins specified herein will not be acceptable.

2-3.05. Valve Seats. Acceptable seating surfaces mating with rubber are AISI Type 304 or 316 stainless steel, monel, or plasma-applied nickel-chrome overlay for all valves; bronze for 20 inch and smaller valves; and alloy cast iron for 20 inch and smaller manually operated valves.

Seats shall be located on the valve body. Valve seat configurations which rely on the mating pipe flange to hold the seat in position in the valve body will not be acceptable.

2-3.06. Shaft Seals. Shaft seals shall be of the chevron type.

2-3.07. Thrust Bearings. Each valve shall be provided with one or more thrust bearings in accordance with the governing standard. Thrust bearings which are directly exposed to line liquid and which consist of a metal bearing surface in rubbing contact with an opposing metal bearing surface will not be acceptable.

2-4. VALVE ACTUATORS. Requirements for valve actuators shall be as specified herein, as indicated in the AWWA Butterfly Valve Schedule, and as specified in 15180 – Valve and Gate Actuators. Valve actuators shall be electric, types.

All 8 inch and larger valves shall have geared actuators.

If valves with an AWWA class designation higher than specified are furnished, actuator torque capabilities shall be increased accordingly and be acceptable to Engineer.

2-4.01. Actuator Sizing. The valve manufacturer shall size the actuator in accordance with AWWA C504, the operating conditions and requirements indicated in the AWWA Butterfly Valve Schedule, and the valve manufacturer's requirements.

Unless otherwise indicated or specified, actuator torque requirements shall be based on a maximum differential pressure across the valve equal to the valve class and a maximum velocity through the valve of 16 feet per second.

Valves with operating stands shall have actuator torques increased by 25 percent. Actuator torques determined by the above requirements shall be increased by any safety factors required by AWWA C504, paragraphs 4.3.8.3 and 4.3.8.6 or indicated or specified herein.

2-5. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except finished surfaces, bearing surfaces, and stainless steel components, of valves and accessories shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting. Epoxy enamel coatings shall be ANSI/NSF 61 certified.

Surfaces shall be painted as follows:

Unfinished Surfaces	
Interior Surfaces	Epoxy enamel.
Exterior Surfaces of Valves To Be Submerged, or Installed in Manholes or Valve Vaults	Epoxy enamel.
Exterior Surfaces of All Other Valves	Universal primer.
Polished or Machined Surfaces	
Flange Faces	Rust-preventive compound.
Other Surfaces	Epoxy enamel.

Interior coatings shall comply with AWWA C550 and shall be free of holidays. The total dry film thickness of shop-applied coatings shall be not less than:

Type of Coating	Minimum Dry Film Thickness
Epoxy Enamel	10 mils
Universal Primer	3 mils

2-6. ACCESSORIES. Requirements for extension stems and stem guides, position indicators, floor boxes, operating stands, torque tubes, valve boxes, and extension bonnets shall be as indicated in the AWWA Butterfly Valve Schedule 15101-S01 and as specified in Section 15180 – Valve and Gate Actuators.

PART 3 - EXECUTION

3-1. INSTALLATION. Valves will be installed in accordance with Section 15010 – Valve Installation.

3-1.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the job site as often as necessary until any problems are corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the

equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping and appurtenances; and has been operated under full load conditions and that it has operated satisfactorily.

All costs for these services shall be included in the contract price.

End of Section

1.010	1.020	1.030	1.040	1.060	1.070	1.080	1.090	3.001	3.010	3.020	3.040	4.030	4.040	4.050	4.080	8.010	8.020	8.040	8.041	8.05	8.060
Tag Number	Size	Type of Service(1)	Type of Installation(2)	AWWA Class(3)	Maximum Non-Shock Shutoff Pressure	Maximum Differential Pressure	Maximum Velocity	Type of Electric Actuator(10)	Type of Housing(7)	Operating Time	Actuator Provides 120 VAC For remote controls	Power for Electric Actuator	Number of Limit Switch Assemblies (6)	Position Transmitter	Control Devices(9)	Extensions Stems	Position Indicator for Buried Valve Actuators	Cast Iron Operating Stands	Fabricated Steel Operating Stands	Torque Tubes	Extension bonnet
	(in)				(psi)	(psi)	(ft/s)			(s)		V/PH									
UV-VBF-1	24	Filter Effluent O-C	IP	150BF				SE	WP			120/1	ELSCH	No	C						
UV-VBF-2	24	Filter Effluent O-C	IP	150BF				SE	WP			120/1	ELSCH	No	C						
UV-VBF-3	24	Filter Effluent O-C	IP	150BF				SE	WP			120/1	ELSCH	No	C						
UV-VBF-4	24	Filter Effluent O-C	IP	150BF				SE	WP			120/1	ELSCH	No	C						

Notes:

(1) Actuators designated "O-C" are for "Open-Close" service. Actuators designated "M" are for "modulating" (throttling) service.

(2) Abbreviations for installation types are as follows:

B4	Buried, depth of 4 feet or less
B20	Buried, depth greater than 4 feet but 20 feet or less
Bxx	Buried, depth greater than 20 feet, actual depth of xx feet
SV20	Submerged or vaulted, depth 20 feet or less
SVxx	Submerged or vaulted, depth greater than 20 feet, actual depth of xx feet
IP	In plant

(3) Suffix letters define valve ends as follows:

F	Flanged
W	Wafer
MJ	Mechanical joint
S	Single Flange

(4) Abbreviations for actuator types are as follows:

WN	Wrench Nut
LVR	Lever
CW	ChainWheel
HW	HandWheel

(5) If a value is indicated, the leakage test shall be performed using this pressure value rather than the pressure indicated by the AWWA class.

(6) Abbreviations for limit switches on manual and cylinder operated valves.

EOT	End of travel (open - close)
PSS	Pump start - stop (two intermediate positions)
ELSCH	See electrical schematics

(7) Abbreviations for electronic or electric actuator housing.

WP	Weatherproof
SUB	Submersible [xx = depth of submergence] (SUBxx)
EXP	Explosion proof

(8) Cylinder actuators shall have torque safety factors applied in accordance with AWWA C504.

(9) Abbreviations for control devices are as indicated.

Table 1: Control Devices				
Abbreviations	Open-Close Push Button	Open-Stop- Close Push Button	Local-Off-Remote	Red and Green Indicator Lights
A	Required		Required	Required
B	Required		Required	
C		Required	Required	Required
D		Required	Required	
E		Required		
F	Required			
G	Required			Required
H		Required		Required

(10) Abbreviations for electric actuator types are as follows:

SE Standard Electric
PE Programmable Electric
NE Networked Electric

Valve actuator torque requirements shall be determined by the valve manufacturer as specified herein. If valves with an AWWA class designation higher than listed above are furnished, actuator torque capabilities shall be increased accordingly, and to the satisfaction of ENGINEER.

END OF SCHEDULE

Section 15140

PIPE SUPPORTS

Data Sheet

Para-graph	Description	Data	Units
1-1	**General**		
	General Equipment Requirements required.	☑ Yes ☐ No	
2-1	**Materials**		
	Types of pipe.	☑ Cast or Ductile iron ☐ Glass lined cast or ductile iron ☐ Stainless steel ☐ Hot-dip galvanized steel ☐ Steel (hot water) ☑ Steel (other) ☐ Copper (hot water) ☑ Copper (other) ☑ PVC/CPVC Schedule 80 (chemical service) ☐ PVC/CPVC Schedule 80 (other) ☐ PVC Schedule 40	
	Types of pipe.	☐ FRP (pressure) ☐ FRP (LP) ☐ Tempered Glass ☐ High silicon iron ☐ Polypropylene DWV ☐ PVDF DWV ☐ Cast iron soil pipe ☐ None ☐ Other	
	When "Other" is selected, indicate the pipe material.		

3-2	Types of pipe supports.	☑ See Table 1 ☐ Other	
	When "Other" is selected, alternative types.		
2-1	Stainless steel pipe supports required.	☐ Yes ☒ No	
	When "Yes" is selected, required locations.		
	Hot-dip galvanized pipe supports required.	☐ Yes ☒ No	
	When "Yes" is selected, required locations.		
3-3	**Construction**		
	Spacings for pipe supports.	☑ Table 2 ☑ Table 3 ☐ Table 4	
3-3.03	Spacing adjusted in accordance with Table 5.	☐ Yes ☒ No	
	When "Yes" is selected, indicate service and specify gravity.		
	Expansion joints required.	☐ Yes ☐ No	
	Indicate figures attached.	☑ Figure 1-15140A ☑ Figure 1-15140B	

Section 15140

PIPE SUPPORTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of pipe hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories. This section also covers the spacing of expansion joints in piping systems. Expansion joint products and materials are covered in the respective piping sections.

Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by Engineer.

1-1.01. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet."

1-2. GENERAL. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements specified herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.

All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.

Pipe supports and expansion joints are not required in buried piping, but concrete blocking or other suitable anchorage shall be provided as indicated on the drawings or specified in other sections.

Piping support system components shall comply with specified piping code requirements.

1-2.01. Abbreviations. Reference to standards and organizations in this section shall be as indicated by the following designations.

AISI American Iron and Steel Institute

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
MSS	Manufacturers Standardization Society of Valve and Fitting Industry

1-2.02. General Equipment Requirements. The General Equipment Requirements shall apply to all equipment provided under this section.

1-3. SUBMITTALS. Complete data and catalog cuts or drawings covering fabricated pipe supports, fabricated inserts, and stainless steel, galvanized, and copper- and plastic-coated pipe supports shall be submitted in accordance with Section 01300 – Submittals.

Data shall include a listing of the intended use and general location of each item submitted.

PART 2 - PRODUCTS

2-1. MATERIALS. Unless otherwise indicated, all pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69. Materials of construction for fabricated steel supports are covered in Section 05990 – Structural and Miscellaneous Metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

Unless otherwise specified or indicated on the drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.

Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item. Continuously threaded rod is not acceptable for hanger rods over 12 inches in length.

Unless otherwise acceptable to Engineer, the use of supports which rely on stressed thermoplastic components to support the pipe will not be acceptable.

Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.

Stainless steel supports shall be furnished, and shall be AISI Type 304 or 316 stainless steel. Stainless steel supports fabricated by welding shall be AISI Type 304L or 316L.

Hot-dip galvanized supports shall be furnished and shall be in accordance with ASTM A153 and A385.

Pipe support types and application shall comply with Table 1 as required.

PART 3 - EXECUTION

3-1. APPLICATION. Concrete inserts or anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.

Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as specified to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

When expansion joints are required, pipe guides shall be provided adjacent to bellows type expansion joints. Guides will not be required where mechanical couplings are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be provided at locations as recommended by the manufacturer.

Pipe supports for insulated cold piping systems shall be sized for the outside diameter of the insulated pipe, and an insulation protection shield shall be installed between the support and the insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields for piping larger than 2 inches or when needed to prevent crushing of the insulation. Inserts shall be of the same thickness as the adjacent insulation and shall be vapor sealed.

Insulated hot piping systems shall be supported by clevises, clamps, support saddles, or rollers. Pipe clamps shall be attached directly to the pipe. Support saddles and rollers shall be sized for the outside diameter of the insulated pipe, and an insulation protection saddle shall be installed at the support.

When supports for the FRP piping systems are in contact with less than 180 degrees of the pipe surface or when the width of the support is less than one-third the nominal pipe diameter (4 inches minimum), an FRP or steel saddle, shaped to the outside diameter of the pipe, shall be bonded to at least the bottom 120 degrees of the pipe.

3-2. TYPES OF SUPPORTS. The specific products for pipe supports shall be as indicated in Table 1 for the specified type and size of support.

TABLE 1 - TYPES OF SUPPORTS

Description and Service	Type	
	MSS SP 69 (Note 1)	Other
Hangers		
2-1/2 inch and smaller pipe		
For hot and cold insulated piping		
Clevis	1	B-Line "B3100" or Anvil "260".
Other services		
J-style	5	B-Line "B3690", Anvil "67", or Unistrut "J Hanger".
Clevis	1	B-Line "B3104" or Anvil "65".
3 Through 10 inch pipe		
For hot insulated piping		
Double bolt	3	B-Line "B3144" or Anvil "295".

TABLE 1 - TYPES OF SUPPORTS		
Description and Service	Type	
	MSS SP 69 (Note 1)	Other
For cold insulated piping		
Clevis	1	B-Line "B3100" or Anvil "260".
For uninsulated cold piping		
Clamp	4	B-Line "3140" or Anvil "212".
Clevis	1	B-Line "B3100" or Anvil "260".
Other services		
Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe; B-Line "B3102" or Anvil "590" for cast iron pipe.
12 inch pipe		
Clevis or saddle	1	See drawings.
14 inch and larger pipe		
Saddle	--	See drawings.
Concrete Inserts, Steel		
12 inch and smaller pipe	18	Channel 12 ga, galv, 1-5/8 by 1-3/8 inches, min. 8 inches long, anchor lugs on 4 inch centers, at least three lugs, end caps, and filler strip.
14 inch and larger pipe, fabricated insert, except as noted	--	See drawings.

TABLE 1 - TYPES OF SUPPORTS		
Description and Service	Type	
	MSS SP 69 (Note 1)	Other
Beam Clamps, Malleable Iron or Steel, 12 inch and smaller pipe	21	B-Line "3050" and "3055" or Anvil "133" and "134".
	28, 29	Anvil "292".
	30	B-Line "3054" or Anvil "228".
Side Beam Bracket	34	B-Line "B3062" or Anvil "202".
Wall Supports and Frames, Steel, 12 inch and smaller pipe (Note 2)		
Brackets	32	B-Line "B3066" or Anvil "195".
	33	B-Line "B3067" or Anvil "199".
Prefabricated channels	--	12 ga, galv, 1-5/8 inches, with suitable brackets and pipe clamps.
Offset pipe clamp, 1-1/2 inch and smaller pipe	--	Galv, 1-1/4 by 3/16 inch steel, with 3/8 inch bolts.
Offset pipe clamp, 2 to 3-1/2 inch pipe	--	Galv, 1-1/4 by 1/4 inch steel, with 3/8 inch bolts.
Floor Supports, Steel or Cast Iron		
6 inch and smaller pipe	37 (with base)	B-Line "B3090" or Anvil "259".

TABLE 1 - TYPES OF SUPPORTS		
Description and Service	Type	
	MSS SP 69 (Note 1)	Other
8 through 24 inch pipe	38	B-Line "B3093" or Anvil "264".
Pipe Alignment Guides	--	B-Line "B3281" through "B3287" or Anvil "255".
Turnbuckles Steel	13	B-Line "B3202" or Anvil "230".
Hanger Rods, Carbon Steel, Threaded Both Ends, 3/8 inch minimum size	--	B-Line "B3205" or Anvil "140".
Weldless Eye Nut, steel	17	B-Line "B3200" or Anvil "290".
Insulation Protection Saddle	39	B-Line "B3160 Series" or Anvil "160 Series".
Insulation Protection Shield	40	B-Line "B3151" or Anvil "167".

Table 1 Notes:

1. MSS SP-69 supports and hangers are illustrated on Figure 1-15140.

2. Pipe clamps or other devices which rely on the application of a clamping force to the supported pipe in order to maintain the clamp position or location in a prefabricated channel or track will not be acceptable for use with nonmetallic pipe or tubing.

3-3. SUPPORT SPACINGS. Pipe supports and expansion joints shall be spaced in accordance with Tables 2, 3, 4, and 5. The types of pipes to be supported are as required. Table 2 covers spacings for the standard operating conditions specified for each pipe material. Tables 3 and 4 cover PVC and FRP pipe spacings where operating conditions are in excess of the temperature and specific gravity requirements covered in Table 2. Table 5 covers PVC and FRP pipe which carries air or liquids with a specific gravity other than 1.0.

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
		feet	feet	feet	
Cast iron or Ductile iron		15	80	80	Note 6
Cast iron or Ductile iron, glass-lined		12	80	80	Note 6
Steel, for hot water heating					
	1-1/4 inch and smaller	7	30	100	Note 3
	1-1/2 to 4 inch	10	30	100	Note 3
	Over 4 inch	15	30	100	Note 3
Steel, for other services					
	1-1/4 inch and smaller	7	30	100	Note 3
	1-1/2 to 4 inch	10	30	100	Note 3
	Over 4 inch	15	80	80	Note 6
Stainless steel					
	1-1/4 inch and smaller	7	30	100	Note 3
	1-1/2 to 4 inch	10	30	100	Note 3
	Over 4 inch	15	80	80	Note 3

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
		feet	feet	feet	
Copper, for hot water					
	1 inch and smaller	5	20	100	Note 3
	Over 1 inch	7	20	100	Note 3
Copper, for other services					
	1 inch and smaller	5	--	--	Note 7
	Over 1 inch	7	50	100	Note 3
PVC, Schedule 80, for alum solution, caustic soda solution, ferric chloride solution, and hypochlorite solution at a maximum temperature of 100°F.					
	1/8 and 1/4 inch	Continuous Support	20	60	Note 3
	1/2 inch	3-1/2	20	60	Note 3
	3/4 inch	4	20	60	Note 3
	1 and 1-1/4 inch	4-1/2	20	60	Note 3
	1-1/2 and 2 inch	5	20	60	Note 3
	2-1/2 inch	5-1/2	20	60	Note 3
	3 inch	6-1/2	20	60	Note 3

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
		feet	feet	feet	
	4 inch	7	20	60	Note 3
	6 inch	8	20	60	Note 3
	8 inch	9	20	60	Note 3
	10 inch	9-1/2	20	60	Note 3
	12 inch	10	20	60	Note 3
PVC, Schedule 80, for other services at a maximum temperature of 100°F and a maximum specific gravity of 1.0.					
	1/8 and 1/4 inch	Continuous Support	20	60	Note 3
	1/2 inch	4	20	60	Note 3
	3/4 inch	4-1/2	20	60	Note 3
	1 and 1-1/4 inch	5	20	60	Note 3
	1-1/2 and 2 inch	5-1/2	20	60	Note 3
	2-1/2 inch	6	20	60	Note 3
	3 inch	7	20	60	Note 3
	4 inch	7-1/2	20	60	Note 3
	6 inch	8-1/2	20	60	Note 3

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
		feet	feet	feet	
	8 inch	9-1/2	20	60	Note 3
	10 inch	10	20	60	Note 3
	12 inch	11	20	60	Note 3
FRP, for double containment and single wall pressure pipe at a temperature of 150°F.					
	1 inch	3-1/2	60	100	Note 3
	1-1/2 inch	4	60	100	Note 3
	2 inch	5	60	100	Note 3
	3 inch	5-1/2	60	100	Note 3
	4 inch	6	40	100	Note 3
	6 inch	7	40	100	Note 3
	8 inch	8	40	100	Note 3
	10 inch	8-1/2	40	100	Note 3
	12 inch and larger	9	40	100	Note 3
FRP, for low pressure and odor control pipe at a maximum temperature of 150°F and a maximum specific gravity of 1.0.					
	1 inch	4	60	100	Note 3

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
		feet	feet	feet	
	1-1/2 inch	4-1/2	60	100	Note 3
	2 inch	5-1/2	60	100	Note 3
	3 inch	6	60	100	Note 3
	4 inch	6-1/2	40	100	Note 3
	6 inch	7-1/2	40	100	Note 3
	8 inch	8-1/2	40	100	Note 3
	10 inch	9-1/2	40	100	Note 3
	12 inch and larger	10	40	100	Note 3
Tempered glass (Note 4)		8	--	--	Note 7
High silicon iron (Note 5)		15	--	--	Note 7
Polypropylene DWV		6	--	--	Note 7
PVDF DWV		6	--	--	Note 7
Cast iron soil pipe		10	--	--	Notes 7, 8
PVC, Schedule 40, for services at a maximum temperature of 100°F, and a maximum specific gravity of 1.0.					

