ADDENDUM NUMBER 3

for

ADVANCED TREATMENT PROJECT
FORT THOMAS TREATMENT PLANT
NORTHERN KENTUCKY WATER DISTRICT

FROM: CH2M HILL

TO: Plan Holders of Record

The following changes, additions, and deletions are hereby made a part of the project Bidding Documents as fully and completely, as if the same were set forth therein. Acknowledge receipt and acceptance of this Addendum in the space provided on the BID FORM .

SPECIFICATIONS

Item No. AD3-1: Invitation to Bid (Section 00 11 13)

Revise the Bid Opening time and date in the first paragraph to 2:00 p.m., local time on the 21st day of January 2010.

Item No. AD3-2: Bid Form (Section 00 41 13)

As a clarification, unbound Bid forms for use in submitting bids will be issued in a subsequent addendum.

Revise Alternate No. 3 Deduct Vegetated Roof Assembly by replacing the specification section number in the second line with "SBS Modified Bituminous Membrane Roofing and Green Roof Surfacing, Section 07 52 00".

Revise Alternate No. 6 Deduct UV System description by replacing the second sentence with the following:

Replace the three reactor trains with blind flanges on the two outside trains at the 48-inch headers on both ends and a single 48-inch pipe through the center train.

Item No. AD3-3: Supplements to Bid Form (Section 00 41 13.1)

Delete Attachments Number 6A, and 6B and replace with the forms attached to this addendum.

Item No. AD3-4: Metal Fabrications (Section 05 50 00)

Revise the section by deleting article 2.06.A and replace with the following:

A. ASTM A240/A204M stainless steel plate
B. ASTM A276, A 151 Type 316 stainless steel angles

Item No. AD3-5: Miscellaneous Specialties (Section 10 80 00)

Delete article 2.01, Flagpole in its entirety.

Item No. AD3-6: Instrumentation and Control Devices for HVAC (Section 23 09 00)

As a clarification, all HVAC controls for this project shall be electrical/electronic. DDC system is not required.

Item No. AD3-7: Automatic Transfer Switches (Section 26 36 23)

Insert the specification section attached to this addendum.

Item No. AD3-8: Trench Backfill (Section 31 23 23.15)

In Article 3.04 BEDDING, in paragraph D. Minimum Thickness, change item 1. To read as follows: "Pipe 15 Inches and Smaller: 6 inches."

Item No. AD3-9: Conveyance Piping - General (Section 33 05 01)

In Article 3.06 THRUST RESTRAINT, delete paragraph A. entirely and replace it with the following paragraph:

"A. Location: Thrust restraint shall be provided at every joint for all buried process and pressure piping."

Item No. AD3-10: Ductile Iron Pipe and Fittings (Section 33 05 01.02)

In Article 2.01 MATERIALS, in paragraph C. Fittings, revise item 1 by inserting the following phrase after "AWWA C110": "…or AWWA C153". Intent of this revision is to allow compact DI fittings.

Item No. AD3-11: Process Piping (Section 40 27 00)

Delete the Piping Schedule in the supplement to this specification section dated November 30, 2009 and replace it the revised Piping Schedule supplement attached to this addendum.

Item No. AD3-12: Process Valves and Operators (Section 40 27 02)

Add the following new valve to the Process Valve and Motor Actuator Schedule supplement at the end of this specification section:

"Tag No.: FT-UE-BFV-005.
Location: Buried line from splitter box to clearwell no. 1.
Valve Type: V504.
Size: 36 inches.
Flow stream: UE.
Max. Operating Flow: 5,300 gpm.
Max. Operating Pressure: 10 psi.
Motor actuated: NO.
Travel time, voltage, phase, service : all 'not applicable' "

Amend the Valve Schedule in the Supplement to add rows at the end of the supplement. The added rows are provided on an attachment to this addendum.

Item No. AD3-13: Instrumentation and Control for Process Systems (Section 40 90 00)

Revise Article 1.01 SUMMARY as follows:

Delete the first two lines of paragraph 1.01 B.4 and replace with the following:

4. Applications Software: Provided by Contractor for PLCs. HMI Wonderware software will be provided by the Owner. Work related to supporting this activity includes:

Delete paragraph 1.01 B.4.b.

Item No. AD3-14: Overhead Cranes (Section 41 22 13.13)

In Table 1 of the Supplement at the end of this specification section change the Hoist type, for both cranes, from "Electric wire rope" to "Electric chain".

Item No. AD3-15: Submersible Pumps (Section 44 42 56.04)

Delete the Submersible Pump Data Sheet in the supplement to this specification section and replace with the revised Submersible Pump Data Sheet attached to this addendum.

Item No. AD3-16: Sampling Pumps (Section 44 42 56.17)

Delete the Sampling Pump Data Sheet in the supplement to this specification section and replace with the revised Sampling Pump Data Sheet attached to this addendum.

In Article 2.03 ACCESSORIES add the following new subarticle:

"D. Provide baseplate and frame for installation each pump assembly as specified and shown. Metal fabrications shall comply with Section 05 50 00."

In Article 3.01 INSTALLATION, in paragraph C in the second line delete the words " … and level…".