TABLE 2 - MAXIMUM PIPE SUPPORT SPACINGS AT STANDARD TEMPERATURES AND SERVICES					
Type of Pipe		Pipe Support Max Spacing	Max Run Without Expansion Joint, Loop, or Bend (Note 1)	Expansion Joint Max Spacing (Note 2)	Type of Expansion Joints
		feet	feet	feet	
	1/8 and 1/4 inch	Continuous Support	20	60	Note 3
	1/2 inch	3-1/2	20	60	Note 3
	3/4 and 1 inch	4	20	60	Note 3
	1-1/4 and 1-1/2 inch	4-1/2	20	60	Note 3
	2 inch	5	20	60	Note 3
	2-1/2 inch	5-1/2	20	60	Note 3
	3 inch	6	20	60	Note 3
	4 inch	6-1/2	20	60	Note 3
	6 inch	7-1/2	20	60	Note 3
	8 inch	8	20	60	Note 3
	10 inch	8-1/2	20	60	Note 3
	12 inch	9-1/2	20	60	Note 3

Table 2 Notes:

1. Unless otherwise acceptable to Engineer, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.

2. Unless otherwise acceptable to Engineer, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein.

3. Expansion joint fittings are specified in the respective piping procurement sections.

4. At least two properly padded supports for each pipe section.

5. At least one support for each pipe section.

6. Expansion joints shall be mechanical couplings.

7. No expansion joints are required.

8. Supports for 5 and 10 foot long pipe sections shall be located within 18 inches of each joint. Supports shall be positioned to maintain the piping alignment and to prevent the piping from sagging.

3-3.01. Temperature Adjustments for PVC Pipe. PVC pipe at a temperature above 100°F shall have maximum support spacings in accordance with the following table. For insulated lines, reduce the support spacing to 70 percent of the listed values.

TABLE 3 - MAXIMUM PIPE SUPPORT SPACINGS FOR PVC PIPE AT NON-STANDARD TEMPERATURES
feet

Nominal Size	Schedule 40		Schedule 80	
inches	120°F	140°F	120°F	140°F
1/4	Continuous Support		Continuous Support	
1/2	3	2-1/2	3-1/2	3
3/4	3-1/2	3	4	3
1	3-1/2	3	4-1/2	3-1/2
1-1/4	4	3-1/2	4-1/2	4
1-1/2	4	3-1/2	5	4

TABLE 3 - MAXIMUM PIPE SUPPORT SPACINGS FOR PVC PIPE AT NON-STANDARD TEMPERATURES feet				
Nominal Size	Schedule 40		Schedule 80	
inches	120°F	140°F	120°F	140°F
2	4-1/2	3-1/2	5	4-1/2
2-1/2	4-1/2	4	5-1/2	4-1/2
3	5	4	6	5
4	5-1/2	4-1/2	6-1/2	5-1/2
6	6-1/2	5	8	6-1/2
8	7	5-1/2	8-1.2	7
10	7-1/2	6	9	7-1/2
12	8	6-1/2	10	8-1/2

3-3.02. Temperature Adjustments for FRP Pipe. FRP pipe at a temperature above and below 150°F shall have maximum support spacings in accordance with the following table.

TABLE 4 - MAXIMUM PIPE SUPPORT SPACINGS FOR FRP PIPE AT NON-STANDARD TEMPERATURES feet			
Nominal Size inches	Temperature		
	75°F	175°F	200°F
1	5	3	2
1-1/2	6	3-1/2	2-1/2
2	7	4	3
3	7-1/2	4-1/2	3-1/2

TABLE 4 - MAXIMUM PIPE SUPPORT SPACINGS FOR FRP PIPE AT NON-STANDARD TEMPERATURES feet			
Nominal Size inches	Temperature		
	75°F	175°F	200°F
4	8	5	4
6	10	6	4-1/2
8	11	6-1/2	5
10	12-1/2	7-1/2	5-1/2
12	13	8	6

3-3.03. Specific Gravity Adjustments for PVC and FRP Pipe. PVC and FRP Pipe shall have the maximum spacing indicated in Table 2, 3, and 4 adjusted in accordance with the following table when the specific gravity of the liquid is greater than 1.0. Table 5 shall not apply to PVC pipe containing alum solution, caustic soda solution, ferric chloride solution, and hypochlorite solution, as these services are specifically covered in Table 2.

TABLE 5 - MAXIMUM SUPPORT SPACING CORRECTION FACTORS FOR PVC AND FRP PIPE	
Specific Gravity	Correction Factor
1.0	1.00
1.1	0.98
1.2	0.96
1.4	0.93
1.6	0.90
2.0	0.85
2.5	0.80
Air	1.40

3-4. INSTALLATION.

3-4.01. General. All piping shall be supported in a manner which will prevent undue stress on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas.

Where horizontal piping is arranged with two or more parallel lines, trapeze hangers may be used in lieu of individual hangers. Trapeze assembly shall consist of structure attachments as previously specified with rod size dependent upon total weight supported. Spacing of assemblies shall be determined by the minimum pipe size included in the group supported. Trapeze horizontal assemblies shall be structural angle or channel section of sufficient size to prevent measurable sag between rods. All lines shall be attached to the horizontal with intermediate pipe guides and U-bolts or one-hole clamps. Pre-engineered support equipment may be used when selected and installed in accordance with the manufacturer's recommendations.

No copper pipe shall contact a pipe support or hanger of dissimilar metal. Hangers and supports for copper pipe shall be copper-plated, plastic coated, or copper pipe shall be galvanically isolated using Neoprene strips or other material as approved.

No piping shall be supported from the pipe above.

Horizontal piping hanger support rods shall attach to steel beams with center-loading I-clamps, or welded beam clips. Hanger support rods shall attach to concrete slabs or beams with inserts.

Anchorage shall be provided to resist both lateral and longitudinal seismic forces. Seismic forces shall be calculated assuming the pipes are full.

3-4.02. Inserts. Reference building structural concrete drawings for concrete inserts. When not provided as part of the building concrete structure, provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

Where concrete slabs form finished ceilings, provide inserts flush with the slab surface.

Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. X-ray locate existing reinforcing rods before drilling.

3-4.03. Pipe Hangers and Supports. Hanger rod sizing for copper pipe and plastic pipe shall be same as for steel pipe. Install hangers to provide a minimum 1/2 inch space between finished covering and adjacent work.

A hanger shall be placed with 18 inches of each horizontal elbow, and on both sides of all piping accessories and valves weighing 20 lbs or more.

Hangers shall have 1-1/2 inches minimum vertical adjustment.

Support horizontal cast iron, ductile iron and no-hub piping systems adjacent to each joint.

Support vertical piping at every floor using riser clamps.

Support riser piping independently of connected horizontal piping.

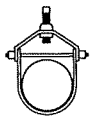
Hanger and hanger components shall be sized specifically for the pipe size it is to be used on.

3-5. PLACEMENT. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as indicated in Tables 2, 3, 4, and 5.

Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

Unless otherwise indicated on the drawings or acceptable to Engineer, piping shall be supported approximately 1-1/2 inches out from the face of walls and at least 3 inches below ceilings.

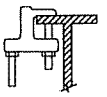
End of Section



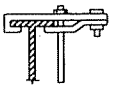
ADJ. STEEL CLEVIS
TYPE-1

ADJ. STEEL
BAND HGR
TYPE-7

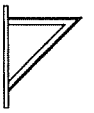
STEEL TURNBUCKLE
TYPE-13



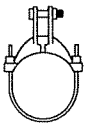
TOP BEAM
C-CLAMP
TYPE-19



TOP I-BEAM CLAMP
TYPE-25

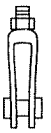


LIGHT WELDED
STEEL BRACKET
TYPE-31

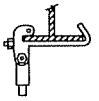


ALLOY STEEL
PIPE CLAMP
TYPE-2

EXTENSION PIPE ON
RISER CLAMP
TYPE-8



STEEL CLEVIS
TYPE-14



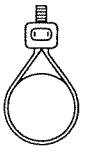
SIDE I-BEAM ON
CHANNEL CLAMP
TYPE-20

CLIP
TYPE-26

MEDIUM WELDED
STEEL BRACKET
TYPE-32

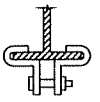
HEAVY WELDED
STEEL BRACKET
TYPE-33

CARBON OR ALLOY
STEEL DOUBLE BOLT
PIPE CLAMP
TYPE-3

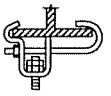


ADJUSTABLE
BAND HGR
TYPE-9

SWIVEL
TURNBUCKLE
TYPE-15

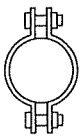


CENTER I-BEAM
TYPE-21



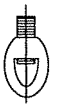
SIDE I-BEAM CLAMP
TYPE-27

SIDE BEAM BRACKET
TYPE-34



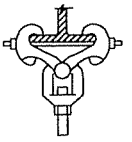
STEEL PIPE CLAMP
TYPE-4

ADJ. SWIVEL RING
BAND TYPE
TYPE-10

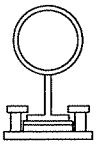


MALLEABLE
IRON SOCKET
TYPE-16

WELDED
ATTATCHMENT
TYPE-22
AS SHOWN OR
INVERTED LESS BOLT



STEEL I-BEAM CLAMP
W/ EYE NUT
TYPE-28



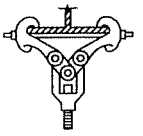
PIPE SLIDE &
SLIDE PLATE
TYPE-35

PIPE HANGER
TYPE-5

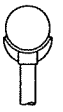
SPLIT PIPE W/WO
TURMBUCKLE ADJ.
TYPE-11

STEEL WELDLESS
EYE NUT
TYPE-17

C-CLAMP
TYPE-23

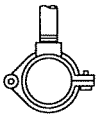


STEEL W.F. CLAMP
W/ EYE NUT
TYPE-29

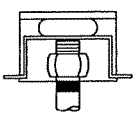


PIPE SADDLE
SUPPORT
TYPE-36

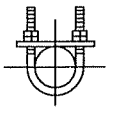
ADJ. SWIVEL PIPE RING
SPLIT RING TYPE OR
SOLID RING TYPE
TYPE-6



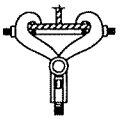
EXTENSION SPLIT
PIPE CLAMP
HINGED OR TWO BOLT
TYPE-12



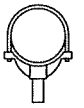
STEEL OR MALLEABLE
CONCRETE INSERT
TYPE-18



U-BOLT
TYPE-24



MALLEABLE BEAM CLAMP
W/EXTENSION PIECE
TYPE-30

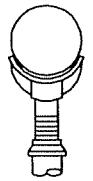


PIPE STANCHION
SADDLE
TYPE-37

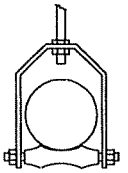
HANGERS AND SUPPORTS

Black & Veatch

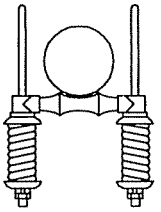
FIG 1-15140(A)



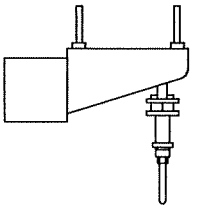
ADJUSTABLE PIPE
SADDLE SUPPORT
TYPE-38



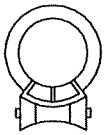
ADJUSTABLE ROLLER
HANGER W/WO SWIVEL
TYPE-43



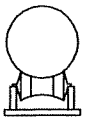
SPRING CUSHION ROLL
TYPE 49



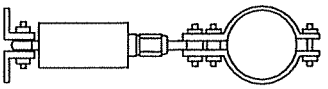
CONSTANT SUPPORT
HORIZONTAL TYPE
TYPE-54



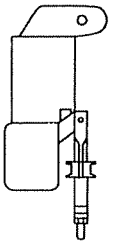
STEEL PIPE COVER
PROTECTION SADDLE
TYPE 39



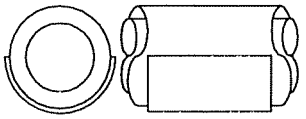
PIPE ROLL
COMPLETE
TYPE 44



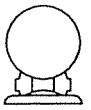
SPRING SWAY BRACE
TYPE 60



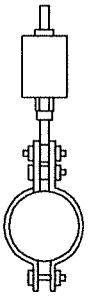
CONSTANT SUPPORT
VERTICAL TYPE
TYPE-65



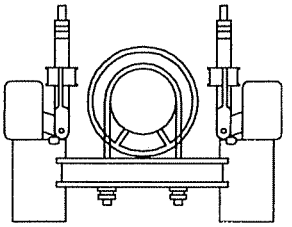
PROTECTION SHIELD
TYPE-41



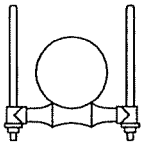
PIPE ROLL & PLATE
TYPE-45



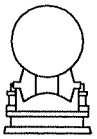
VARIABLE SPRING
HANGER
TYPE-61



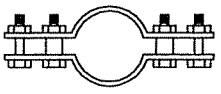
CONSTANT SUPPORT
TRAPEZE TYPE
TYPE-64



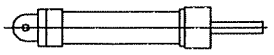
SINGLE PIPE ROLL
TYPE-41



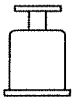
ADJUSTABLE PIPE ROLL & BASE
TYPE-46



CARBON OR ALLOY STEEL
RISER CLAMP
TYPE-42



RESTRAINT CONTROL
DEVICE
TYPE-47



VARIABLE SPRING
BASE SUPPORT
TYPE-62

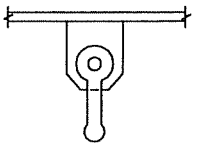
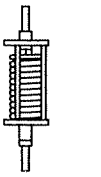
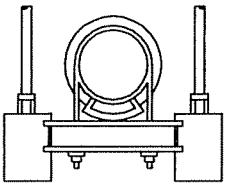


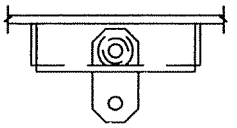
PLATE LUG
TYPE-67



SPRING CUSHION
TYPE-48



VARIABLE SPRING
TRAPEZE HANGER
TYPE-53



HORIZONTAL TRAVELER
TYPE-58

HANGERS AND SUPPORTS

Black & Veatch		*FIG 1-15140(B)*

Section 15180

VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing manual and powered valves and gate actuators and accessories as specified herein.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Actuators shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standards. Except as modified or supplemented herein, all powered actuators shall conform to applicable requirements of ANSI/AWWA C540.

Except as modified or supplemented herein, all manual and cylinder actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.

Except as modified or supplemented herein, all manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

Except as modified or supplemented herein, all manual actuators for sluice and slide gates shall conform to the applicable requirements of ANSI/AWWA C560.

1-2.03. Power Supply. Power supply to electric actuators will be as indicated on the valve or gate schedule.

1-2.04. Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1-2.05. Temporary Number Plates. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with Section 01300 – Submittals. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

The drawings shall include separate wiring diagrams for each electrically operated or controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.

For electric or cylinder actuators, certified copies of reports covering proof-of-design testing of the actuators as set forth in Section 5 of ANSI/AWWA C540, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C540, shall be submitted to Engineer before the actuators are shipped.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.

Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

2-1.02. Valve Actuators. Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the maximum pressure differential across the valve and maximum velocities through the valve where indicated in the respective valve schedules.

Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the drawings or directed by Engineer.

2-1.03. Gate Actuators. Actuators shall be sized to produce the torque or thrust required to operate the gate when subject to the seating and unseating operating heads as indicated in the respective gate schedules.

Both the design head and the operating head shall be measured from the surface of the liquid to the center line of the gate.

2-1.04. Limit Switches. Limit switches shall be provided as indicated on the drawings or in the valve and gate schedules.

Limit switches for programmable and standard electric actuators shall be as indicated in their respective paragraphs.

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of ANSI/AWWA C504 and C540.

2-3. VALVE MANUAL ACTUATORS. Not used.

2-4. GATE MANUAL ACTUATORS. Not used.

2-5. PROGRAMMABLE ELECTRIC ACTUATORS. Not used.

2-6. STANDARD ELECTRIC ACTUATORS.

2-6.01. General. Standard electric actuators as listed in the valve and gate schedules shall be provided by the valve or gate manufacturer.

All standard electric actuators shall be multiturn type and shall be Auma Basic Compact with external gearbox, without exception.

Standard electric actuators produced by other manufacturers are not acceptable.

Each standard electric actuator shall be furnished complete with a motor, gearing, handwheel, limit switches and torque sensors, lubricants, heating elements, wiring, and terminals. Each actuator shall be constructed as a self-contained unit with a cast iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer.

Actuators shall be designed to cycle the valve or gate from the fully open to the fully closed position or the reverse in approximately 60 seconds or as indicated in the valve and gate schedules.

Actuator motors may be mounted horizontally adjacent to or vertically above the reduction gearing. All gearing shall be oil lubricated.

2-6.02. Motors. Motors shall be totally enclosed, high torque design made expressly for valve actuator service, capable of operating the valve under full differential pressure for two complete strokes or one complete cycle of travel without overheating. Motors shall be designed in accordance with NEMA standards and shall operate successfully at any voltage within 10 percent above or below rated voltage. Motor bearings shall be permanently lubricated.

2-6.03. Power Gearing. Power gearing shall consist of hardened steel spur or helical gears and alloy bronze or hardened steel worm gear, all suitably lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter. Steel gears shall be hardened to at least 350 Brinell. Planetary or cycloidal gearing or aluminum, mild steel, or nonmetallic gears will not be acceptable. Gearing shall be designed to be self-locking so that actuation of a torque switch by a torque overload condition will not allow the actuator to restart until the torque overload has been eliminated. If a secondary gear box is required, it shall be designed to withstand the locked rotor torque of the actuator.

2-6.04. Handwheel Mechanism. The handwheel shall not rotate during motor operation. During handwheel operation the motor shall not affect the actuator operation. The actuator shall be responsive to electrical power and control at all times and, when under electrical control, shall instantly disengage the handwheel. The handwheel shall rotate counterclockwise to open the valve. An arrow indicating the opening direction and the word "Open" shall be cast on the handwheel. The force required to operate the handwheel shall not exceed 80 lbs. The handwheel shall have a padlockable declutch lever.

2-6.05. Torque Sensing. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device. Each torque sensing device shall be provided with an adjustment setting indicator. The adjustment shall permit a variation of approximately 40 percent in torque setting. Switches shall have a rating of not less than 6 amperes at 120 volts ac and 0.5 ampere at 115 volts dc.

2-6.06. Limit Switches. Each standard electric actuator shall be designed to be readily field adaptable for four limit switch assemblies. Each switch assembly shall consist of at least three separate limit switches, shall be operated by the driving mechanism, and shall be independently adjustable to trip at any point at and between the fully open and fully closed valve positions. All switches shall have an inductive contact rating of not less than 6 amperes at 120 volts ac, 3 amperes at 240 volts ac, 1.5 amperes at 480 volts ac, and 0.5 ampere at 115 volts dc.

Each quarter-turn actuator shall be provided with end-of-travel limit switches in addition to four spdt switches, each independently adjustable at any point of valve travel.

2-6.07. Position Transmitter. Not used.

2-6.08. Heating Elements. Space heating elements shall be provided to prevent condensation in the motor and limit switch housing. Heating elements shall be rated 120 volts ac. Heaters shall be continuously energized.

2-6.09. Terminal Facilities. Terminal facilities for connection to motor leads, switches, position transmitter, and heating elements shall be provided in readily accessible terminal compartments. Each terminal compartment shall have at least two openings for external electrical conduits, one sized at least 3/4 inch and the other at least 1-1/4 inches. Each terminal compartment shall be large enough to allow easy routing and termination of fifteen 12 AWG conductors.

2-6.10. Controller. Each valve or gate shall be furnished with a reversing controller located inside the actuator enclosure and shall have controller devices as indicated in the valve and gate schedules. The controller shall be equipped with:

a. A motor overload protective device in each phase or solid state motor protection.

b. A space heater element, rated 120 volts ac, sized to be continuously energized for prevention of condensation within the controller enclosure.

c. A fused control power circuit taken from one power lead on the load side of the breaker and line side of the reversing starter to ground. If power supply is greater than 120 volts ac, a control power transformer with fused secondary, with volt-ampere capacity suitable for starter control plus continuous service to space heater elements in motor housing, limit switch compartment, and controller enclosure.

d. A terminal block with connectors for all external controls. All leads from the actuator motor and limit switch assembly shall be routed to terminal connections in the controller for external connections to all other control devices.

e. Auxiliary control contacts as indicated in the electrical schematics.

Reversing controllers shall be both mechanically and electrically interlocked and shall be provided with the necessary direct-operated auxiliary contacts for required interlocking and control.

Valve controllers shall be expressly selected for long life and reliable, low maintenance service under rugged service conditions.

2-6.11. Control Module. Valves or gates indicated for modulating service in the valve and gate schedules shall be provided with a control module for position modulating type service. The control module shall be mounted within the valve actuator limit switch housing. The module shall accept a standard 4-20 mA dc analog input signal with a load impedance of not greater than 400 ohms. The control module shall contain adjustments for span, zero, gain, and deadband.

The actuator shall have a slide-wire type position feedback potentiometer which provides a position feedback signal to the control module.

2-6.11.01. Control Performance. For any operating torque within the specified range of the valve actuator, the valve and actuator shall perform within these specified limits:

Linearity	Linearity of actual valve position as compared to demand signal shall be within ±4 percent of span over the entire operating range.
Repeatability	For any repeated demand signal to the valve actuator, the actual valve position shall be repeated.
Deadband	Deadband of the valve actuator shall be adjustable from 1 to 10 percent of span.
Hysteresis	For any repeated demand signal to the valve actuator, from either an increasing or a decreasing direction, the actual valve position shall be repeated within 1 degree of valve shaft rotation.

2-7. HYDRAULIC CYLINDER ACTUATORS. Not used.

2-8. AIR CYLINDER ACTUATORS. Not used.

2-9. AIR-OIL CYLINDER ACTUATORS. Not used.

2-10. PORTABLE ELECTRIC ACTUATORS. Not used.

2-11. PORTABLE HYDRAULIC ACTUATORS. Not used.

2-12. ACTUATOR ACCESSORIES.

2-12.01. Extension Stems. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the drawings, or

otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease-filled protective boot. All stem connections shall be pinned.

At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet, whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. Unless otherwise indicated on the drawings, the length of the stem extension shall be as necessary to position the valve operator 12 inches above the maximum liquid level in the immediate area.

Extension stems for buried valve actuators shall extend to within 6 inches of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.

Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.

2-12.02. Position Indicators. Not used.

2-12.02.01. Position Indicators for Buried Actuators. Not used.

2-12.03. Floor Boxes. Not used.

2-12.04. Torque Tubes. Not used.

2-12.05. Valve Boxes. Not used.

2-13. SHOP PAINTING. All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

The following surfaces shall be painted:

Polished or Machined Surfaces	Rust-preventive compound.
Other Surfaces	Epoxy enamel.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Actuators will be installed on the valves in accordance with Section 15010 – Valve Installation.

End of Section

Section 16050

ELECTRICAL

Data Sheet

Para-graph	Description	Data	Units
	General		
1-1	Install equipment and wiring devices furnished by OWNER.	☐ Yes ☒ No	
1-2.01	General Equipment Requirements.	☒ Yes ☐ No	
1-3	Listed or labeled by approved testing laboratory.	☒ Yes ☐ No	
1-4.02	Cable identification with wire markers.	☒ Heat shrink type with custom typed numbers ☐ Self-laminating write-on type	
	Power Service Entrance		
2-1	Power service entrance required.	☒ Yes ☐ No	
	Power entrance and metering devices.	☑ Meter board, socket and test cabinet ☐ Meter transformer cabinet ☑ Disconnect, ground, conduit and fittings ☐ Other	
	When "Other" is selected, indicate alternative.		
	Underground materials required.	☑ Trenching and backfill ☑ Ducts ☐ Service cables ☑ Concrete ☐ Other	
	When "Other" is selected, indicate alternative.		
	Telephone Service Entrance		
2-2	Telephone service entrance required.	☐ Yes ☒ No	

	Telephone entrance.	☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible]	
	When "Other" is selected, indicate alternative.		
	Cable Products		
2-3.01	Lighting cable required.	☐ Yes ☒ No	
	Lighting cable types.	☐ [illegible] ☐ [illegible] ☐ [illegible] ☐ [illegible]	
2-3.02	600 volt power cable required.	☒ Yes ☐ No	
	Power cable types.	☑ Figure 2-16050 for XHHW ☐ Figure 3-16050 for THHN-THHW ☐ Figure 13-16050 for RHH-RHW-USE	
2-3.03	Instrument cable required.	☒ Yes ☐ No	
	Instrument cable types.	☑ Figure 4-16050 for single pair ☐ Figure 5-16050 for single triad ☐ Figure 6-16050 for multiple pair and/or triad	
2-3.04	Multiconductor control cable required.	☒ Yes ☐ No	
	Control cable types.	☑ Figure 7-16050 for 14 AWG THHN-THWN ☐ Figure 8-16050 for 12 AWG THHN-THWN	
2-3.05	Medium voltage power cable required.	☐ Yes ☒ No	
	Medium voltage power cable types.	☐ Figure 9-16050 for [illegible] ☐ Figure 10-16050 for [illegible]	

2-3.06	Tray cable required.	☐ Yes ☒ No	
	Tray cable types.	☐ Figure 14-16050 for Load ≤ 2 kV ☐ Figure 14-16050 for Load ≤ 15 kV	
2-3.07	Metal clad lighting cable required.	☐ Yes (Figure 14-16050) ☒ No	
	Raceways		
2-4	Raceways required. Contractor may choose to install either rigid steel or rigid aluminum raceways. Installation shall consist of entirely of steel or aluminum but not a combination of both..	☑ Rigid steel conduit ☐ Intermediate metal conduit ☑ Liquidtight flexible metal conduit ☐ Utility (PVC) duct ☑ Rigid nonmetallic (PVC) conduit ☑ PVC coated rigid steel conduit ☐ Electrical metallic tubing (EMT) ☑ Rigid aluminum conduit (RAC) ☐ Other	
	When "Other" is selected, indicate alternative.		
	Lighting Panels		
2-8	Lighting panels required.	☐ Yes ☒ No	
	Minimum breaker interrupting capacity at rated voltage.	☐ 10,000 ☐ 22,000 ☐ Other	amp [A]
	When "Other" is selected, indicate alternative.		amp [A]
	Power Panels		
2-9	Power panels required.	☒ Yes ☐ No	
	With neutral.	☐ Yes ☒ No	
	Minimum breaker interrupting capacity at 240 volts.	☐ 10,000 ☐ 22,000 ☐ 65,000	amp [A]
	Minimum breaker interrupting capacity at 277 volts.	☐ 14,000 ☐ 25,000 ☐ 65,000	amp [A]

	Minimum breaker interrupting capacity at 480 volts.	☐ 14,000 ☒ 25,000 ☐ 65,000	amp [A]
	Buses.	☐ Insulated neutral ☑ Ground bus ☐ Removable bond to neutral bus	
	Transient Voltage Surge Suppression		
2-10	Transient voltage surge suppression required.	☒ Yes ☐ No	
	Lighting panel(s) connection type.	☐ Direct Connection ☐ Connected via Disconnect Switch	
	Power panel(s) exposure level.	☐ High Exposure Level ☐ Medium-High Exposure Level ☒ Medium Exposure Level ☐ See table	
	Power panel(s) connection type.	☒ Direct Connection ☐ Connected via Disconnect Switch	
	Retrofit of existing equipment.	☐ Yes ☒ No	
	Retrofit TVSS enclosures required.	☐ [illegible] ☐ [illegible]	
	Retrofit TVSS connection type.	☐ [illegible] ☐ [illegible]	
	Voltage, phase.	☐ 120/240 1-phase ☐ 120/208 3-phase ☐ 240 3-phase 3W ☐ 240 3-phase 4W ☑ 480 3-phase 3W ☐ 480 3-phase 4W ☐ Other_____	
2-10.8	**TVSS Options**		
	Dual Form "C" Dry contacts.	☒ Yes ☐ No	
	Motor Starters		
2-11	Motor starters required.	☐ Yes ☒ No	

	Minimum NEMA size (3 phase).	☐ Size 0 ☐ Size 1	
	Minimum starter interrupting capacity at 480 volts (3 phase).	☐ 14,000 ☐ 25,000 ☐ 65,000	amp [A]
	Minimum starter interrupting capacity at 240 volts (1 phase).	☐ 10,000 ☐ 22,000	amp [A]
	Manual Starters		
2-12	Manual starters required.	☒ Yes ☐ No	
	Control Stations		
2-13	Control stations required.	☒ Yes ☐ No	
	If "Yes" is selected, emergency break glass switches required.	☐ Yes ☒ No	
	Circuit Breakers		
2-14	Circuit breakers required.	☐ Yes ☒ No	
	Minimum breaker interrupting capacity at 480 volts.	☐ 14,000 ☐ 25,000 ☐ 65,000	amp [A]
	Disconnect Switches		
2-15	Disconnect switches required.	☐ Yes ☒ No	
	Transformers		
2-16	Transformers required.	☐ Yes ☒ No	
	Power Centers		
2-17	Power centers required.	☒ Yes ☐ No	
	Power Factor Capacitors		
2-18	Power factor capacitors required.	☐ Yes ☒ No	
	Lighting Contactors		
2-19	Lighting contactors required.	☐ Yes ☒ No	
	Photoelectric Controls		
2-20	Photoelectric controls required.	☐ Yes ☒ No	

	Relay Enclosures		
2-21	Relay enclosures required.	☐ Yes ☒ No	
	Alarm Horn and Beacon		
2-22	Alarm horn and beacon required.	☐ Yes ☒ No	
	Heat-Traced Piping		
2-23	Heat traced piping required.	☐ Yes ☒ No	
	Door Entry Switches		
2-24	Door entry switches required.	☐ Yes ☒ No	
	Coordination Report		
3-1	Coordination report required.	☒ Yes ☐ No	
	Power and Telephone Service Entrances Installation		
3-2	Name of electric utility.	Duke Energy	
	Electric utility contact person and telephone number.	Dale Ankenman 513-287-5455	
	Name of telephone utility.	NA	
	Telephone utility contact person and telephone number.		
	Cable Installation		
3-4	Underground cable pulling procedure required.	☐ Yes ☒ No	
	When "Yes" is selected, indicate circuit numbers.		
	Cable insulation testing required.	☒ Yes ☐ No	
	Conduit Installation		
3-5	At specified locations. Rigid steel or rigid aluminum.	☒ Rigid steel ☐ Intermediate metal	
	Heliax coaxial cable required.	☐ Yes ☒ No	
	Underground conduit required.	☒ Yes ☐ No	
	If "yes" is selected, indicate type of concrete encased underground conduit.	☐ PVC Utility duct ☒ Schedule 40 PVC	
	Reuse of existing conduits allowed.	☒ Yes ☐ No	

	Grounding		
3-8.02	Maximum grounding system resistance.	☐ 25 ohms ☐ 10 ohms ☒ 5 ohms ☐ Not required (Comply with National Electrical Code)	
3-8.03	Grounding system testing required.	☒ Yes ☐ No	
	Buildings or structures required testing.	☑ Each new building or structure grounding system ☐ Each existing building or structure grounding system indicated below	
	Existing buildings or structures to be tested.		
	Modifications to Existing Equipment		
3-11	Modifications to existing equipment required.	☐ Yes ☒ No	

Section 16050

ELECTRICAL

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of all equipment and materials needed for the electrical requirements of this contract. It also covers conduit, wiring, and terminations for electrical equipment installed under Section 16100.

This section covers the installation of electrical equipment furnished under other sections, except electrical items designated to be installed under those sections.

Both inch-pound (English) and SI (metric) units of measurement are specified herein; the units of measurement shall be as indicated on the top of the Data Sheet.

1-1.01. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the Data Sheet".

1-2. GENERAL. Electrical apparatus on all equipment shall be installed complete and placed in readiness for proper operation.

Electrical materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Requirements. As required, the General Equipment Requirements shall apply to all equipment provided under this section.

1-2.02. Coordination. Electrical work shall conform to the construction schedule and the progress of other trades.

1-2.03. Anchor Bolts and Expansion Anchors. All anchor bolts, nuts, washers, and expansion anchors shall comply with section 05550, Anchorage in Concrete and Masonry, except smaller than 3/4 inch [19 mm] will be permitted to match NEMA standard size bolt holes on motors and electrical equipment.

1-2.04. Drawings. Supplementing this section, the drawings indicate locations of equipment and enclosures and provide one-line and schematic diagrams regarding the connection and interaction with other equipment.

1-3. CODES AND PERMITS. All work shall be performed and materials shall be furnished in accordance with the NEC - National Electrical Code, the NESC - National Electrical Safety Code, and the following standards where applicable:

ANSI	American National Standards Institute.
ASTM	American Society for Testing and Materials.
AWG	American Wire Gauge.
Fed Spec	Federal Specification.
ICEA	Insulated Cable Engineers Association.
IEEE	Institute of Electrical and Electronics Engineers.
IES	Illuminating Engineering Society.
NEMA	National Electrical Manufacturers Association.
NFPA	National Fire Protection Association.
UL	Underwriters' Laboratories.

As required, equipment covered by this section shall be listed by UL, or by a nationally recognized third party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. If no third-party testing laboratory provides the required listing, an independent test shall be performed at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to be used.

1-4. IDENTIFICATION.

1-4.01. Conduit. Conduits in manholes, handholes, building entrance pull boxes, junction boxes, and equipment shall be provided with identification tags. Identification tags shall be 19 gage [1 mm thick] stainless steel, with 1/2 inch [13 mm] stamped letters and numbers as indicated on the drawings. Identification tags shall be attached to conduits with nylon tie wraps and shall be positioned to be readily visible.

1-4.02. Cable. Except for lighting and receptacle circuits, each individual wire in power, control, indication, and instrumentation circuits shall be provided with identification markers at the point of termination.

The wire markers shall be of the heat-shrinkable tube type, with custom typed identification numbers.

The wire numbers shall be as indicated on the equipment manufacturer's drawings.

The wire markers shall be positioned to be readily visible for inspection.