Item No. AD3-17: UV System (Section 44 44 73)

Delete the section in its entirety and replace with the revised section attached to this addendum.

DRAWINGS

Item No. AD3-18: Index of Drawings (FT-G-002)

Add the following drawing to the index of drawings:

"FT-D-507 SAMPLING PUMP DETAILS"

Item No. AD3-19: General Site Plan (Sheet FT-C-101)

Add Note F. into Contractor Notes: "Contractor shall notify Sanitation District 1 at least 72 hours prior to commencing construction activity at 859-578-6880".

Item No. AD3-20: Site Layout & Paving Plan (Sheet FT-C-103)

Add the following note:

Note: Flagpole near Filter Building shall be removed and salvaged before excavation in the area of the pole. Reset pole in location designated by the Construction Contract Administrator after excavation and backfill have been completed.

Revise the note for the concrete steps at west side of the existing filter building from "Replace concrete steps w/ step size of 7" riser & 11" tread" to "Replace concrete steps per attached details"

Add Concrete Pavement Jointing Note:

A. Provide 1/2-inch expansion joints with filler, backer rod and sealer at maximum 50-foot spacing and where abutting walls and other structures

B. Provide contraction/sawed joints at maximum 12-foot spacing longitudinally and transversely

C. Contraction joints shall be minimum 1/3 pavement depth

D. Contractor shall submit joint pattern to engineer prior to commencing concrete placement

Item No. AD3-21: Grading and Drainage Plan (FT-C-104)

In the Drainage Structure Notes table at the upper left of this drawing, revise the structure type for STM STR #2, #3 and #4 to be 5' DIA STORM MANHOLE instead of 4' diameter storm manhole.

Revise STM STR #5 structure type from 4' diameter storm manhole to KDOH drop box inlet Type 7.

Item No. AD3-22: Site Piping & Utilities Plan (Sheet FT-C-105)

Add a 36" butterfly valve & valve box on 36" DI-UV effluent to clear well #1 line, south of 36" DI MJ TEE (key note #5)

Item No. AD3-23: Yard Pipe Profiles (FT-C-501)

In the 12 inch DI BW pipe profile on the right side of this drawing, in the title of this profile change the word "ALTERNATE" to "BACK UP". This pipe line is not part of any bidding alternate.

Item No. AD3-24: Civil Construction Details (FT-C-601)

In the upper right corner of this drawing delete the "Bedding and Backfill Details for Water, Storm and Sanitary Sewer" and replace it with the revised "Bedding and Backfill Details for Water, Storm and Sanitary Sewer" sketch attached to this addendum.

Item No. AD3-25: AT Building Lower Basement North Plan (FT-S-122)

As a clarification, the column dimensions are provided on AT Building Beam and Column Schedules, Drawing FT-S-601.

Item No. AD3-26: AT Building Basement North Plan (FT-S-132)

As a clarification, the columns shown in the GAC Pump Room, in the wall between the GAC Pump Room and the UV Disinfection Room and in the UV Disinfection Room extend from the lower basement as shown on Drawing FT-S-122 where the column designations are shown.

Item No. AD3-27: AT Building Second Floor North Plan (FT-S-152)

Add the following column designations to the columns shown in the area indicated as Open to GAC Pump Room Below. The two columns at the south side of the area are designated C5 and the two columns on the north side are designated C2.

Item No. AD3-28: AT Building Section (FT-S-302)

Add an elevation call out "EL 832.00" to the upper-most slab on the right side of the drawing.

Item No. AD3-29: AT Building Section (FT-S-311)

In the floor elevations listed on the left side of the section change the lowest elevation from 764.00 to 761.00.

Item No. AD3-30: AT Building Lintel Schedule and Roof Panel Loading Diagrams (FT-S-602)

In the Lintel Schedule for item L2 add a note that the Rod anchor and Bent Plate shall be stainless steel.

Item No. AD3-31: Chemical Feed Details (FT-D-506)

In the Partial Site Piping Plan at the upper right of this drawing, under the General Notes, delete general note A and replace it with the following note:

> "A Where the new 36"x 36" wye is inserted in the existing filter effluent line just east of the chemical feed vault, beginning on the west/downstream side of this wye, remove and replace at least 20 linear feet of existing 36" filter effluent pipe with new 36" DI pipe so that the new chemical feed vault construction will incorporate the new 36" piping. Provide additional 36" DI fittings as required to accommodate this."

Item No. AD3-32: Sampling Pump Details (FT-D-507)

Drawing "FT-D-507 SAMPLING PUMP DETAILS" is attached to this addendum and shall be incorporated into the bid documents and contract drawings.

Item No. AD3-33: AT Building Details (FT-D-505)

Add a valve FT-AS-BFV-010 to the discharge piping for the blower prior to the tee. This valve is shows on the Air Scour Blower P&ID.

Item No. AD3-34: Electrical – AT Building Site Plan (FT-E-102)

The enclosure for FWSP-002 referenced by Keyed Note 19 on this drawing is shown at the east vent of clearwell no. 2. Revise the location of this enclosure by moving it counterclockwise 90 degrees so it is adjacent to the north vent of clearwell no. 2. Refer to drawing FT-D-507.