Power wires shall be color coded with electrical tape or colored wire jacket; white-N, black, and red for 120/240 volt, 3-wire; and gray-N, brown, orange and yellow for 480/277 volt, 4-wire circuits.

1-4.03. Motor Starters. Not used.

1-4.04. Control Stations. Control stations shall be provided with nameplates identifying the related equipment. Pilot controls and indicating lights shall have engraved or etched legends ("start", "stop", etc.) as indicated on the drawings. Nameplates shall be laminated black-over-white plastic, with 1/8 inch [3 mm] engraved letters, and shall be securely fastened to the control stations.

1-4.05. Circuit Breakers. Not used.

1-4.06. Disconnect Switches. Not used.

1-5. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the WORK PERFORMED BY THE CONTRACTOR, shall be submitted in accordance with the submittals section. The drawings and data shall include, but shall not be limited to, the following:

Drawings and data.

Operating manuals.

Samples.

1-5.01. Submittal Identification. Information covering all materials and equipment shall be submitted for review in accordance with the submittals section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:

a. Lamp fixture descriptive sheets shall show the fixture schedule letter, number, or symbol for which the sheet applies.

b. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.

c. Sheets or drawings covering more than the item being considered shall have all inapplicable information crossed.

d. A suitable notation shall identify equipment and materials descriptive literature not readily cross-referenced with the drawings or specifications.

e. Schematics and connection diagrams for all electrical equipment shall be submitted for review. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted, unless it is clearly marked to show the intended connections.

f. Transient voltage surge suppressor submittals shall include drawings (including unit dimensions, weights, component and connection locations, mounting provisions, and wiring diagrams), all testing documentation as specified herein, equipment manuals that detail the installation, operation and maintenance instructions for the specified unit(s), and manufacturer's descriptive bulletins and product sheets.

CONTRACTOR shall submit the name and qualifications of the Engineering and Testing Services firm proposed to perform the coordination study and the on site testing.

Within 90 days after the Notice to Proceed, Contractor shall furnish a submittal for all types of cable and conduit to be provided. The submittal shall include the cable manufacturer and type, and sufficient data to indicate that the cable and conduit meet the specified requirements.

In addition to the complete specifications and descriptive literature, a sample of the largest size of each type of cable shall be submitted for review before installation. Each sample shall include legible and complete surface printing of the cable identification.

1-6. PROTECTION AND STORAGE. During construction, the insulation on all electrical equipment insulation shall be protected against absorption of moisture, and metallic components shall be protected against corrosion by strip heaters, lamps, or other suitable means. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously.

PART 2 - PRODUCTS

2-1. POWER SERVICE ENTRANCE. Contractor shall consult the local electric utility regarding their service installation requirements, and shall furnish the service equipment in compliance with these requirements.

As required, power service equipment shall include meter board, meter socket, meter test cabinet, metering transformer cabinet, disconnect means, grounding materials, and riser conduits and service entrance fittings required by the utility and for compliance with codes and regulations.

As required for underground services, trenching and backfill, ducts, service cables, and concrete for duct banks and transformer pads shall be furnished.

When required, a weatherhead shall be provided on each service riser conduit.

2-2. TELEPHONE SERVICE ENTRANCE. Not used.

2-3. CABLE. All cables of each type (such as lighting cable or 600 volt power cable) shall be from the same manufacturer.

All types of cable shall conform to the Cable Data Figures at the end of this section and as described herein.

2-3.01. Lighting Cable. Not used.

2-3.02. 600 Volt Power Cable. As required, cable in power, control, indication, and alarm circuits operating at 600 volts or less, except where lighting, multiconductor control, and instrument cables are permitted, shall be 600 volt (Figure 2-16050 XHHW-2), (Figure 3-16050 THHN-THWN), or (Figure 13-16050 RHH-RHW-USE) power cable as required.

2-3.03. Instrument Cable. As required, cable for electronic circuits to instrumentation, metering, and other signaling and control equipment shall be two- or three-conductor instrument cable twisted for magnetic noise rejection and protected from electrostatic noise by a total coverage shield. Types of instrument cables shall be (Figure 4-16050 single pair), (Figure 5-16050 single triad), or (Figure 6-16050 multiple pair and/or triad) as required.

2.3.04. Multiconductor Control Cable. When indicated on the drawings or as required, cable in control, indication and alarm circuits shall be multiconductor. Cable shall be (Figure 7-16050 14 AWG THHN-THWN) or (Figure 8-16050 12 AWG THHN-THWN) as required.

2-3.05. Medium Voltage Power Cable. Not used.

2-3.06. Tray Cable. Not used.

2-3.07. Metal Clad Lighting Cable. Not used.

2-4. CONDUIT. As required, conduit and raceways shall be as described in the following paragraphs:

2-4.01. Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, shall conform to ANSI C80.1, and shall be manufactured in accordance with UL 6.

2-4.02. Intermediate Metal Conduit (IMC). Not used.

2-4.03. Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moistureproof polyvinyl chloride jacket, and shall be UL labeled.

2-4.04. Utility (PVC) Duct. Not used.

2-4.05. Rigid Nonmetallic (PVC) Conduit. PVC conduit shall be heavy wall, Schedule 40, UL labeled for aboveground and underground uses, and shall conform to NEMA TC-2 and UL 651.

2-4.06. PVC-Coated Rigid Steel Conduit. The conduit shall be rigid steel. Before the PVC coating is applied, the hot-dip galvanized surfaces shall be coated with a primer to obtain a bond between the steel substrate and the coating. The PVC coating shall be bonded to the primed outer surface of the conduit. The bond on conduit and fittings shall be stronger than the tensile strength of the PVC coating. The thickness of the PVC coating shall be at least 40 mils [1000 µm].

A chemically cured two-part urethane coating, at a nominal 2 mil [50 µm] thickness, shall be applied to the interior of all conduit and fittings. The coating shall be sufficiently flexible to permit field bending the conduit without cracking or flaking of the coating.

Every female conduit opening shall have a PVC sleeve extending one conduit diameter or 2 inches [50 mm], whichever is less, beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit before coating. The wall thickness of the sleeve shall be at least 40 mils [1000 µm].

All fittings, condulets, mounting hardware, and accessories shall be PVC-coated. All hollow conduit fittings shall be coated with the interior urethane coating described above. The screw heads on condulets shall be encapsulated by the manufacturer with a corrosion-resistant material.

PVC coated rigid steel conduit shall be manufactured by Ocal, Perma-Cote, or Robroy.

2-4.07. Electrical Metallic Tubing (EMT). Not used.

2-4.08. Rigid Aluminum Conduit (RAC). Rigid aluminum conduit and fittings shall be manufactured of 6063-T1 alloy, shall conform to ANSI C80.5, and shall be manufactured in accordance with UL 6.

2-5. WIRING DEVICES, BOXES, AND FITTINGS. Concealed conduit systems shall have flush-mounted switches and convenience outlets. Exposed conduit systems shall have surface-mounted switches and convenience outlets.

2-5.01. Conduit Boxes and Fittings.

a. Galvanized or cadmium plated, threaded, malleable iron, or, when required, aluminum boxes and fittings shall be manufactured by Crouse-Hinds, Appleton, or O Z Gedney.

b. Rigid PVC device boxes and fittings shall be manufactured by Carlon or Cantex.

c. Sheet steel device boxes shall be manufactured by Appleton, Raco, or Steel City.

d. PVC coated device boxes shall be manufactured by Ocal, Perma-Cote, or Robroy Industries.

e. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement to avoid unnecessary bends and fittings.

2-5.02. Device Plates.

a. Galvanized or cadmium-plated device plates shall be used on surface mounted outlet boxes where weatherproof plates are not required.

b. Device plates on flush mounted outlet boxes where weatherproof plates are not required shall be AISI Type 302 stainless steel, Eagle "93nnn series", Hubbell "S series", or Leviton "840nn-40 series"; nylon or polycarbonate, Eagle "513nV series", Hubbell "Pn series", or Leviton "807nn-I series".

c. Device plate mounting hardware shall be countersunk and finished to match the plate.

d. Device plates for switches outdoors or indicated as weatherproof shall have provisions for padlocking switches "On" and "Off", and shall be Appleton "FSK-1VS", Crouse-Hinds "DS185" or O Z Gedney "FS-1-WSCA".

e. Device plates for receptacles indicated as weatherproof shall be Appleton "FSK-WRD", Crouse-Hinds "WLRD1", or O Z Gedney "FS-1-WDCA.

f. Flush-mounted, weatherproof plates shall be provided with adapter plates, Appleton "FSK-SBA" or Crouse-Hinds "FS031".

g. Device plates for ground fault interrupter receptacles indicated to be weatherproof shall be Appleton "FSK-WGFI", Eagle "966", or O Z Gedney "FS-1-GFCA".

h. Receptacle covers outdoors or otherwise indicated to be weatherproof while in-use shall be die cast aluminum and shall include a padlock eye. Covers for standard convenience outlets shall be Hubbell "WP8M" or Thomas and Betts Red Dot "CKMDV". Covers for ground fault interrupter receptacles shall be Hubbell "WP26M" or Thomas and Betts Red Dot "CKMGV".

i. Engraved device plates, where required, shall be manufactured by Leviton, or equal.

j. Device plates on PVC conduit fittings shall be Carlon "E98 Series" or Cantex "513300 Series".

2-5.03. Wall Switches.

a. Switches on ac lighting panel load circuits through 277 volts shall be 20 amperes, 120/277 volts, Eagle "2221V" through "2224V", Hubbell "HBL 1221I" through "HBL 1224I", or Leviton "1221-2I" through "1224-2I".

b. Switches for pulse control of lighting contactors shall be 20 amperes, 120/277 volts, momentary, double-throw, center "Off", Eagle "2220V", Hubbell "1557I" or Leviton "1257-I".

c. Switches on ac lighting panel load circuits through 277 volts in Class I, Division 1 and Division 2, Group D hazardous areas indicated on the drawings shall be 20 ampere, 120/277 volts. Hazardous area switches shall be factory sealed tumbler switches, Appleton "EDS" or Killark "FXS".

2-5.04. Receptacles.

a. Standard convenience outlets shall be duplex, three-wire, grounding, 20 amperes, 125 volts, Eagle "5362V", Hubbell "5362I" or Leviton "5362-I" for 120 volt circuits, and 250 volts, Eagle "5462V", Hubbell "5462I" or Leviton "5462-I" for 240 volt circuits.

b. Ground fault circuit interrupter receptacles shall be duplex, 20 amperes, 125 volts, Eagle "GF8300V", Hubbell "GF5362I" or Leviton "8899-I".

c. Welding receptacles shall be 30 amperes, 600 volts, 3 phase, with grounding conductors connected through a fourth pole, Appleton "ACRE3034-100", Crouse-Hinds "AR348" plus "ARRC33" and "AR30" or Leviton " 430MI5W". One matching plug, Appleton "ACP3034BC", Crouse-Hinds "APJ3485" or Leviton "430P5W" with appropriate woven grip and plug cap, shall be furnished for the cable size directed by OWNER.

d. Welding receptacles shall be 60 amperes, 240 volts, 3 phase, with grounding conductors connected through a fourth pole, Appleton "ACRE6035-150", Crouse-Hinds "AREA6485" or Leviton "460MI9W". One matching plug, Appleton "ACP6034BC", Crouse-Hinds "APJ6485" or Leviton "460P9W" with appropriate woven grip and plug cap, shall be furnished for the cable size directed by OWNER.

e. Receptacles in Class I, Division 1 and Division 2, Group D hazardous areas indicated on the drawings shall be three-wire, grounding, 20 amperes, 125 volts. Hazardous area receptacles shall be factory sealed, with an integral switch that is only activated when an approved matching plug is fully inserted and rotated into the engaged position. Hazardous area receptacles shall be Appleton "ENR", Crouse-Hinds "ENR", or Killark "UGR".

2-5.05. Special Outlets. Clock outlets shall be Eagle "93632", Hubbell "5235" or Leviton "5261-CH".

2-6. JUNCTION BOXES, PULL BOXES, AND WIRING GUTTERS. Indoor boxes (larger than switch, receptacle, or fixture type) and gutters shall be constructed of sheet steel, shall be galvanized after fabrication, and shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts. When required, aluminum or stainless steel shall be used for aluminum conduit systems and shall be rigidly supported by stainless steel hardware and framing materials, including nuts and bolts.

Indoor boxes and gutters in corrosive areas indicated on the drawings and outdoor boxes and gutters shall be NEMA Type 4X, ABS or stainless steel and shall be rigidly supported by PVC-coated or stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

Bolt-on junction box covers 3 feet [900 mm] square or larger, or heavier than 25 lbs [11 kg], shall have rigid handles. Covers larger than 3 by 4 feet [900 by 1200 mm] shall be split.

Where indicated on the drawings, junction and pull boxes with a removable side opposite the underground conduits shall be provided over building ends of underground conduit banks. Boxes shall be sized in accordance with the National Electrical Code, including space for full size continuations of all underground conduits not originally continued. Conduit arrangement shall leave maximum space for future conduits.

2-7. LIGHTING FIXTURES. Lighting fixtures shall be furnished as described in the fixture schedule and as indicated on the drawings. Lighting fixtures shall be furnished complete with lamps. Pendant fixtures shall have swivel type box covers and threaded conduit pendants unless otherwise specified.

2-7.01. Electronic Ballasts. Electronic ballasts furnished with fluorescent type lighting fixtures shall be CBM certified as meeting requirements of ANSI C82.11 with a THD level of not more than 20 percent.

2-8. LIGHTING PANELS. Not used.

2-9. POWER PANELS. Unless otherwise specified, each power panel, with or without a neutral as required, shall be dead-front, 3 phase panelboard with circuit breakers, in accordance with the drawings and the following:

2-9.01. Cabinet. The panel shall have a flush-mounted or surface-mounted enclosure with a NEMA designation appropriate for the location where it will be installed. The enclosure shall have a door with latch and lock. At the completion of the contract, a neatly printed or typed directory listing the panel and circuit identities shall be mounted inside the door.

2-9.02. Circuit Breakers. Circuit breakers shall be thermal-magnetic, bolt-in, individually front replaceable, and shall indicate "On", "Off", and "Tripped". Breakers indicated as multiple-pole shall be common trip type. Breakers up to 240 volts shall have interrupting ratings not less than 10,000, 22,000 or 65,000 amperes as required. Breakers for 277 volts shall have interrupting ratings not less than 14,000, 25,000 or 65,000 amperes as required. Breakers for 480 volts shall be rated 600 volts, with interrupting ratings not less than 14,000, 25,000 or 65,000 amperes at 480 volts as required. Handle clips to

prevent casual operation of breakers shall be provided for 10 percent (at least two) of the breakers and applied to the circuits directed.

2-9.03. Buses. The panel shall have 3 phase buses, a neutral bus insulated from the cabinet, and/or a ground bus as required. Buses shall be copper, with ampere and voltage ratings and main lugs or breakers as indicated. The ground bus shall be similar to a neutral bus and shall have a good ground connection to the cabinet, a removable bond to the neutral bus as required, clamp type lugs for the ground cable in each supply conduit, and connections for a ground cable in each load conduit.

2-10. TRANSIENT VOLTAGE SURGE SUPPRESSION.

2-10.01. Scope. Transient voltage surge suppression (TVSS) devices shall be provided as specified herein and as indicated on the drawings. Each unit shall be designed for parallel connection to the wiring system and shall utilize non-linear voltage-dependent metal oxide varistors (MOV) in parallel.

TVSS devices shall be furnished and installed for the electrical equipment indicated on the drawings and designated in this section as required and as specified herein. All new lighting and power panels shall be furnished with integral TVSS devices.

2-10.02. Standards. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

ANSI/IEEE C62.41 and C62.45;

ANSI/IEEE C62.1 and C62.11;

National Electrical Manufacturers Association (NEMA LS1 Guidelines);

National Fire Protection Association (NFPA 20, 70 [NEC], 75, and 78);

Underwriters Laboratories UL 1449 Second Edition and 1283

The unit shall be UL 1449 Second Edition Listed as a Transient Voltage Surge Suppressor and UL 1283 Listed as an Electromagnetic Interference (EMI) Filter.

2-10.03. Environmental Requirements.

a. Operating Temperature: -40°F to +140°F [-40°C to +60°C].

b. Relative Humidity: Reliable operation with 5 percent to 95 percent non-condensing.

2-10.04. Electrical Requirements.

a. Unit Operating Voltage. The nominal unit operating voltage and configuration shall be as indicated on the drawings.

b. Maximum Continuous Operating Voltage (MCOV). The TVSS device shall be designed to withstand a MCOV of not less than 115 percent of nominal RMS voltage.

c. Operating Frequency. Operating frequency range shall be 47 to 63 Hertz.

d. Protection Modes. All protected modes are defined per NEMA LS-1, Paragraph 2.2.7. Following IEEE Standard 1100, section 9.11.2 recommendations, Four-wire configured systems shall provide, Line-to-Neutral (L-N), Line-to-Ground (L-G), and Neutral-to-Ground (N-G), and Line-to-Line (L-L) protection. Three-wire configured systems shall provide, Line-to-Line (L-L) protection and Line-to-Ground (L-G) protection.

e. Rated Single Pulse Surge Current Capacity. The rated single pulse surge current capacity, in amps, for each mode of protection of the unit shall be as required and shall be no less than listed in the following table. Lighting panels shall be rated for the low exposure level capacity unless otherwise noted.

	L-N	L-G	N-G	L-L
High Exposure Level	120 kA	120 kA	120 kA	120 kA
Medium-High Exposure Level	100 kA	100 kA	100 kA	100 kA
Medium Exposure Level	80 kA	80 kA	80 kA	80 kA
Low Exposure Level	60 kA	60 kA	40 kA	60 kA

f. UL 1449 Second Edition Suppression Voltage Rating (SVR). The maximum SVR per mode for the device (inclusive of disconnect) shall be as required and shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L
120/240 1-phase	500 V	500 V	500 V	800 V
120/208 3-phase	500 V	500 V	500 V	800 V
240 V 3W		800 V		800 V
240 V 4W	800 V	800 V	500 V	1500 V
480 V 3W		1500 V		1800 V
480 V 4W	900 V	1000 V	1500 V	1800 V

g. Noise Attenuation. EMI noise rejection or attenuation values shall be measured in accordance with test and evaluation procedures outlined in NEMA LS-1. The unit shall be capable of a minimum -40 dB attenuation at 100kHz when tested per the 50 ohm insertion loss method as defined by MIL-STD-220A.

h. Minimum Repetitive Surge Current Capacity. The minimum number of repetitive surges per mode as a result of testing a 20 kV, 10kA ANSI/IEEE C62.41 Category C3 surge current with less than a 10 percent degradation of clamping voltage shall be as follows:

   For integral and external installation and power panels: 5,000.

i. Overcurrent Protection. At high and medium-high exposure levels, the TVSS device shall incorporate internal fusing capable of interrupting, at minimum, up to 200 kA symmetrical fault current with 600 volts ac applied.

j. Unit Status Indicators. The unit shall include long-life, externally visible phase indicators that monitor the on-line status of the unit.

2-10.05. Testing Documentation. Contractor shall submit documentation of third party testing from a nationally recognized testing laboratory (NRTL) for the following:

a. Single Pulse Surge Current Capacity Testing. Verify that the suppressor components can survive the published surge current rating for each mode and for each phase using the ANSI/IEEE C62.41, 8 x 20 microsecond current wave.

b. Minimum Repetitive Surge Current Capacity Testing. Confirm the minimum number of repetitive surges per mode the device can protect against with less than a 10 percent degradation of clamping voltage as a result of testing a 20 kV, 10kA ANSI/IEEE C62.41 Category C3 surge current.

c. UL 1449 Second Edition Testing. Provide verification that the TVSS device complies with these ratings.

d. Overcurrent Protection Testing.

Verify that the total surge current can be passed through the fuse with no charring, flames, or projection of materials. Testing of the fuse only will not be acceptable for this requirement. Testing shall indicate the lowest possible surge that can disrupt the fusing.

Confirm that the fuse can withstand the rated fault current. Testing shall be conducted in both high and low impedance fault conditions and shall confirm no charring, flaming, or projection of materials.

e. Let-through Voltage Testing. Supply an oscilloscope graph for each of the following wave forms tested in accordance with ANSI/IEEE C62.45:

ANSI/IEEE Category C3 combination wave (20 kV, 10kA, 8 x 20 microsecond impulse).

ANSI/IEEE Category C1 combination wave (6 kV, 3kA, 8 x 20 microsecond impulse).

ANSI/IEEE Category B3 ringwave (6 kV, 500 A, 100 kHz).

f. EMI Testing. Provide spectrum analysis based on MIL-STD 220A test procedures between 50 kHz and 200 kHz.

2-10.06. Warranty. The manufacturer shall provide a minimum Five 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.

2-10.07. Installation. The TVSS devices shall be installed according to the manufacturer's recommendations. If possible for the integral units, provide direct bus connections.

2-10.08. Options.

a. Disconnect Switch. Not Used.

b. Enclosure. Not Used. As required for the TVSS units to be mounted externally of the protected electrical equipment, provide NEMA rated enclosures suitable for the locations indicated on the drawings.

c. Dual Form "C" Dry Contacts. As required, the TVSS system shall be provided with a set of form "C" dry contacts (normally open and normally closed) to facilitate connection to a plant control system or other remote monitoring system. The contacts shall be normally open or normally closed and shall change state upon any alarm condition.

2-10.09. Acceptable Manufacturers. Integral TVSS devices shall be manufactured by Cutler-Hammer, General Electric, Siemens Energy & Automation, or Square D. External TVSS devices shall be manufactured by Cutler-Hammer, General Electric, Siemens Energy & Automation, Square D, Control Concepts, or Current Technology. The products of other manufacturers will not be acceptable.

2-11. SEPARATELY ENCLOSED MOTOR STARTERS. Not used.

2-12. SEPARATELY ENCLOSED MANUAL STARTERS. Separately enclosed manual starters not specified elsewhere shall be provided hereunder. Manual starters shall be provided with thermal overload protection properly sized for the motors served and with a contact and overload in each phase lead. Manual starters shall be mounted in NEMA Type 1 enclosures unless otherwise noted. Manual starters outdoors or indicated to be weatherproof shall have NEMA Type 4 enclosures.

2-13. CONTROL STATIONS. Control stations shall be provided as indicated on the one-line diagrams or schematics or as required by the equipment furnished. Pilot devices shall be 30.5 mm heavy-duty, oiltight construction, and shall perform the functions indicated. Pilot lights shall be full voltage type with LED lamps. Indoor control stations shall have NEMA Type 13 enclosures. Control stations outdoors or indicated to be weatherproof shall have NEMA Type 4X stainless steel enclosures with protective caps on the control devices. Control stations in NEC Class I, Division 1 and Division 2, Group D hazardous areas shall have NEMA Type 7 enclosures, or be factory sealed type, Appleton "Contender Series" or Killark "Seal-X Series".

2-13.01. Emergency Break-Glass Switch. Not used.

2-14. SEPARATELY ENCLOSED CIRCUIT BREAKERS. Not used.

2-15. DISCONNECT SWITCHES. Not used.

2-16. LIGHTING AND AUXILIARY POWER TRANSFORMERS. Not used.

2-17. POWER CENTERS. Power centers shall consist of a primary breaker, a 480-120/240 volt transformer, a secondary breaker, and a distribution panelboard in a NEMA Type 3R enclosure.

2-17.01. Transformer. Transformer shall be 3 kVA self-air-cooled, dry type. Transformer shall have at least two full capacity voltage taps.

2-17.02. Circuit Breakers. Circuit breakers shall be thermal-magnetic, bolt-in, individually front replaceable, and shall indicate "On", "Off", and "Tripped". Four single pole, 20 ampere circuit breakers shall be provided. Provisions for four additional circuit breakers shall be provided..

2-18. POWER FACTOR CORRECTION CAPACITORS. Not used.

2-19. LIGHTING CONTACTORS. Not used.

2-20. PHOTOELECTRIC CONTROLS. Not used.

2-21. RELAY ENCLOSURES. Not used.

2-22. ALARM HORN AND BEACON. Not used.

2-23. HEAT-TRACED PIPING. Not used.

2-24. DOOR ENTRY SWITCHES. Not used.

PART 3 - EXECUTION

3-1. COORDINATION STUDY. Contractor shall commission a coordination study of relays, fuses, circuit breakers, and all other protective devices and shall submit a coordination report as specified herein. The study shall include the portion of the system indicated to be installed, starting with the smallest -- 480 volt, 3 phase, 60 Hz -- circuit protective device on the load end, to the nearest protective device on the power company's line side.

Contractor shall be responsible for and shall ensure that all relays, and circuit breakers are set according to the study results.

The study shall include, but shall not be limited to, the following:

Color-coded printouts of coordination curves prepared with calculation software.

A tabulation of all protective relay and circuit breaker trip settings and recommended sizes and types of medium-voltage fuses.

Motor starting profiles for all 50 horsepower [37 kW] and larger motors.

Transformer damage curves and protection, evaluated in accordance with ANSI/IEEE C57.109.

Coordination curve(s) from the power company, if available.

Calculated short-circuit values at all nodes in the distribution system included within the scope of the coordination study.

An Engineering and Testing Services firm acceptable to Engineer shall conduct the coordination study.

Contractor shall be responsible for obtaining the following:

The coordination curves for relays, fuses, and circuit breakers.

Transformer damage curves.

Motor data.

Other applicable information for all new and existing electrical equipment.

Contractor shall coordinate with the power company to obtain the required protective device curves and shall be responsible for all the field work associated with obtaining the necessary data on existing relays, circuit breakers, fuses, and transformers to be included in the coordination study.

The available 3 phase, symmetrical fault current at the point of service shall be obtained from the Power Company.

The coordination report shall be bound in a standard 8-1/2 by 11 inch [210 by 275 mm] three-ring binder and shall be submitted in accordance with the submittals section. Final selection of all protective device settings or sizes shall be subject to review and acceptance by ENGINEER.

3-2. POWER AND SERVICE ENTRANCE INSTALLATION. Contractor shall consult the local electric utility regarding their service installation requirements, and shall install the service equipment in compliance with these requirements.

Contractor shall coordinate details and timing of service entrance installations with the utility. Contractor shall complete and submit service applications to the electric utility as necessary.

3-3. TELEPHONE SERVICE ENTRANCE INSTALLATION. Not used.

3-4. CABLE INSTALLATION.

3-4.01. General. Except as otherwise specified or indicated on the drawings, cable shall be installed according to the following procedures, taking care to protect the cable and to avoid kinking the conductors, cutting or puncturing the jacket, contamination by oil or grease, or any other damage.

a. Stranded conductor cable shall be terminated by lugs or pressure type connectors. Wrapping stranded cables around screw type terminals is not acceptable.

b. Stranded conductor cable shall be spliced by crimp type connectors. Twist-on wire connectors may be used for splicing solid cable and for terminations at lighting fixtures.

c. Splices may be made only at readily accessible locations.

d. Cable terminations and splices shall be made as recommended by the cable manufacturer for the particular cable and service conditions. All shielded cable stress cone terminations shall be IEEE Class 1 molded rubber type. Shielded cable splices shall be tape or molded rubber type as required. Shielded cable splices and stress cone terminations shall be made by qualified splicers. Materials shall be by 3M Company, Plymouth/Bishop, or Raychem Electric Power Products.

e. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.

f. Cable-pulling lubricant shall be compatible with all cable jackets; shall not contain wax, grease, or silicone; and shall be Polywater "Type J".

g. Cables operating at more than 3,000 volts line-to-line shall be fireproofed in all cable vaults, manholes, and handholes. Fireproofing shall be done with a half-lapped layer of 3M "Scotch 77 Arc-Proofing Tape", anchored at each end with a double wrap of 3M "Scotch 69 Glass Cloth Tape" or with equivalent tape by Anixter or Plymouth/Bishop.

h. Where necessary to prevent heavy loading on cable connections, in vertical risers, the cable shall be supported by Kellems, or equal, woven grips.

i. Spare cable ends shall be taped, coiled, and identified.

j. Cables shall not be bent to a radius less than the minimum recommended by the manufacturer. For cables rated higher than 600 volts, the minimum radius shall be 8 diameters for nonshielded cable and 12 diameters for shielded cable.

k. All cables in one conduit, over 1 foot [305 mm] long, or with any bends, shall be pulled in or out simultaneously.

l. Circuits to supply electric power and control to equipment and devices are indicated on the one-line diagrams. Conductors in designated numbers and sizes shall be installed in conduit of designated size. Circuits shall not be combined to reduce conduit requirements unless acceptable to ENGINEER.

3-4.02. Underground Cable Pulling Procedure. Not used.

3-4.03. Cable Insulation Test. As required, conductors with insulation rated 5,000 volts and higher shall be given a field dc insulation test.

The ampacity of direct current testing equipment shall be at least 2,500 microamperes.

Final test voltages and the duration of the test shall be as indicated on the Cable Data Sheets attached to this Section. Cable insulation testing shall be recorded on the Cable Test Data Form attached to this Section. Figure 15-16050.

Test procedures shall conform to ICEA S-93-639 (NEMA WC 74), 5-46 kV Shielded Power Cable For Use In The Transmission & Distribution of Electric Energy, and the applicable qualification testing standards of AEIC CS-8.

The tests shall be performed by experienced personnel specializing in electrical cable testing. Triplicate copies of test data for each cable shall be submitted to Engineer. A Cable Test Data Form is included in this section.

3-5. CONDUIT INSTALLATION. Except as otherwise specified or indicated on the drawings, conduit installation and identification shall be done according to the following procedures.

3-5.01. Installation of Interior and Exposed Exterior Conduit. This section covers the installation of conduit inside structures, above and below grade, and in exposed outdoor locations. In general, conduit inside structures shall be concealed. Large conduit and conduit stubs may be exposed unless otherwise specified or indicated on the drawings. No conduit shall be exposed in water chambers unless so indicated on the drawings.

Unless otherwise indicated on the drawings, Contractor shall be responsible for routing the conduit to meet the following installation requirements:

a. Conduit installed in all exposed indoor locations, except corrosive areas indicated on the drawings, and in floor slabs, walls, and ceilings of hazardous (classified) locations, shall be rigid steel or rigid aluminum as required. Exposed steel conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts; exposed rigid aluminum conduit shall be rigidly supported by aluminum or stainless steel hardware and framing materials with stainless steel nuts and bolts.

b. Conduit installed in floor slabs and walls in non-hazardous locations shall be rigid Schedule 40 PVC.

c. Conduit installed in all exposed outdoor locations shall be PVC-coated rigid steel, rigidly supported by PVC-coated framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

d. Final connections to dry type transformers, to motors without flexible cords, and to other equipment with rotating or moving parts shall be liquidtight flexible metal conduit with watertight connectors installed without sharp bends and in the minimum lengths required for the application, but not longer than 6 feet [1.8 m] unless otherwise acceptable to Engineer.

e. Terminations and connections of rigid steel and intermediate metal conduit shall be taper threaded. Conduits shall be reamed free of burrs and shall be terminated with conduit bushings.

f. Exposed conduit shall be installed either parallel or perpendicular to structural members and surfaces.

g. Two or more conduits in the same general routing shall be parallel, with symmetrical bends.

h. Conduits shall be at least 6 inches [150 mm] from high temperature piping, ducts, and flues.

i. Conduit installed in corrosive chemical feed and storage areas as indicated by Area Type on the drawings shall be rigid Schedule 40 PVC.

j. Rigid Schedule 40 PVC conduit shall have supports and provisions for expansion as required by NEC Article 352.

k. Metallic conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside.

l. Rigid Schedule 40 PVC conduit shall be secured to sheet metal device boxes using a male terminal adapter with a locknut inside or by using a box adapter inserted through the knockout and cemented into a coupling.

m. Conduits in walls or slabs, which have reinforcement in both faces, shall be installed between the reinforcing steel. In slabs with only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduits larger than 1/3 of the slab thickness shall be concrete encased under the slab.

n. Conduits that cross structural joints where structural movement is allowed shall be fitted with concretetight and watertight expansion/ deflection couplings, suitable for use with metallic conduits and rigid Schedule 40 PVC conduits. The couplings shall be Appleton Type DF, Crouse-Hinds Type XD, or O-Z Type DX.

o. Conduit shall be clear of structural openings and indicated future openings.

p. Conduits through roofs or metal walls shall be flashed and sealed watertight.

q. Conduit installed through any openings cut into concrete or masonry structures shall be neatly grouted.

r. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.

s. Exposed conduit stubs for future use shall be terminated with galvanized pipe caps.

t. Concealed conduit for future use shall be terminated in equipment or fitted with couplings plugged flush with structural surfaces.

u. Where the drawings indicate future duplication of equipment wired hereunder, concealed portions of conduits for future equipment shall be provided.

v. Horizontal conduit shall be installed to allow at least 7 feet [2.1 m] of headroom, except along structures, piping, and equipment or in other areas where headroom cannot be maintained.

w. Conduit shall not be routed across the surface of a floor, roof, or walkway unless approved by Engineer.

x. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer's installation procedure using appropriate tools.

y. All conduits that enter enclosures shall be terminated with acceptable fittings that will not affect the NEMA rating of the enclosure.

z. Nonmetallic conduit, which turns out of concrete slabs or walls, shall be connected to a 90 degree elbow of PVC-coated rigid steel conduit before it emerges.

aa. Power conductors to and from adjustable frequency drives shall be installed in steel conduit.

3-5.02. Underground Conduit Installation. All excavation, backfilling, and concrete work shall conform to the respective sections of these specifications. Underground conduit shall conform to the following requirements:

a. All underground conduits shall be concrete encased unless indicated otherwise on the drawings. Concrete encasement within 15 feet of building entrances, under and within 5 feet of roadways, and within 10 feet of indicated future excavations shall be reinforced as detailed on the drawings.

b. Concrete encased conduit shall be as required. Conduits shall have end bells where terminated at walls. All joints shall be solvent welded in accordance with the recommendations of the manufacturer.

c. Concrete encasement on exposed outdoor conduit risers shall continue to 6 inches [150 mm] above grade, with top crowned and edges chamfered.

d. Conduit and concrete encasement installed underground for future extension shall be terminated flush at the bulkhead with a coupling and a screw plug. The termination of the duct bank shall be reinforced with bars 100 diameters long that shall be terminated 2 inches [50 mm] from the bulkhead. Matching splice bars shall be 50 bar diameters long. Each longitudinal bar shall be provided with a Lenton "Form Saver" coupler and plate or a Dayton "Superior DBR" coupler at the bulkhead. The coupler shall be threaded to accept a dowel of like diameter in the future. Threads shall be protected with screw-in plastic caps. A 1-3/4 by 3/4 inch [45 by 20 mm] deep horizontal shear key shall be formed in the concrete encasement above and below the embedded conduits. After concrete placement, conduit and bar connector ends shall be cleaned and coated with two coats of thixotropic coal tar.

e. Underground conduits indicated not to be concrete encased shall be rigid Schedule 40 PVC.

f. Underground conduit bend radius shall be at least 2 feet [600 mm] at vertical risers and at least 3 feet [900 mm] elsewhere.

g. Underground conduits and conduit banks shall have at least 2 feet [600 mm] of earth cover, except where indicated otherwise.

h. Underground conduit banks through building walls shall be cast in place, or concreted into boxouts, with water stops on all sides of the boxout. Water stops are specified in the cast-in-place concrete section.

i. Underground nonmetallic conduits, which turn out of concrete or earth in outdoor locations, shall be connected to 90 degree elbows of PVC-coated rigid steel conduit before they emerge.

j. Conduits not encased in concrete and passing through walls, which have one side in contact with earth, shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.

k. Underground conduits shall be sloped to drain from buildings to manholes.

l. Each 5 kV or higher voltage cable, each 250 kcmil [120 mm^2] or larger cable, and each conduit group of smaller cables shall be supported from manhole walls by Kindorf "D-990" or Unistrut "P-3259" inserts, with Kindorf "F-721-24" or Unistrut "P-2544" brackets and Unistrut "P1753" or "P1754" fiberglass reinforced polyester cable saddles.

m. Telephone cables shall not be installed in raceways, conduits, boxes, manholes, or handholes containing other types of circuits.

n. Intercommunication and instrument cables shall be separated the maximum possible distance from all power wiring in pull-boxes, manholes, and handholes.