Item No. AD3-35: AT Building Basement South Plan (Sheet FT-P-131)

Delete reference to " 1" DRAIN PIPING UP ", note to right of elevator.

Revise the note east of stair No. 1 to read:

> " 4" SANITARY UP" in-lieu-of "4" SANITARY UP & DOWN."

Revise the cold water line in east wall near elevator to read as follows:

" 3" WATER LINE UP. "

Item No. AD3-36: AT Building Basement North Plan (Sheet FT-P-132)

As a clarification, provide concrete encased sleeve as indicated. Any DWV piping over a water line shall be encased per code. Refer to attached detail.

Revise plan to show DWV piping for SSK & LAV and water closet in wall rather than in chase.

As a clarification, Contractor shall use distance from expansion joint to trench drain shown on structural plans if a conflict exists.

Revise the note west of elevator wall should to read

" 4" SANITARY PIPING UP " in-lieu-of "4" SANITARY PIPING UP/DOWN".

Revise the plan to add a Floor Drain w/trap in the center of Washroom # B04

Revise the plan to extend the 3" waste line to wall between LAV & WC. Provide a 3"Vent up in wall & extend to 4" vent up at WC. Provide reducing tee to accept 1 ½" vent from LAV.

Item No. AD3-37: AT Building First Floor South Plan (Sheet FT-P-141)

Revise the CW Line indicated as rising to second floor to a 3" line.

As a clarification, the CW piping shall be continued on sheet FT-P-151. The line is for future restrooms & Second Floor.

Revise the plan by relocating the ¾" water lines to reflect them coming down inside building (exposed) on exterior walls. The other ¾" water line in Lobby up through maintenance room serves hose bibb on roof. Refer to FT-P-160.

Item No. AD3-38: AT Building First Floor North Plan (Sheet FT-P-142)

Revise the plan to provide DWV piping in wall, not in chase.

Revise the note by restroom to read as follows:

" 3" CW DN & 2" CW LINE UP"

Revise the note in SW corner of Electrical Room as follows:

" 4" VENT UP " in lieu of " 4" VTR ".

Revise the plan to provide a 3″ Floor Drain w/trap in the center of Washroom 106.

Revise the plan to extend 3″ waste line to wall between CAV & WC. Provide an 8″ vent up in wall and extend to 4″ vent at WC. Provide reducing tee to accept 1 ½″ vent from LAV.

Item No. AD3-39: AT Building Second Floor South Plan (Sheet FT-P-151)

Revise the note south of Stair No. 1 to read as follows:

" 4″ SANITARY DOWN. "

Relocate vent through roof SW of where indicated to match roof.

Delete ¾″ CW Line indicated above Contactor #8.

Revise the plan to show a ¾″ CW Line on West wall (West of Contactor #4) that shall drop exposed on wall & provide a ½″ Hose Valve.

Item No. AD3-40: AT Building Second Floor North Plan (Sheet FT-P-152)

Delete reference to " **4″ SANITARY UP & DOWN "** near NW corner of the GAC Operating Room.

Revise plan to route 4″ vent at SE corner of Washroom 203 to the south and connect to 4″ vent serving the capped 4″ waste piping for future restroom.

Revise the plan to provide DWV piping for restroom in wall not chase.

As a clarification, refer to FT-P-160 for vent-thru-roof location.

Revise the plan to provide a 1 ½″ Hose Reel on the East wall between Contactors #2 & 1. Extend the 1 ½″ CW Line from the Hose Reel between Contactors #4 & #3 along wall & down on wall to Hose Reel. Provide service shut off valve.

Revise plan to provide a 3″ Floor Drain w/trap in the center of Washroom 302.
Extend 3″ waste line to wall between LAV & WC. Provide a 3″ vent up in wall & extend to 4″ vent at LAV**.** Provide a reducing tee to accept a 1 ½″ vent from LAV.

Item No. AD3-41: AT Building Overall Roof Plan (Sheet FT-P-160)

Delete the 4″ VTR on wall South of the door from the Lobby into Stair #1.

STANDARD DRAWING DETAILS

Item No. AD3-42: Standard Drawing Details

Add the following details attached to this addendum:

0330-046 Concrete Stair Cantilevered
0514-020 Typical Beam Connection – Aluminum
0514-056 Beam/Wall Connection –Aluminum
1080-002 Floor Mat and Frame