3-5.03. Sealing of Conduits. After cable has been installed and connected, conduit ends shall be sealed by forcing nonhardening sealing compound into the conduits to a depth at least equal to the conduit diameter. This method shall be used for sealing all conduits at handholes, manholes, and building entrance junction boxes, and for 1 inch [25 mm] and larger conduit connections to equipment.

Conduits entering chlorine feed and storage rooms shall be sealed in a junction box or conduit body adjacent to the point of entrance.

Conduits entering hazardous (classified) areas and submersible or explosion proof enclosures shall have Appleton "Type ESU" or Crouse-Hinds "EYS" sealing fittings with sealing compound.

3-5.04. Reuse of Existing Conduits. Existing conduits may be reused subject to the concurrence of ENGINEER and compliance with the following requirements:

a. A wire brush shall be pulled through the conduit to remove any loose debris.

b. A mandrel shall be pulled through the conduit to remove sharp edges and burrs.

3-6. WIRING DEVICES, BOXES, AND FITTINGS INSTALLATION. Metallic and nonmetallic conduit boxes and fittings shall be installed in the following locations:

3-6.01. Conduit Boxes and Fittings.

a. Galvanized or cadmium plated or aluminum or aluminum alloy, threaded, malleable iron boxes and fittings shall be installed in concrete walls, ceilings, and floors; in the outdoor faces of masonry walls; and in all locations where weatherproof device covers are required. These boxes and fittings shall also be installed in exposed rigid steel and intermediate metal conduit systems.

b. Galvanized or cadmium plated sheet steel boxes shall be installed in the indoor faces of masonry walls, in interior partition walls, and in joist supported ceilings.

c. Rigid PVC device boxes shall be installed in exposed nonmetallic conduit systems.

d. PVC coated boxes and fittings shall be installed in PVC coated conduit systems.

e. Telephone conduit shall be provided with separate junction boxes and pull fittings.

3-6.02. Device Plates. Oversized plates shall be installed where standard-sized plates do not fully cover the wall opening.

3-6.03. Wall Switches.

a. Wall switches shall be mounted 3'-6" [1.05 m] above floor or grade.

b. After circuits are energized, all wall switches shall be tested for proper operation.

3-6.04. Receptacles.

a. Convenience outlets shall be 18 inches [450 mm] above the floor unless otherwise required.

b. Convenience outlets outdoors and in garages; in basements, shops, storerooms, and rooms where equipment may be hosed down; shall be 4 feet [1.2 m] above floor or grade.

c. Welding receptacles shall be surface-mounted 4 feet [1.2 m] above the floor.

d. After circuits are energized, each receptacle shall be tested for correct polarity and each GFCI receptacle shall be tested for proper operation.

e. Conduit and wire for convenience outlet installation is not shown on the drawings and shall be sized, furnished, and installed by Contractor. Conductors shall be minimum 12 AWG and conduit shall be minimum 3/4 inch for convenience outlet installation.

3-6.05. Special Outlets.

a. Wall thermostats shall be 4'-6" [1.35 m] above the floor unless otherwise required. Thermostats on exterior walls shall be suitably insulated from wall temperature.

b. Telephone outlets shall be 18 inches [450 mm] above the floor unless otherwise required. Telephone outlets outdoors and in garages; in basements, shops, storerooms, and rooms where equipment may be hosed down; shall be 4 feet [1.2 m] above floor or grade.

c. Clock outlets shall be located 7 feet [2.1 m] above the floor.

d. Horns and strobe lights for audio/visual alarms shall be mounted a minimum of 8 feet above finished floor and shall be positioned to provide maximum penetration of the surrounding area.

3-7. EQUIPMENT INSTALLATION. Except as otherwise specified or indicated on the drawings, the following procedures shall be used in performing electrical work.

3-7.01. Setting of Equipment. All equipment, boxes, and gutters shall be installed level and plumb. Boxes, equipment enclosures, metal raceways, and similar items mounted on water- or earth-bearing walls shall be separated from the wall by at least 1/4 inch [6 mm] thick corrosion-resistant spacers. Where boxes, enclosures, and raceways are installed at locations where walls are not suitable or available for mounting, concrete equipment pads, framing material, and associated hardware shall be provided.

3-7.02. Sealing of Equipment. All outdoor substation, switchgear, motor control center, and similar equipment shall be permanently sealed at the base, and all openings into equipment shall be screened or sealed with concrete grout to keep out rodents and insects the size of wasps and mud daubers. Small cracks and

openings shall be sealed from inside with silicone sealant, Dow-Corning "795" or General Electric "SCS1200".

3-8. GROUNDING.

3-8.01. General. The electrical system and equipment shall be grounded in compliance with the National Electrical Code and the following requirements:

a. All ground conductors shall be at least 12 AWG [4 mm^2] soft drawn copper cable or bar, bare or green-insulated in accordance with the National Electrical Code.

b. Ground cable splices and joints, ground rod connections, and equipment bonding connections shall meet the requirements of IEEE 837, and shall be exothermic weld connections or irreversible high-compression connections, Cadweld "Exothermic" or Burndy "Hyground". Mechanical connectors will not be acceptable. Cable connections to bus bars shall be made with high-compression two-hole lugs.

c. Ground cable through exterior building walls shall enter within 3 feet [900 mm] below finished grade and shall be provided with a water stop. Unless otherwise indicated, installation of the water stop shall include filling the space between the strands with solder and soldering a 12 inch [300 mm] copper disc over the cable.

d. Ground cable near the base of a structure shall be installed in earth and as far from the structure as the excavation permits, but not closer than 24 inches [600 mm]. The tops of ground rods and ground cable interconnecting ground rods shall be buried a minimum of 30 inches [750 mm] below grade, or below the frost line, whichever is deeper.

e. All powered equipment, including lighting fixtures and receptacles, shall be grounded by a copper ground conductor in addition to the conduit connection.

f. Ground connections to equipment and ground buses shall be made with copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be made with irreversible high-compression type lugs inserted under permanent assembly bolts or under new bolts drilled and inserted through enclosures, other than explosion proof enclosures, or by grounding locknuts or bushings. Ground cable connections to anchor bolts; against gaskets, paint, or varnish; or on bolts holding removable access covers will not be acceptable.

g. The grounding system shall be bonded to the station piping by connecting to the first flange inside the building, on either a suction or discharge pipe, with a copper bar or strap. The flange shall be drilled and tapped to provide a bolted connection.

h. Ground conductors shall be routed as directly as possible, avoiding unnecessary bends. Ground conductor installations for equipment ground connections to the grounding system shall have turns with minimum bend radii of 12 inches [300 mm].

i. Ground rods not described elsewhere shall be a minimum of 3/4 inch [19 mm] in diameter by 10 feet [3 m] long, with a copper jacket bonded to a steel core.

j. Test wells and covers for non-traffic areas shall be molded high density polyethylene. Test wells for traffic areas shall be precast concrete construction rated for traffic duty with concrete or cast iron covers.

3-8.02. Grounding System Resistance. The grounding system design depicted on the contract drawings is the minimum design required for each building or structure. Each system shall comply with the maximum resistance, as required. Contractor shall confirm the system grounding resistance with the results of the testing specified herein. Systems exceeding the maximum resistance specified shall be supplemented with additional grounding provisions and retested until the maximum specified resistance is achieved.

3-8.03. Grounding System Testing. Each building or structure grounding system shall be tested to determine the resistance to earth as required. Testing shall be performed by an independent electrical or grounding system testing organization. Testing shall be completed after not less than three full days without precipitation and without any other moistening or chemical treatment of the soil.

3-8.03.01. New Grounding Systems. Grounding systems of each new building or structure shall be tested for resistance to earth utilizing the three-point fall of potential test as defined by IEEE 81. Testing shall be completed prior to installation of the electrical distribution equipment to ensure the grounding system is isolated from the utility grounding system and the systems of other structures. The current source probe for the test shall be placed in soil at a distance of 5 to 10 times the distance of the widest measurement across the grounding system ring or grid to ensure adequate measurements outside of the grounding system's sphere of influence. Test probe measurements shall be taken at a distance of one foot from the grounding system reference connection and at each 10 percent increment from the grounding system reference connection to the current source probe location. Test results shall be documented on a graphical plot with resistance in ohms on the vertical axis and

distance in feet on the horizontal axis. The results shall clearly indicate a system resistance plateau which confirms a valid test procedure.

3.8.03.02. Existing Grounding Systems. Grounding systems of each existing building or structure indicated shall be tested for resistance to earth. Where existing grounding systems can be isolated from the building power service or utility power service a three-point fall of potential test shall be completed as indicated above. Where isolation of the building grounding system is not practical, a clamp-on resistance test will be an acceptable alternative. Clamp-on resistance testing shall be completed utilizing a ground resistance tester specifically designed for clamp on resistance testing, such as the AEMC "Model 3711". Clamp-on resistance measurements shall be taken at the service side of the service entrance neutral, upstream of the neutral to ground bonding connection to ensure a single path between the grounding system and the utility reference.

3.8.03.03. Grounding System Test Report. A report certified by the testing organization shall be prepared and submitted in accordance with the submittals section. The final report shall include complete testing results for each building or structure, graphical representation of the test point results for the three-point fall of potential method, and complete observations of all site weather conditions and other environmental conditions that may affect the test results. Final acceptance of the results reported shall be subject to the review and approval of ENGINEER.

3-9. LIGHTING FIXTURE INSTALLATION. The drawings indicate the general locations and arrangements of the lighting fixtures. Fixtures in rows shall be aligned both vertically and horizontally unless otherwise specified. Fixtures shall be clear of pipes, mechanical equipment, structural openings, indicated future equipment and structural openings, and other obstructions.

Conduit and wire for lighting fixture installation is not shown on the drawings and shall be sized, furnished and installed by Contractor. Circuits to emergency lighting units, exit signs, and fixtures indicated to be night lights shall not be switched. Circuits to fluorescent lighting fixtures indicated to have emergency battery packs shall include an additional un-switched hot conductor. Conductors shall be minimum 12 AWG and conduit shall be minimum 3/4 inch for lighting fixture installation.

3-10. POWER FACTOR CORRECTION CAPACITOR INSTALLATION. Not used.

3-11. MODIFICATIONS TO EXISTING EQUIPMENT. Not used.

End of Section

STANDARD SPECIFICATIONS

REFERENCE: ICEA S-95-658 (NEMA WC 70).

CONDUCTOR: Concentric-lay, uncoated copper; strand Class B. Wet/dry maximum operating temperature 90°C.

INSULATION: Cross-linked thermosetting polyethylene, ICEA S-95-658, Paragraph 3.6.

SHIELD: None.

JACKET: None.

FACTORY TESTS: Cable shall meet the requirements of ICEA S-95-658.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm²		in.	μm	in.	mm
14	2.5	7	0.030	760	0.17	4.32
12	4.0	7	0.030	760	0.19	4.83
10	6.0	7	0.030	760	0.21	5.33
8	10.0	7	0.045	1140	0.27	6.86
6	16.0	7	0.045	1140	0.31	7.87
4	25.0	7	0.045	1140	0.36	9.14
2	35.0	7	0.045	1140	0.42	10.67
1	40.0	19	0.055	1400	0.48	12.19
1/0	50.0	19	0.055	1400	0.52	13.21
2/0	70.0	19	0.055	1400	0.57	14.48
4/0	95.0	19	0.055	1400	0.68	17.27
250	120.0	37	0.065	1650	0.75	19.05
350	185.0	37	0.065	1650	0.85	21.59
500	300.0	37	0.065	1650	0.98	24.89
750	400.0	61	0.080	2030	1.22	31.00
1,000	500.0	61	0.080	2030	1.37	34.80

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, XLP, XHHW-2, conductor size, and voltage class.

600 Volt, Single Conductor Lighting/Power Cable (600-1-XLP-NONE-XHHW-2)

BLACK & VEATCH	Cable Data	Figure 2-16050

STANDARD SPECIFICATIONS

REFERENCE: UL 62, UL 1277.

CONDUCTOR: 16 AWG (1.5 mm²), 7-strand, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, not less than 15 mils (380 μm) average thickness; 13 mils (330 μm) minimum thickness, UL 62, Type TFN.

LAY: Twisted pair with 1-1/2 inch to 2-1/2 inch (38.10 mm - 63.5 mm) lay.

SHIELD: Cable assembly, combination aluminum-polyester tape and 7-strand, 20 AWG (0.5 mm²) minimum size, tinned copper drain wire, shield applied to achieve 100 percent cover over insulated conductors.

JACKET: Conductor: Nylon, 4 mils (100 μm) minimum thickness, UL 62.

Cable assembly: Black, flame-retardant polyvinyl chloride, UL 1277, applied over tape-wrapped cable core.

CONDUCTOR IDENTIFICATION: One conductor black, one conductor white.

FACTORY TESTS: Insulated conductors shall meet the requirements of UL 62 for Type TFN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the vertical-tray flame test requirements of UL 1277.

Cable Details

	Assembly Jacket Thickness*		Maximum Outside Diameter	
	in.	μm	in.	mm
Single Pair	0.045	1140	0.34	8.64

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 80 percent of the value indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, Type TC, Type TFN, conductor size, single pair, and voltage class.

600 Volt, Single Pair, Shielded Instrument Cable (600-SINGLE-PAIR-SH-INSTR)

BLACK & VEATCH	Cable Data	Figure 4-16050

STANDARD SPECIFICATIONS

REFERENCE: UL 83, UL 1277, ICEA S-58-679.

CONDUCTOR: 14 AWG (2.5 mm²), 7 or 19 strands, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, not less than 15 mils (380 μm) average thickness; 13 mils (330 μm) minimum thickness, UL 83, Type THHN and THWN.

SHIELD: None.

JACKET: Conductor: Nylon, 4 mils (100 μm) minimum thickness, UL 83.

Cable assembly: Black, flame-retardant polyvinyl chloride, UL 1277, applied over tape-wrapped cable core.

CONDUCTOR IDENTIFICATION: ICEA S-58-679, Method 1, Table 2 or ICEA S-58-679, Method 3, Table 2. White or green conductors shall not be provided.

FACTORY TESTS: Insulated conductors shall meet the requirements of UL 83 for Type THHN-THWN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the flame test requirements of UL 1277 for Type TC power and control tray cable.

Cable Details

Number of Conductors	Assembly Jacket Thickness*		Maximum Outside Diameter	
	in.	μm	in.	mm
2	0.045	1140	0.38	9.65
3	0.045	1140	0.39	9.91
4	0.045	1140	0.44	11.18
5	0.045	1140	0.46	11.68
7	0.045	1140	0.49	12.45
9	0.045	1140	0.61	15.49
12	0.060	1520	0.66	16.76
19	0.060	1520	0.77	19.56
24	0.060	1520	0.93	23.62
30	0.080	2030	0.98	24.89
37	0.080	2030	1.05	26.67

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 80 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, Type TC, Type THWN or THHN, conductor size, number of conductors, and voltage class.

600 Volt, Multiconductor 14 AWG (2.5 mm²) Control Cable (600-MULTI-THHN-THWN)

BLACK & VEATCH	Cable Data	Figure 7-16050

Project and Location _____ Project No. _____

Circuit Designation _____ Date _____

DC TEST DATA

Time in Minutes After 100% Test Voltage Is Applied	Current, μA		
	Phase A	Phase B	Phase C
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
kV dc after 1 min Decay			

DC Test Voltage _____

Cable Installation: New ____ Used ___ Years____

Cable: Size _____ Length: _____

Oper. kV _____ Grounded _____ Ungrounded _____

Rated Cable Voltage _____

Insulation Wall _____
(Type & Thickness)

Conductor Jacket Wall _____
Type & Thickness)

Shield _____
(Type)

Cable Manufacturer _____

Temperature _____ Humidity_____

Type of Termination _____

Type of Splice & Location_____

_____

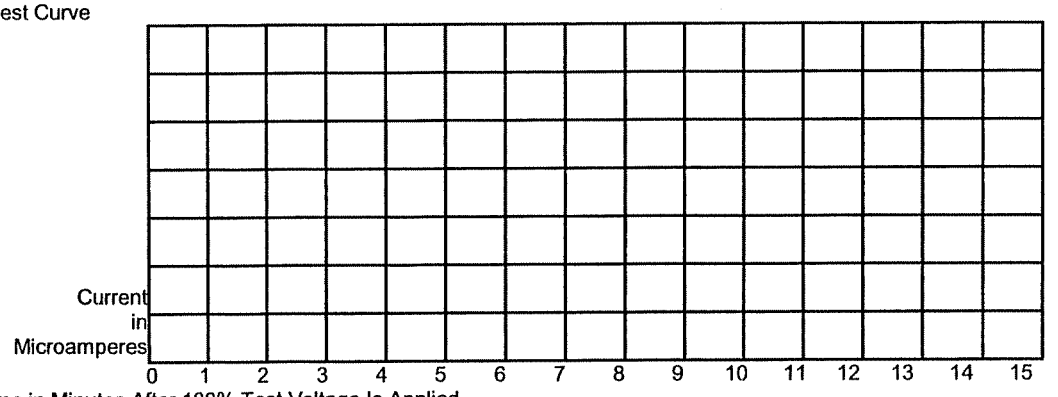
Remarks_____

100 Microamperes (μA) = 0.1 Milliampere

APPLICATION OF TEST VOLTAGE

The initially applied direct-current voltage shall be not greater than 3.0 times the rated alternating-current voltage. The rate of increase from the initially applied voltage to the specified test voltage shall be not over 100 percent in 10 seconds nor less than 100 percent in 60 seconds. The duration of the direct-current voltage test shall be 15 minutes for shielded cables and 5 minutes for nonshielded cables.

Test Curve



NOTES:

1. Plot results of tests on all three phases on this graph.
2. Assign and indicate values for each division on the microamperes scale as required for the circuit being tested.

Cable Test Data Form

BLACK & VEATCH	Cable Data	Figure 15-16050

Section 16100

ELECTRICAL EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of electrical equipment.

1-2. GENERAL. Equipment specified to be installed under this section shall be erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

The electrical equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 14 days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished under the original procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Delivery. When sills are required for electrical equipment, they shall be shipped ahead of the scheduled equipment delivery to permit installation before concrete is placed.

1-3.02. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Section 01614, and in accordance with manufacturer's written instructions, until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment clean and dry at all times. Openings shall be plugged or capped (or otherwise sealed by packaging) during temporary storage.

1-3.03. Handling. Electrical equipment shall be moved by lifting, jacking, or skidding on rollers as described in the manufacturer's instructions. Special lifting harness or apparatus shall be used when required. Lifting and jacking points shall be used when identified on the equipment. Contractor shall have required unloading equipment on site to perform unloading work on the date of equipment delivery.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. INSTALLATION. All installation work shall be in accordance with manufacturer's written instructions.

Electrical equipment cubicles and vertical sections shall be installed plumb and level. Drawout equipment carriages, circuit breakers, and other removable components shall operate free and easy without binding or distortion.

Unless otherwise indicated or specified, all indoor floor-mounted electrical equipment and control cabinets shall be installed on concrete equipment pads four inches [102 mm] in height.

Indoor metalclad switchgear shall be bolted to steel floor channels which are installed level and flush with the top of the concrete floor or equipment pad.

Outdoor metalclad switchgear and interrupter gear with integral floor channels or beams shall be secured to concrete pads with anchor bolts and clips.

Motor control centers with integral floor sills shall be secured to concrete floors or equipment pads with anchor bolts.

3-1.01. Cleaning. All deposits of oil, grease, mud, dirt or debris shall be cleaned from the electrical equipment following installation and field wiring. A detergent water based solution, or other liquid cleaners not harmful to material or equipment finishes, shall be used as recommended by the manufacturer.

End of Section

Section 16425

SWITCHBOARDS

Data Sheet

Para-graph	Description	Data	Units
	General		
	Tag numbers.	SWBD-1	
	Switchboard designations.	480 VOLT SWBD	
	Quantity of switchboards required	1	
	Location of switchboards.	Outside	
1-2.01.	General Equipment Requirements required.	☐ Yes ☒ No	
1-2.05.	Listed or labeled by approved testing laboratory.	☒ Yes ☐ No	
1-2.06.	Nameplates.	☒ Permanent nameplates required ☐ Namplates by others	
1-4.	Operation and maintenance manuals required.	☒ Yes ☐ No	
	Spare parts.	None	
1-6.	Coordination study.	☒ Yes ☐ No	
	Time current curves required for:	☑ Main breaker ☐ Tie breaker ☑ Largest feeder breaker ☑ Smallest breaker	
	System Characteristics		
	Voltage, phase.	☐ 240, 3 phase ☒ 480, 3 phase ☐ Other voltage	V [V]
	When "Other" is selected, indicate alternative value.		
	Frequency.	☐ 50 ☒ 60	Hz [Hz]
	Number of wires.	☒ 3 wire ☐ 4 wire	

	Construction Features		
	NEMA enclosure type.	☐ NEMA Type 1 ☐ NEMA Type 3R walk-in ☒ NEMA Type 3R non-walk-in	
	Main bus rating.	☐ 400 ☐ 600 ☒ 800 ☐ 1200 ☐ 1600 ☐ 2000 ☐ 2500 ☐ 3000 ☐ 4000	A [A]
	Connected.	☒ Front ☐ Rear	
	Access.	☒ Front ☐ Rear	
	Install against wall.	☐ Yes ☒ No	
	Section bottom type.	☐ Open ☒ Barriered	
	Busing		
2-2.02.	Neutral connection.	☐ Bus ☒ Pad	
	Bus fault rating (symmetrical).	☒ 50,000 ☐ 75,000 ☐ 100,000 ☐ 200,000	A [A]
	Incoming Line Section(s)		
	Number of incoming line sections.	☒ 1 ☐ 2	
	Service entrance rated.	☒ Yes ☐ No	
	Incoming cables.	☐ Top ☒ Bottom	
2-2.04.01	Cable pull box required.	☐ Yes ☒ No	

2-2.04.01	Cable pull box utility seal provisions.	☐ Yes ☐ No	
2-2.04.02	Busway entry compartment.	☐ Yes ☒ No	
2-2.04.03	Power utility metering requirements.	☐ Yes ☒ No	
2-2.04.04	Incoming line metering.	☐ Yes ☒ No	
2-2.04.04	If "Yes" is selected, indicate if metering is to be compatible with Metering System Software and Network in Section 16050.	☐ Yes ☐ No	
2-2.04.05	Transient voltage surge suppression.	☒ Yes ☐ No	
	Exposure level.	☐ High ☒ Medium-High	
2-2.04.05.08	TVSS options.		
	Dual Form "C" Dry contacts.	☒ Yes ☐ No	
2-2.04.06	Main breaker required.	☒ Yes ☐ No	
	If "Yes" is selected, indicate main breaker type.	☒ Molded case ☐ Fixed mounted insulated case power ☐ Drawout insulated case power	
	Operation.	☒ Manual ☐ Electrical	
	Breaker trip features (molded case).	☑ Magnetic/thermal trip ☐ Solid-state electronic trip ☐ Short time delay (electronic trip) ☐ Ground fault protection	
2-2.04.06	Interlocking.	☐ Key ☐ Electrical	
	Tie Breaker Section		
2-2.05.	Tie breaker section required.	☐ Yes ☒ No	

	Type.	☐ Molded case ☐ Fixed mounted insulated case power ☐ Drawout insulated case power	
	Operation.	☐ Manual ☐ Electrical	
	Breaker trip features (molded case).	☐ Magnetic/thermal trip ☐ Solid-state electronic trip ☐ Short time delay (electronic trip) ☐ Ground fault protection	
	Distribution Section		
2-2.06.	Distribution breakers required.	☒ Yes ☐ No	
	Type.	☒ Molded case ☐ Fixed mounted insulated case power ☐ Drawout insulated case power	
	Breaker trip features (molded case).	☑ Magnetic/thermal trip ☐ Solid-state electronic trip ☐ Short time delay (electronic trip) ☐ Ground fault protection	
	Cable exit.	☐ Top ☑ Bottom	
	Operation.	☒ Manual ☐ Electrical	
2-2.07.	**Molded Case Circuit Breakers**		
	MCB mounting.	☐ Individually ☒ Panel ☐ Individual main (tie) with panel distribution	
	MCB fault current rating (symmetrical).	☒ 35,000 ☐ 50,000 ☐ 65,000 ☐ 100,000	A [A]

2-2.08.	**Insulated Case Circuit Breakers**		
	ICB fault current rating (symmetrical).	☐ 35,000 ☐ 50,000 ☐ 65,000 ☐ 100,000	A [A]
	Environmental Conditions		
	Location.	☐ Inside building ☑ Outdoors	
2-2.09.	Undercoating required.	☑ Yes ☐ No	
	Installation		
3-2.01.	Installation check required.	☑ Yes ☐ No	
	If "Yes" is selected, indicate number of days.	1, follow up as needed	
	If "Yes" is selected, indicate number of round trips.	As needed	
3-2.02.	Installation supervision required.	☐ Yes ☑ No	
	If "Yes" is selected, indicate number of days.		
	If "Yes" is selected, indicate number of round trips.		

Section 16425

SWITCHBOARDS

PART 1 - GENERAL

1-1. SCOPE. This section covers switchboard equipment, which shall be furnished as specified herein and as indicated on the drawings. Switchboards shall meet the following requirements, and the design conditions and features as required.

Switchboards shall be designated and shall be located as required.

1-1.01. Terminology. When the phrase "as required" is stated in this section it shall mean "as required in the attached Data Sheet".

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Requirements. Not Used.

1-2.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers, and the layout area indicated on the drawings is based on typical values. The supplier shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by Engineer.

1-2.03. Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

1-2.04. Abbreviations. Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:

AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
AWG	American Wire Gage
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

1-2.05. Governing Standards. All equipment furnished under this section shall be designed, constructed, and tested in accordance with all the applicable standards of ANSI, NEMA, and UL, including, but not limited to, NEMA PB 2 and UL 891 (switchboards); NEMA AB1 and UL 489 (molded-case circuit breakers); ICS-6 (enclosures); and NEMA PD 2.2 (Ground Fault Protection).

As required, equipment covered by this section shall be listed by UL or a nationally recognized third-party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. In the event no third-party testing laboratory provides the required listing, an independent test shall be conducted at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to Engineer.

1-2.06. Nameplates. As required, each switchboard section shall have a nameplate permanently affixed to it, listing the following information:

Name of manufacturer

System voltage

Main bus rating

Type

Manufacturer's shop order number and date

In addition, each circuit breaker and instrument on the front of the switchboard shall have a suitable nameplate. Each incoming line section shall be furnished with a nameplate to indicate the power source or substation from which it is fed.

The nameplates for the distribution circuit breakers shall indicate the equipment fed through the breaker. Nameplates shall be black and white laminated phenolic material of suitable size, and shall be engraved with 3/4 inch [19 mm] high letters for section and circuit breaker identity and 1/8 inch [3 mm] letters for other information. The engraving shall extend through the black exterior lamination to the white center.

Each control device and each control wire terminal block connection inside the units shall be identified with a permanent nameplate or painted legend to match the identification on the manufacturer's wiring diagram.

1-2.07. System Characteristics. The equipment will be connected to a system as required.

1-3. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the switchboard, shall be submitted in accordance with the submittals section. The drawings and data shall include, but shall not be limited to, the following:

Switchboard

Elevation, plan, conduit entrance locations, and weight.

Circuit breaker time-current characteristic curves.

Nameplate legends and equipment schedule.

Single-line and control wiring interconnection diagrams.

Metering section details.

Shop test report.

Installation report.

Transient voltage surge suppressor submittals shall include drawings (including unit dimensions, weights, component and connection locations, mounting provisions, and wiring diagrams), all testing documentation as specified herein, equipment manuals that detail the installation, operation and maintenance instructions for the specified unit(s), and manufacturer's descriptive bulletins and product sheets.

1-4. OPERATION AND MAINTENANCE DATA AND MANUALS. As required, adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with the submittals section.

Operation and maintenance manuals shall include the following:

a. Assembly, installation, alignment, adjustment, and checking instructions.

b. Lubrication and maintenance instructions.

c. Guide to troubleshooting.

d. Parts lists and predicted life of parts subject to wear.

e. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.

f. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-5. SPARE PARTS. Spare parts shall be provided as required.

Spare parts shall be suitably packaged, as specified herein, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed.

1-6. COORDINATION STUDY. As required, a coordination study of the power distribution system will be conducted as specified in the electrical section. The equipment manufacturer shall provide the following information to Engineer with the initial equipment drawing submittal:

Protective relay coordination curves for each solid-state trip device.

Time current curves shall be provided for circuit breakers as required.

Data for all devices with adjustable settings shall be submitted, with all literature necessary to determine the appropriate settings. This shall include, but shall not be limited to, Operation Manuals for each type of adjustable trip device.

1-7. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the shipping section. Handling and storage shall be in accordance with the handling and storage section.

Switchboards shall be equipped to be handled by crane. Where cranes are not available, switchboards shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. The switchboard shall be manufactured by Cutler-Hammer, General Electric, Siemens Energy & Automation, or Square D, without exception.

2-2. CONSTRUCTION. All equipment furnished under this section shall be designed and constructed in accordance with the following requirements:

2-2.01. Enclosure. The switchboard shall be of deadfront, modular type construction with the required number of vertical sections bolted together to form one rigid, metal-enclosed unit as required. All sections shall be aligned in both front and rear. The switchboard frame shall be of formed UL gauge steel, rigidly bolted together to support all cover plates, buses, and circuit breakers. Steel base channels shall be bolted to the frame. Each section shall have a removable top plate and, as required, an open or a barriered bottom for installation and termination of conduit. All front covers shall be removable with a single tool and all doors shall be hinged, with removable hinge pins.

2-2.02. Busing. The main a bus shall be tin-plated copper and shall be of sufficient size to limit the temperature rise to 65°C, based on UL tests. End sections shall be predrilled for units to be added in the future.

2-2.02.01. Neutral Bus. Not Used.

2-2.02.02. Neutral Pad. As required, the incoming line section shall be equipped with a neutral bond lug suitable to bond the service entrance neutral conductors. The service entrance neutral pad shall be equipped with a main bonding jumper to the switchboard ground bus in accordance with the National Electrical Code.

2-2.03. Ground Bus. The ground bus shall extend the entire length of the switchboard and shall be firmly secured to each vertical section. A ground lug shall be provided at each end of the ground bus for connection to building grounding system with 4/0 AWG bare copper cables. Other ground lugs for feeder circuits shall also be supplied as indicated on the drawings.

2-2.04. Incoming Line Sections. Incoming line sections shall be provided as shown on the one-line diagram and as specified herein.

2-2.04.01. Cable Pull Box. Not Used. As required, the cable pull box shall include provisions for a power utility seal.

2-2.04.02. Busway Entry Compartment. Not Used.

2-2.04.03. Power Utility Metering Compartment. Not Used.

2-2.04.04. Incoming Line Metering Compartment. Not Used.

2-2.04.05. Transient Voltage Surge Suppression.

2-2.04.05.01. Scope. Transient voltage surge suppression (TVSS) devices shall be provided as specified herein and as indicated on the drawings. Each unit shall be designed for parallel connection to the facility's wiring system and shall utilize non-linear voltage-dependent metal oxide varistors (MOV) in parallel.

TVSS devices shall be furnished and installed for the electrical equipment indicated on the drawings and designated in this section as required and as specified herein. TVSS devices shall be installed integral to each switchboard.

2-2.04.05.02. Standards. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

ANSI/IEEE C62.41-1991 and C62.45-1992;

ANSI/IEEE C62.1 and C62.11;

National Electrical Manufacturers Association (NEMA LS1-1992 Guidelines);

National Fire Protection Association (NFPA 20, 70 [NEC], 75, and 78);

Underwriters Laboratories UL 1449 Second Edition and 1283

The unit shall be UL 1449 Second Edition Listed as a Transient Voltage Surge Suppressor and UL 1283 Listed as an Electromagnetic Interference (EMI) Filter.

2-2.04.05.03. Environmental Requirements.

a. Operating Temperature: -40°F to +140°F (-40°C to +60°C).

b. Relative Humidity: Reliable operation with 5 percent to 95 percent non-condensing.

2-2.04.05.04. Electrical Requirements.

a. Unit Operating Voltage. The nominal unit operating voltage and configuration shall be as indicated on the drawings.

b. Maximum Continuous Operating Voltage (MCOV). The TVSS device shall be designed to withstand a MCOV of not less than 115 percent of nominal RMS voltage.

c. Operating Frequency. Operating frequency range shall be 47 to 63 Hertz.

d. Protection Modes. All protected modes are defined per NEMA LS-1-1992, paragraph 2.2.7. Following IEEE Standard 1100-1992, section 9.11.2 recommendations, four-wire configured systems shall provide Line-to-Neutral (L-N), Line-to-Ground (L-G), and Neutral-to-Ground (N-G), and Line-to-Line (L-L) protection. Three-wire configured systems shall provide Line-to-Line (L-L) protection and Line-to-Ground (L-G) protection.

e. Rated Single Pulse Surge Current Capacity. The rated single pulse surge current capacity, in amps, for each mode of protection of the unit shall be as required and shall be no less than as follows:

	L-N	L-G	N-G	L-L
High Exposure Level	120 kA	120 kA	120 kA	120 kA
Medium-High Exposure Level	100 kA	100 kA	100 kA	100 kA

f. UL 1449 Second Edition Suppression Voltage Rating (SVR). The maximum SVR for the device (inclusive of disconnect) shall be as required and shall not exceed the following:

Voltage	L-N	L-G	N-G	L-L
240 V 3W		700 V		800 V
240 V 4W	800 V	800 V	500 V	1500 V
480 V 3W		1500 V		1800 V
480 V 4W	900 V	800 V	1500 V	1800 V

g. Noise Attenuation. EMI noise rejection or attenuation values shall be measured in accordance with test and evaluation procedures outlined in NEMA LS-1-1992. The unit shall be capable of a minimum -40 dB attenuation at 100kHz when tested per the 50 ohm insertion loss method as defined by MIL-STD-220A.

h. Minimum Repetitive Surge Current Capacity. The minimum number of repetitive surges per mode as a result of testing a 20 kV, 10kA ANSI/IEEE C62.41 Category C3 surge current with less than a 10 percent degradation of clamping voltage shall be 5000.

i. Overcurrent Protection. At high and medium-high exposure levels, the TVSS device shall incorporate internal fusing capable of interrupting, at minimum, up to 200kA symmetrical fault current with 600 VOLT AC applied.

The device shall be capable of allowing passage of the rated maximum surge current for every mode without fuse operation.

j. Unit Status Indicators. The unit shall include long-life, externally visible phase indicators that monitor the on-line status of the unit.

2-2.04.05.05. Testing Documentation. Contractor shall submit documentation of third party testing from a nationally recognized testing laboratory (NRTL) for the following:

a. Single Pulse Surge Current Capacity Testing. Verify that the suppressor components can survive the published surge current rating for each mode and for each phase using the ANSI/IEEE C62.41, 8 x 20 microsecond current wave.

b. Minimum Repetitive Surge Current Capacity Testing. Confirm the minimum number of repetitive surges per mode the device can protect against with less than a 10 percent degradation of clamping voltage as a result of testing a 20 kV, 10kA ANSI/IEEE C62.41 Category C3 surge current.

c. UL 1449 Second Edition Testing. Provide verification that the TVSS device complies with these ratings.

d. Overcurrent Protection Testing.

Verify that the total surge current can be passed through the fuse with no charring, flames, or projection of materials. Testing of the fuse only will not be acceptable for this requirement. Testing shall indicate the lowest possible surge that can disrupt the fusing.