Attachment Number 6A

GUARANTEED PRESENT WORTH TABLE - OPTION 1 TROJAN TECHNOLOGIES

LINE	ITEM	UNITS	AMOUNT
	LUMP SUM BID PRICE FOR TROJAN EQUIPMENT		
A	For furnishing all materials, equipment and labor needed to install the complete UV disinfection system as shown on the Drawings or specified herein– Lump Sum Amount of:	$	
B	UV Reactor Model		
C	UV Reactor Flange Diameter (inches)		
D	Number of lamps installed per UV reactor		
E	Number of duty reactors (excluding standby reactor)		
	SYSTEM OPERATING PERFORMANCE INFORMATION AT ADF		
1	Number of Reactors operating at ADF	EA	
2	Total number of Lamps in service at ADF	EA	
3	Total number of Ballasts in service at ADF Size = _____kW	EA	
4	Total number of Sensors in service at ADF	EA	
5	Warranted Lamp Life (Not to Exceed 12,000 Hours)	Hours	
6	Warranted Ballast Life (Not to Exceed 10 Years)	Years	
7	Warranted Sensor Life (Not to Exceed 10 Years)	Years	
8	Warranted Lamp Sleeve Life	Years	
9	Guaranteed Lamp Replacement Cost	$	
10	Guaranteed Ballast Replacement Cost	$	
11	Guaranteed UV Sensor Replacement Cost	$	
12	Guaranteed Lamp Sleeve Replacement Cost	$	
13	Guaranteed Maximum Total UV System Power Consumption at ADF	kW	
	LIFECYCLE COST EVALUATIONS		
14	Annual Power Consumption (Line 13 x 8,766 hrs/yr)	kW-h/yr	
15	Annual Power Cost (Line 14 x $.08/kw-H)	$/yr	
16	POWER -PRESENT WORTH VALUE (LINE 15 X 13.41)	$	
17	Lamps Replaced Annually [(8,766/Line 5) x Line 2]	Lamps/Yr	

18	Annual Lamp Replacement Cost (Line 17 x Line 9)	$	
19	LAMP REPLACEMENT PRESENT WORTH (Ln 18 x 13.41)	$	
20	Ballasts Replaced Annually(Line 3 /Line 6)	Blst/yr	
21	Annual Ballast Replacement Cost (Line 20 x Line 10)	$	
22	BALLAST REPLACEMENT PRES WORTH (Ln 21 x 13.41)	$	
23	Sensors Replaced Annually (Line 4 /Line 7)	Snsr/yr	
24	Annual Sensor Replacement Cost (Line 23 x Line 11)	$	
25	SENSOR REPLACEMENT PRES WORTH (Ln 24 x 13.41)	$	
TOTAL LIFECYCLE COST			
26	Trojan Present Worth (Ln A+ Ln16+ Ln19+ Ln 22+ Ln25)	$	

CERTIFICATION INSTRUCTIONS

This Attachment shall be filled in by the Bidder using information supplied by the UV supplier and shall be submitted with the Bid. Certification signature on this attachment is not required at the time of the Bid.

Within 7 days following the Bid opening the apparent low bidder and any other bidders requested by the Owner shall submit to the Owner a duplicate copy of this Attachment as attached to the original Bid with a signature by an officer of the UV supplier to provide the certification below:

CERTIFICATION

"With the exception of Line A which includes Installing Contractor cost over which we have no control, we certify that all of the cost information, warranties and guarantees are true and valid.

_____ (signature)

_____ _____

(printed name and officer position) (date signed)

Attachment Number 6B

GUARANTEED PRESENT WORTH TABLE - OPTION 2 CALGON CORPORATION

LINE	ITEM	UNITS	AMOUNT
	LUMP SUM BID PRICE FOR CALGON EQUIPMENT		
A	For furnishing all materials, equipment and labor needed to install the complete UV disinfection system as shown on the Drawings or specified herein– Lump Sum Amount of:	$	
B	UV Reactor Model		
C	UV Reactor Flange Diameter (inches)		
D	Number of lamps installed per UV reactor		
E	Number of duty reactors (excluding standby reactor)		
	SYSTEM OPERATING PERFORMANCE INFORMATION AT ADF		
1	Number of Reactors operating at ADF	EA	
2	Total number of Lamps in service at ADF	EA	
3	Total number of Ballasts Size 1 in service at ADF Size = _____kW	EA	
4	Total number of Ballasts Size 2 in service at ADF Size = _____kW	EA	
5	Total number of Sensors in service at ADF	EA	
6	Warranted Lamp Life (Not to Exceed 12,000 Hours)	Hours	
7	Warranted Ballast Life (Not to Exceed 10 Years)	Years	
8	Warranted Sensor Life (Not to Exceed 10 Years)	Years	
9	Warranted Lamp Sleeve Life	Years	
10	Guaranteed Lamp Replacement Cost	$	
11	Guaranteed Ballast Size 1 Replacement Cost	$	
12	Guaranteed Ballast Size 2 Replacement Cost	$	
13	Guaranteed UV Sensor Replacement Cost	$	
14	Guaranteed Lamp Sleeve Replacement Cost	$	
15	Guaranteed Maximum Total UV System Power Consumption at ADF	kW	
	LIFECYCLE COST EVALUATIONS		
16	Annual Power Consumption (Line 15 x 8,766 hrs/yr)	kW-h/yr	

17	Annual Power Cost (Line 16 x $.08/kw-H)	$/yr	
18	POWER -PRESENT WORTH VALUE (LINE 17 X 13.41)	$	
19	Lamps Replaced Annually [(8,766/Line 6) x Line 2]	Lamps/Yr	
20	Annual Lamp Replacement Cost (Line 19 x Line 10)	$	
21	LAMP REPLACEMENT PRESENT WORTH (Ln 20 x 13.41)	$	
22	Ballasts Size 1 Replaced Annually(Line 3 /Line 7)	Blst1/yr	
23	Annual Ballast Size 1 Replacement Cost (Line 22 x Line 11)	$	
24	BALLAST Size 1 REPLACEMENT PRES WORTH (Ln 23 x 13.41)	$	
25	Ballasts Size 2 Replaced Annually(Line 4 /Line 7)	Blst2/yr	
26	Annual Ballast Size 2 Replacement Cost (Line 25 x Line 12)	$	
27	BALLAST Size 2 REPLACEMENT PRES WORTH (Ln 26 x 13.41)	$	
28	Sensors Replaced Annually (Line 5 /Line 8)	Snsr/yr	
29	Annual Sensor Replacement Cost (Line 28 x Line 13)	$	
30	SENSOR REPLACEMENT PRES WORTH (Ln 29 x 13.41)	$	
TOTAL LIFECYCLE COST			
31	Calgon Present Worth (Ln A+ Ln18+ Ln21+ Ln 24+ Ln27+Ln30)	$	

CERTIFICATION INSTRUCTIONS

This Attachment shall be filled in by the Bidder using information supplied by the UV supplier and shall be submitted with the Bid. Certification signature on this attachment is not required at the time of the Bid.

Within 7 days following the Bid opening the apparent low bidder and any other bidders requested by the Owner shall submit to the Owner a duplicate copy of this Attachment as attached to the original Bid with a signature by an officer of the UV supplier to provide the certification below:

CERTIFICATION

"With the exception of Line A which includes Installing Contractor cost over which we have no control, we certify that all of the cost information, warranties and guarantees are true and valid.

_____ (signature)

_____ _____

(printed name and officer position) (date signed)

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 SCOPE

A. It is the intent of this specification to provide one (1) metal-clad, 15 kv automatic transfer system with integrated distribution.

B. All components, testing and services specified and required for a complete system shall be included.

1.02 MANUFACTURERS QUALIFICATIONS

A. The equipment to be supplied shall provide the highest reliability and the greatest ease of maintenance.

B. The Manufacturer shall have experience in the design, building, testing and service of this type of equipment and be able to document their qualifications. Only suppliers with the ability and experience to provide this type of system shall be acceptable.

C. The Manufacturer shall have a minimum of 10 years experience in supplying this type of equipment.

1.03 APPLICABLE CODES AND STANDARDS

A. The following standards are required as they apply to the equipment specified. Current code dates in effect at the time the contract is awarded shall be followed.

1. American National Standards Institute, Inc. (ANSI)
   Institute of Electrical & Electronic Engineers (IEEE):
   a. C.37.20.1 Switchgear Assemblies.
   b. C.57.13 Standard requirements for Instrument Transformers.
2. National Electric Manufacturers Association (NEMA):
   a. SG-5 Power Switchgear Assemblies.
3. National Fire Protection Association (NFPA):
   a. NFPA 70-2002 National Electric Code.
   b. NFPA 110 Emergency & Standby Power Systems.
4. Underwriters Laboratory (UL): Circuit Breakers and Metal-Clad Switchgear Over 600 Volts (DLAH).

5. Canadian Standard Association (CSA).
6. State and Local Codes as they apply.

1.04 DOCUMENTATION

A. Submittals for approval shall include the following:

1. Elevation drawings with estimated weights.
2. Outline drawing showing conduit entry areas and anchoring information.
3. AC and / or DC Schematic drawings.
4. Sequence of Operation.
5. Complete nameplate schedule.

B. One complete set of full size as-built drawings and material summary shall be shipped with the equipment, mounted on the inside of the control section door.

C. Two operation and maintenance manuals shall be supplied with the equipment when shipped. The manuals, at a minimum, shall contain:

1. Sequence of operation
2. Installation instructions
3. Maintenance instructions
4. Material summary
5. Complete drawings
6. Component instructions and manufacturers literature
7. Spare parts information

1.05 TESTING

A. The equipment shall be factory tested to simulate a complete and integrated system. The circuit breakers supplied shall be installed in their actual positions and electrically and mechanically tested. A narrative of the system operation shall be provided and shall be utilized when testing the equipment. Upon request, copies of the test reports shall be submitted to the engineer.

B. All testing shall be in accordance with any applicable standards.

1.06 SERVICE

A. The manufacturer shall maintain a competent, factory authorized service organization that is available on a 24-hour basis.

1.07 WARRANTY

A. The manufacturer shall warrant the equipment, accessories and operation for a period of one (1) year from the date of final acceptance or eighteen (18) months from the date of shipment.

1.08 EXTRA MATERIALS

A. Furnish the following spare parts:

1. Drawout breaker maintenance tools.
2. Two (2) of each type of fuse.
3. Two (2) of each type of lamp.
4. Two (2) of each type of relay.

PART 2 EQUIPMENT

2.01 MANUFACTURERS

A. Lake Shore Electric.

B. Russelectric.

C. Approved or equal.

2.02 CONSTRUCTION

A. The enclosure shall be made from a minimum of 14-gauge sheet steel and shall be provided with barriers and stiffeners to form a solid unitized assembly. Suitable means of lifting shall be provided.