Confirm that the fuse can withstand the rated fault current. Testing shall be conducted in both high and low impedance fault conditions and shall confirm no charring, flaming, or projection of materials.

e. Let-through Voltage Testing. Supply an oscilloscope graph for each of the following wave forms tested in accordance with ANSI/IEEE C62.45:

ANSI/IEEE Category C3 combination wave (20 kV, 10kA, 8 x 20 microsecond impulse)

ANSI/IEEE Category C1 combination wave (6 kV, 3kA, 8 x 20 microsecond impulse)

ANSI/IEEE Category B3 ringwave (6 kV, 500 A, 100 kHz)

f. EMI Testing. Provide spectrum analysis based on MIL-STD 220A test procedures between 50 kHz and 200 kHz.

2-2.04.05.06. Warranty. The manufacturer shall provide a minimum Five 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.

2-2.04.05.07. Installation. The TVSS devices shall be installed according to the manufacturer's recommendations. If possible for the integral units, provide direct bus connections.

2-2.04.05.08. Options

a. Disconnect Switch. Each TVSS device shall be furnished with an integral disconnect switch. The unit shall be UL1449 Second Edition listed as such, and the UL1449 Second Edition Suppression Voltage Ratings shall be provided. The disconnect switch shall be fused and capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.

b. Dual Form "C" Dry Contacts. As required, the TVSS system shall be provided with a set of form "C" dry contacts (normally open and normally closed) to facilitate connection to a plant control system or other remote monitoring system. The contacts shall be normally open or normally closed and shall change state upon any alarm condition.

2-2.04.06. Main Breaker. As required, each incoming line section shall include a molded case, fixed mounted insulated case, or drawout insulated case power circuit breaker with a current rating as indicated on the drawings. Internal control power transformers shall be provided to furnish control power for insulated case power circuit breakers.

Compression type terminals shall be provided for terminating the number and size of copper conductors indicated on the drawings.

2-2.05. Tie Breaker Section. Not Used.

2-2.06. Distribution Section. The distribution section shall be provided to house branch circuit breakers as indicated on the drawings. Circuit breakers shall be molded case (individually mounted or panel mounted as required), fixed mounted insulated case, or drawout insulate case as required. Circuit breakers shall be removable from the front without disturbing adjacent units. The switchboard shall contain space for future units as indicated on the drawings.

2-2.07. Molded Case Circuit Breakers. Molded case circuit breakers shall be individual or panel mounted as required. Circuit breakers shall be rated to interrupt and withstand an available fault current at the system line voltage as required. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break, over-center switching mechanism that is mechanically tripfree. As required, circuit breakers shall be thermal magnetic or shall be furnished with a solid-state electronic trip unit complete with built-in current transformers. The ampere rating of the trip unit shall be as indicated on the drawings.

The trip unit shall have adjustable settings for continuous amperes, instantaneous pickup, and short-time pickup. As required, the trip unit shall be provided with additional short delay trip time adjustment for better system coordination. Circuit breakers indicated to be rated less than 100 amperes shall be thermal-magnetic types.

As required, built-in ground fault protection shall have adjustable pick-up ratings not exceeding 1,200 amperes, time delay adjustable from 0.1 to 0.5 seconds, and a neutral ground fault current transformer.

The solid-state electronic trip breakers shall have built-in test points for testing long delay, instantaneous, and ground fault functions of the breaker by means of a 120 volt ac operated test kit.

2-2.08. Insulated Case Power Circuit Breakers. Insulated case power circuit breakers shall be fixed or drawout type, as required, with a manually or electrically operated stored energy mechanism as required. The insulated case breakers shall be UL listed for operation at 100 percent of continuous current rating. The circuit breakers shall be rated to interrupt and withstand an available fault current as required, at system line voltage, as required. The breaker control faceplate shall include color-coded visual indicators for open and closed positions as well as mechanism charged and discharged positions. Manual push buttons shall be provided for opening and closing the breaker.

Each breaker shall be furnished with a solid-state tripping system consisting of three current sensors, a solid-state trip device, and shunt trip. The solid-state element shall have long delay current pickup, short delay pickup, instantaneous pickup, ground fault pickup and fault trip indicators. All elements of the solid-state trip device shall be of the sealed potentiometer type providing adjustable current pickup in percentage of current sensor primary rating and time delay adjustments. The current sensor primary ampere rating shall be as indicated on the drawings.

The breaker shall have built-in test points for testing long delay, short delay, instantaneous, and ground fault functions of the breaker by means of a 120 volt ac operated test kit.

2-2.09. Shop Painting. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop painted with the manufacturer's standard coating. Finish color shall be ANSI 61. Field painting, other than touchup painting, will not be required. A sufficient quantity of additional coating material and thinner shall be furnished for field touch up of damaged coatings.

As required, the underside of equipment to be installed in exposed outdoor locations shall be thoroughly cleaned and coated with an automotive type undercoating material. The coating shall be thick enough to withstand normal handling during shipping and installation. The underside is defined as the surfaces in contact with the floor or pad and other surfaces not readily accessible for field painting. The coating may be factory or field applied.

2-3. ACCESSORIES.

2-3.01. Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2-4. SHOP TESTS. After the equipment has been completely assembled, it shall be shop tested for general operating conditions, circuit continuity, and high potential and other standard tests for the particular class of equipment as defined by industry standards. Four certified copies of the test results shall be submitted to Engineer before the equipment is shipped.

PART 3 - EXECUTION

3-1. INSTALLATION. Installation will be in accordance with Section 16100.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. As required, an experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Section 01650, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The representative shall verify that the settings of all protective devices are as recommended in the coordination study, make all adjustments, approve the installation, and test the ground fault system. The ground fault system testing shall satisfy the requirements of the National Electrical Code.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting conduit or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price for the number of days and round trips to the site as required.

3-2.02. Field Installation Supervision. Not Used.

End of Section

Section 16610

UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1-1. SCOPE. This section covers uninterruptible power supply equipment, which shall be furnished and installed as specified herein and as indicated on the drawings. The equipment shall be a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power supply (UPS). The UPS shall operate in conjunction with the existing plant electrical system to provide power conditioning and backup for the UV disinfection system electrical loads. The unit shall be designated "UPS-1" on the drawings.

System operation shall convert incoming 480-volt, 3-phase power into dc power, maintain and charge backup batteries, and reconvert outgoing power into a sinusoidal 480-volt, three-phase, AC power source. The UPS shall consist of the UPS module, batteries/battery cabinet(s) and a maintenance by-pass isolation switch. The UPS module shall include a rectifier, inverter, battery charger, static bypass, associated control and monitor panel and other features as described herein or as indicated on the drawings.

Additional accessories and appurtenances shall be provided as specified herein and as required to yield a complete and properly operating system. Locations and arrangement of enclosures and provide one-line diagrams regarding the connection and interaction with other equipment are indicated on the drawings.

The Uninterruptible Power Supply is associated with Alternative A as indicated in the Contract Documents.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

The Uninterruptible Power Supply shall be a product of a manufacturer who has supplied such equipment for at least 5 years. The UPS shall be designed and coordinated to operate in conjunction with the UV disinfection system specified in Section 13700 – UV Disinfection System. The supplier shall submit reference information on at least three projects which were designed and furnished by the supplier, and which utilized similar hardware.

1-2.01. General Equipment Requirements. The General Equipment Requirements shall apply to all equipment furnished under this section.

1-2.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. Contractor shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by Engineer.

1-2.03. Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

1-2.04. Abbreviations. Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:

ANSI	American National Standards Institute
AWG	American Wire Gage
FS	Federal Specifications
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

1-2.05. Governing Standards. The equipment furnished under this section shall be designed, constructed, and tested in accordance with UL 1778, Standard for Uninterruptible Power Supply Equipment, and the latest applicable standards of ANSI, NEMA, and IEEE.

The Uninterruptible Power Supply shall be UL listed in accordance with UL 1778.

1-2.06. Nameplates. Nameplates with designation of each control or indicating device shall be mounted on the switch enclosure. Nameplates shall be black and white laminated phenolic material of suitable size, and shall be engraved with 3/4 inch high letters for section identity and 1/8 inch letters for other information. The engraving shall extend through the black exterior lamination to the white center.

Each control device and each control wire terminal block connection inside the units shall be identified with a permanent nameplate or painted legend to match the identification on the manufacturer's wiring diagram.

1-2.07. System Characteristics. The equipment will be connected to a 480-volt 3-phase, 60 Hz, 3-wire grounded wye (no neutral loads) system.

1-3. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the transfer switch, shall be submitted in accordance with Section 01300 – Submittals. The drawings and data shall include, but shall not be limited to, the following:

a. Drawings showing front and side views, plan, and weight.

b. Rating and specifications.

c. Circuit breaker time-current characteristic curves, if applicable.

d. Single-line, control schematic, and wiring connection diagrams.

e. Operation and maintenance and manuals including a list of spare parts.

1-4. OPERATION AND MAINTENANCE MANUALS. Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with Section 01300 – Submittals.

Operation and maintenance shall include the following:

a. Assembly, installation, alignment, adjustment, and checking instructions.

b. Lubrication and maintenance instructions.

c. Guide to troubleshooting.

d. Parts list and predicted life of parts subject to wear.

e. Outline, cross-section, and assembly drawings; engineering drawings and wiring diagrams.

f. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions packed with or attached to the equipment when delivered.

1-5. SPARE PARTS. Spare parts shall be provided as recommended to support the uninterruptible power supply equipment emergency needs. The spare parts shall include at least one complete set of all plug-in components and shall include the following:

a. Power fuses.

b. Control fuses.

c. Indicating lights.

d. Rectifier power semiconductors.

e. Inverter power semiconductors.

f. Other field-replaceable component parts.

Spare parts shall be suitably packaged, as specified herein, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed.

1-6. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with Section 01612 – Shipping. Handling and storage shall be in accordance with Section 01614 – Handling and Storage.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS.

The Uninterruptible Power Supply shall be as manufactured by Eaton Electrical Powerware or equal.

2-2. CONSTRUCTION FEATURES.

2-2.01. Enclosure. The enclosure for the uninterruptible power supply shall be indoor rated, NEMA Type 1 freestanding construction suitable for mounting on an equipment housekeeping pad. Each cabinet shall require front access only for installation, service and maintenance. The back and side enclosures shall be capable of being located directly adjacent to a wall. The cabinet shall provide top and bottom cable entry. The UPS equipment shall be designed for forced-air cooling.

2-2.02. Rating. Uninterruptible Power Supply shall be rated for continuous duty in both normal and emergency positions.

2-2.03. Modes of Operation. The UPS Module shall operate as an on-line, fully automatic system in the following modes:

a. Normal – Utilizing commercial AC power, the critical load shall be continuously supplied by the inverter. The inverter shall power the load while regulating both voltage and frequency. The rectifier shall derive power from the plant's AC power source and shall supply DC power to the inverter. Simultaneously, the battery charger shall charge the battery.

b. Battery – Upon failure of the commercial AC power, the critical load shall continue to be supplied by the inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.

c. Recharge – Upon restoration of the AC source, the battery charger shall recharge the batteries and simultaneously the rectifier shall provide power to the inverter. This shall be an automatic function and shall cause no interruption to the critical load.

d. Bypass – If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel..

2-3. PERFORMANCE AND DESIGN REQUIREMENTS.

2-3.01. Equipment Description. The UPS module shall consist of the following standard components.

2-3.01.01. Rectifier/Charger. The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency pulse-width-modulation (PWM) design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module.

The rectifier shall be capable of drawing power from the utility with a power factor of 0.95 under nominal conditions or from power supplied by a standby power engine generator.

The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

The battery charger shall supply a float current to the batteries to maintain them at a fully charged state while incoming power is provided. The charging voltage shall be temperature-compensated over the entire operating temperature range to avoid overcharging or undercharging the batteries. The battery charger shall automatically apply an elevated voltage (equalization charge) to the batteries as required by the battery manufacturer.

The charger shall be capable of being configured for a charging mode that increases battery life by allowing the battery to rest, reducing positive plate corrosion, and a charging mode floating the battery at a set level, which can be adjusted via software, used for flooded cell applications

The UPS battery charging system shall have the following characteristics:

a. Nominal Voltage: 2.25 V per cell.

b. Equalizing Voltage: 2.38 V maximum per cell (adjustable).

c. Automatic (time based) or manual (user initiated) equalization available.

UPS module will automatically adjust battery shutdown based upon loading and battery capacity.

The UPS module shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge. The absolute minimum operational voltage is 1.67 V per cell (adjustable).

The UPS module will automatically disconnect the battery system in case of full battery discharge followed by prolonged utility AC voltage failure. The time window before battery disconnection occurs shall be programmable for both time and voltage.

2-3.01.02. Inverter. The inverter shall feature an IGBT pulse-width-modulation design with high speed switching. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module.

The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

2-3.01.03. Static Bypass. The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers.

2-3.01.03.01. Automatic Transfer to Bypass. The transfer to bypass shall be automatically initiated for the following conditions:

a. Output overload period expired.

b. Critical bus voltage out of limits.

c. Internal over temperature period expired.

d. Total battery discharge.

e. UPS failure.

2-3.01.03.02. Automatic Re-transfer. Uninterrupted automatic re-transfers shall take place whenever the inverter is capable of assuming the critical load. The automatic re-transfer shall be inhibited for the following conditions:

a. When transfer to bypass is activated manually or remotely.

b. In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The fourth transfer shall lock the critical load on the bypass source.

c. UPS failure.

2-3.01.03.03. Manual Transfer to Bypass Uninterrupted manual transfers shall be initiated from the UPS control panel. Uninterrupted manual transfers to and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.

All transfers to bypass shall be inhibited for the following conditions:

a. Bypass voltage out of limits (+/- 10% of nominal).

b. Bypass frequency out of limits (+/- 3 Hz, adjustable, factory set).

c. Bypass out of synchronization.

d. Bypass phase rotation / installation error.

The static transfer time, no break, shall be completed in less than 4ms.

2-3.01.04. 2-breaker Maintenance Bypass. The UPS shall include a manual maintenance bypass switch to isolate UPS module from normal AC input and critical load. Switch shall provide complete isolation of UPS for servicing and, if necessary, complete removal and replacement of UPS while still providing bypass power to critical load. Switch shall be make-before-break, interlocked between UPS and bypass to prohibit improper operation. Maintenance Bypass Breaker and the Maintenance Isolation Breaker shall be rated 480-volt and sized at 300amp, 35kaic.

2-3.01.05. Battery Cabinet. The battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements.

The battery cabinet shall have the following features:

a. Batteries shall be sized to provide ten (10) minutes of battery backup time at 125kw load.

b. The battery cabinet shall be the same depth and height as the UPS module. The battery cabinet shall feature a mechanical enclosure similar to the UPS module. Each battery cabinet shall require front access only for installation, service and maintenance. Power wiring internal to each battery cabinet shall be factory provided.

c. Each battery cabinet shall feature up to 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.

d. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string within that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition. The circuit breaker in each battery cabinet shall feature a 48VDC under voltage release device. The under voltage release device shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.

e. Power and Control wiring between the battery cabinet and the UPS shall be factory provided with compression type connectors between cabinets. The batteries shall be configured with a 1/4" spade type connector for attaching sense leads to each jar to facilitate the future addition of a battery monitoring system.

Expected battery life shall be a minimum of 200 complete full load discharge cycles when operated and maintained within specifications.

2-3.01.06. Monitoring and Control components. The UPS shall provide monitor and control capability and shall include a control panel with status indicators, an alarm and metering display, provisions for building alarm monitoring, and communication ports.

2-3.01.07. Battery Management System. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information shall be available.

The battery management system shall automatically test the battery string(s) to ensure that the battery is capable of providing greater that 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery string(s) not capable of providing 80%, the UPS system will alarm that the battery needs attention/replacement.

The battery test shall be able to detect for an open battery string, shorted battery string and a battery capacity (runtime) less than 80% of "new" battery capacity.

All control components shall meet or exceed the voltage withstand capability in accordance with IEEE 472 and NEMA ICS 1-109.

2-3.03. Indication and Alarms. Indicators and alarms shall be provided as a part of the UPS. Indicator LED lights and alarms shall be provided on the face of the UPS. Alarms and indicators shall be permanently labeled.

Indicator lights shall be provided for the following:

a. UPS Normal.

b. UPS On Battery.

c. Bypass On.

d. Alarm/Overload.

The UPS shall activate a manually resettable audible alarm upon any of the following conditions.

a. Inverter or rectifier fault.

b. Overload.

c. Low battery voltage.

d. Battery overcharge.

A common isolated "UPS Trouble" alarm contact shall be provided for input to the plant PLC for remote alarming. The alarm contact shall close on any of the alarm conditions listed above.

An isolated "UPS on Battery" alarm contact shall be provided for input to the plant PLC for remote alarming. The alarm contact shall close to signify loss of utility power at the UPS.

2-3.04. Shop Painting. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop painted with the manufacturer's standard coating. Finish color shall be ANSI 61 and acceptable to Owner. Field painting, other than touchup painting, shall not be required. A sufficient quantity of additional coating material and thinner shall be furnished to permit field touchup of damaged coatings.

2-3.05. Shop Tests. After the equipment has been completely assembled, it shall be shop tested for general operating condition, circuit continuity, high

potential, and for compliance with the governing standards. Certified test results shall be submitted to Engineer before the equipment is shipped.

PART 3 - EXECUTION

3-1. INSTALLATION. The transfer switch will be installed in accordance with Section 16100 – Electrical Equipment Installation.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Section 01650 – Startup Requirements, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

All control devices, including interlocks, indicating lights, control relays, and time delay relays, shall be checked for correct operation. The operation of the Uninterruptible Power Supply shall be tested for proper transfer of power from normal source to emergency source and back to normal source. The bypass function shall also be tested for proper operation.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting conduit or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price for the number of days and round trips to the site as required.

3-2.02. Training of Owner's Personnel. The training of Owner's personnel in the proper operation, troubleshooting and maintenance of the equipment shall be in accordance with Section 01020 – Training.

End of Section