B. All equipment bases shall be fabricated with an adequate number of anchor bolt holes designed to put the base in direct contact with the concrete pad when bolted.

C. All doors shall be pan type and be provided sufficient hinges and stiffeners to support the door and components for an absolute minimum deflection and wobbling when opening or closing. Doors must open a minimum of 105 degrees.

D. Front doors shall be supplied with a lockable handle. All door locks shall be keyed alike to operate from a single key, and one key shall be supplied for each lock. Full height doors will fasten at three points to secure the door firmly when closed. The rear of the transfer switch shall be accessible through bolted-on panels.

E. All equipment shall be arranged in a logical manner to facilitate ease of operation and maintenance of the equipment.

F. The complete assembly shall be thoroughly cleaned and treated prior to painting. The unit shall be painted ANSI-61 Light Gray and be suitable for indoor and outdoor application.

G. Main bus shall be rated 600 amps and shall be fabricated from silver plated copper. The maximum temperature rise allowed shall not exceed ANSI C37.20.1. All joints shall be bolted with a minimum of two bolts.

H. A ¼" x 2" copper ground bus shall extend the full length of the switchgear and shall effectively ground all non-current carrying metallic parts.

I. Control wiring shall be 600 volt, switchboard type, minimum size of 14-gauge. Use solderless compression type, forked tongue connectors for terminating all wires. Control wires shall be continuously marked with numbers and numbers shall be completely visible at all points of termination.

J. Control wiring in all high voltage compartments shall be enclosed in conduit.

K. Grommetted holes shall be provided between each of the vertical sections to allow control wiring to pass through. Wiring shall not be spliced and shall be free of abrasions and tool marks. The wires shall be neatly laced up and harnessed, and shall be supported to prevent sagging or breakage from weight or vibration. Wiring bundles shall be contained in covered metal or plastic gutters.

L. Engraved laminated plastic nameplates having white letters on black backgrounds shall identify major components, vertical sections and breakers.

M. Warning labels shall be provided with "DANGER HIGH VOLTAGE" for all access areas to power circuits.

N. Provide a circuit breaker lifting device.

2.03 COMPONENTS

A. ATS switching shall be accomplished through the use of drawout, vacuum circuit breakers. Ratings of the breakers shall comply with Section 3.01 below. Include all necessary accessories and special tools if required for operation of the circuit breaker.

B. Potential transformers shall be indoor type with ratings coordinated with the loads required per ANSI Standard C57.13. Primary and secondary fuses shall be provided for all potential transformers.

C. Control power fuses (600 volt) shall be mounted in locations where they are readily accessible. Pull-out type fuses shall be provided for all primary circuit and shall be of the current limiting type.

D. Terminal blocks shall be suitable for ring tongue terminals and provided with binding head screws, minimum screw size of 8/32. The terminal block rating shall be 600 volts.

E. Solid state controls, relays, timers or monitors shall meet the following specifications:

Accuracy:	±2% of set point
Temp Range:	-40 degrees C (-40°F) to +65 degrees C (150°F)
Protection:	Transient overvoltage withstand of 1500 volts peak, 1msec. time constant
Ratings:	Current ratings to exceed application of devices. Devices shall be UL listed if available.

2.04 AUTOMATIC TRANSFER CONTROLS

A. Controls shall be microprocessor based and shall provide all necessary functions of the automatic transfer switch. The controller shall be equipped with a real time and date clock, battery backup, and non-volatile memory storage.

B. A HMI shall be provided containing a 2 line, 40 character, LCD display, LED indicating lights as specified herein, and a touch pads to allow access to the system.

C. The controller shall be equipped to accept power quality or condition signals from a variety of external relays or monitors connected to either the normal or emergency sources.

D. The controller shall store all timer and mode settings in non-volatile memory so that upon re-energizing the switch it will return to the previous position without loss of data.

E. The controller shall allow for five modes of operation: Off/Reset, Automatic, Load Test, Hand Crank and Fault.

F. In the fault mode, the transfer switch shall be locked and the reason for its failure shall be displayed on the HMI display.

G. The controller shall have complete diagnostic capabilities so that every input and output can be monitored for troubleshooting or maintenance purposes.

H. The controller shall have an operating range of -40°C to +85°C

I. The controller shall meet IEEE C62.41 surge test.

J. The controller shall be able to withstand unlimited power interruptions.

2.05 AUTOMATIC TRANSFER SWITCH FEATURES

A. The transfer switch controller shall be equipped with no less than 5 timers as follows:

1. Time Delay to Engine Start - Adjustable time delay after a failure of the Normal source before initiating an Engine-Start signal to allow for temporary short-duration fluctuations in voltage. Timer shall be field adjustable from 0 to 300 seconds, in 1-second increments.
2. Time Delay to Emergency - Adjustable time delay after the engine has started before transferring the load from the Normal source to the Emergency source. Timer shall be field adjustable from 0 to 300 seconds, in 1-second increments.
3. Time Delay to Return - Adjustable time delay after the return of Normal power before retransferring the load from the Emergency source to the Normal source. Timer shall be field adjustable from 0.0 to 60.0 minutes.
4. Engine Cool Down Timer - Adjustable time delay after retransferring the load from the Emergency source to the Normal source before shutting down the engine. Timer shall be field adjustable from 0.0 to 60 minutes, in 0.1-minute increments.
5. Minimum Run Timer - Adjustable time delay after starting engine before shutting it down. Timer shall be field adjustable from 0.0 to 60 minutes, in 0.1-minute increments.
6. Time Delay in Neutral - Adjustable time delay to provide delay between opening the contacts on one source and closing the contacts on the other source. This shall be the programmable time delay required when the automatic transfer switch is serving inductive loads. Timer shall be field adjustable from 0 to 300 seconds, in 1-second increments.

B. A Digital Plant Exerciser shall be provided to provide for the regular automatic exercising of the Emergency Power System on a pre-selected schedule at field adjustable periods. The controller shall allow exercising with

load or without load. In the event of an engine-generator failure, when operating in the plant exerciser mode, the automatic transfer switch shall immediately return to the normal source, if available.

C. A Close Differential Under Voltage Relay shall be provided to continuously monitor normal voltage. The under voltage relay shall be field adjustable from 70% (seventy percent) to 100% (one hundred percent) of nominal voltage. Factory set at 90% (ninety percent) pick-up and 80% (eighty percent) dropout.

D. A single-phase frequency and voltage-sensing relay shall be provided for protection against transferring to the Emergency source until the generator has reached both operating frequency and voltage.

E. A Customer Relay Interface Board shall be provided to allow customer interface to the transfer switch controls. All interfaces shall be voltage free contacts rated 10 amps at 120VAC. The following interface points shall be made available.

1. Engine start contacts consisting of one normally open and one normally closed.
2. Switch Position contacts consisting of two normally open and two normally closed.
3. Trouble contacts consisting of two normally open and two normally closed.

F. Light Emitting Diode (LED) pilot lights shall be provided on the HMI panel to indicate the following conditions:

1. Normal Source Available
2. Normal Switch Closed
3. Emergency Source Available
4. Emergency Switch Closed
5. System not in Automatic (Flashing light)
6. Normal Breaker Withdrawn
7. Emergency Breaker Withdrawn
8. Normal Breaker Test Position
9. Emergency Breaker Test Position

G. A Maintenance Disconnect switch shall be provided to disconnect control circuitry from line for maintenance purposes.

H. A momentary Load Test Switch shall be mounted inside the enclosure for ease of servicing. This switch shall cycle the transfer switch through a complete transfer to emergency and retransfer to normal.

I. Override Pushbutton: An Override Pushbutton shall be provided mounted on the inside of the enclosure to bypass the Time Delay to Return Timer.

J. A Key Pad Enable Switch shall be mounted inside the enclosure, which will inhibit use of the HMI operator interface.

K. Terminals shall be provided for the connection of dry contacts from a remote source to initiate transfer of the load from normal source to the emergency source.

L. A Thermostatically Controlled Strip Heater and exhaust fan shall be provided on all Outdoor Enclosed switches.

2.06 ADDITIONAL ACCESSORIES, EQUIPMENT AND FEATURES REQUIRED

A. Transfer Switch to have integrated distribution as shown on drawings. Vacuum Breaker distribution breakers to be 600AF, Fixed, Manually Operated with overcurrent protection.

B. Service Entrance Rated: The complete automatic transfer switch shall be properly labeled as suitable for use as service entrance equipment. LED pilot lights shall be provided on the HMI panel to indicate “Normal Tripped” or “Emergency Tripped” as necessary. Also included shall be over current protection on service source disconnect, lock out – tag out provisions, Neutral bus with line, lugs, ground bonding and jumper strap, appropriate markings and service entrance disconnecting device.

C. Ground Fault Protection: Ground Fault Protections shall be provided where required by U.L. and/or NEC Article 230. Upon detection of a ground fault, the HMI will display the fault, both sources will be disconnected from load, and the trouble contacts shall change state. Transfer switch must be manually reset after the ground fault is cleared.

D. Surge Suppression: Secondary Surge Suppressors shall be provided on both Normal and Emergency sources.

E. Overcurrent Protection: Overcurrent protection shall be provided on the (Normal or Emergency) source with “tripped” indication on the HMI panel. Overcurrent protection shall also be provided on each distribution breaker.

F. ATS to have Load Side Digital Metering.

G. 24 VDC control battery and charger.

2.07 SOURCE QUALITY CONTROL

A. Factory test components assembled switches and associated equipment to ensure proper operation. Check transfer time and voltage, frequency and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.01 APPLICATION

A. ATS with Distribution shall be 13,800volts, 3ϕ, 3wire, 60hertz, 600 amperes, 500MVA in an outdoor free standing enclosure. Vacuum Breakers to contain overcurrent protection.

3.02 INSTALLATION

A. Free Standing Equipment: Level and anchor unit to floor.

B. Identify components according to Division 16 Section “Basic Electrical Materials and Methods”.

3.03 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communications requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.04 CONNECTIONS

A. Ground equipment as indicated and as required by NFPA 70.

B. Connect power cables from both sources and load. Verify that both sources have the identical phase sequence.

3.05 FIELD QUALITY CONTROL

A. Testing: Test transfer switch products by operating them in all modes. Perform tests recommended by manufacturer under the supervision of manufacturer’s factory-authorized service representative. Correct deficiencies and report results in writing. Record adjustable relay settings.

B. Testing: Perform the following field quality control testing under the supervision of the manufacturer's factory-authorized service representative in addition to tests recommended by the manufacturer:

1. Before energizing equipment, after transfer switch products have been installed:
   a. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
   b. Check for electrical continuity of circuits and for short circuits. Inspect for physical damage; proper installation and connection; and integrity of barriers, covers, and safety features.
   c. Perform manual transfer operation.
2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Perform contact resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown sequence.

C. Coordinate tests with tests of generator plant and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain transfer switches and related equipment as specified below:

1. Coordinate this training with that for generator equipment.
2. Training of Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing and maintaining equipment shall be provided.
3. Review all data in maintenance manuals.
4. Schedule training with Owner with at least seven days' advance notice.
5. Provide a minimum of four hours of instruction.

END OF SECTION

Piping Schedule										
Service	**Legend**	**Size(s) (In.)[1]**	**Exposure**	**Piping Material**	**Specification Section**	**Joint Type**	**Lining/ Coating [2]**	**Test Pressure and Type (psig-x), x = Type indicated in Legend**	**Pipe Color and Label**	**Remarks**
AIR SCOUR	AS	ALL	EXP, SUB	SST	40 27 00	FLANGED, WELDED	Per Spec	50 – H	Per Spec	
AIR SCOUR VENT	ASV	ALL	EXP	SST	40 27 00	WELDED	Per Spec	50 – H	Per Spec	
BACKWASH WASTE WATER	BWW	ALL	EXP, SUB	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	G	Per Spec	
BACKWASH WASTE WATER	BWW	ALL	BUR	DI	33 05 01	RESTRAINED	Per Spec	G	None	
GAC/UV BYPASS	BYP	ALL	BUR	DI	33 05 01	RESTRAINED	Per Spec	50 – H	None	
CONTACTOR WASTE	CTW	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	50 – H	Per Spec	
DRAIN	DR	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	G	Per Spec	
DRAIN	DR	ALL	BUR	DI OR PVC	33 05 01	MECH JT, HU	Per Spec	G	None	Also noted as “DRAIN”
FILTER BACKWASH WATER SUPPLY	FBWS	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	100 – H	Per Spec	
FILTER BACKWASH WATER SUPPLY	FBWS	ALL	BUR	DI	33 05 01	RESTRAINED	Per Spec	100 – H	None	Also noted as “BW”

Piping Schedule										
Service	**Legend**	**Size(s) (In.)[1]**	**Exposure**	**Piping Material**	**Specification Section**	**Joint Type**	**Lining/ Coating [2]**	**Test Pressure and Type (psig-x), x = Type indicated in Legend**	**Pipe Color and Label**	**Remarks**
FILTER EFFLUENT	FE	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	50 – H	Per Spec	
FILTER EFFLUENT	FE	ALL	BUR, ENC	DI	33 05 01	RESTRAINED	Per Spec	50 – H	None	Also noted as "GAC Influent"
FINISHED WATER SAMPLE	FW	ALL	EXP, BUR	PVC	40 27 00 33 05 01	W	None	50 – H	Per Spec	Also noted as "FINISHED WATER SAMPLE LINE"
GAC BACKWASH WATER SUPPLY	GBS	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	100 – H	Per Spec	
GAC EFFLUENT	GE	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	50 – H	Per Spec	
GAC EFFLUENT	GE	ALL	BUR	DI	33 05 01	RESTRAINED	Per Spec	50 – H	None	Also noted as "GAC EFL"
GAC INFLUENT	GI	ALL	EXP, SUB	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	50 – H	Per Spec	
OVERFLOW	OF	ALL	BUR, SUB	DI	40 27 00 33 05 01	FLANGED, GRVD CPLG, MECH JT RESTRAINED	Per Spec	G	Per Spec	Also noted as "EQ OVERFLOW"

Piping Schedule										
Service	**Legend**	**Size(s) (In.)[1]**	**Exposure**	**Piping Material**	**Specification Section**	**Joint Type**	**Lining/ Coating [2]**	**Test Pressure and Type (psig-x), x = Type indicated in Legend**	**Pipe Color and Label**	**Remarks**
SLURRY FEED	SF	ALL	BUR, EXP, SUB	SST	40 27 00	FLANGED, GRVD CPLG, WELDED	Per Spec	100 – H	Per Spec	
SLURRY WATER SUPPLY	SWS	ALL	EXP, SUB	DI	40 27 00	FLANGED	Per Spec	150 – H	Per Spec	
UV EFFLUENT	UE	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	50 – H	Per Spec	
UV EFFLUENT	UE	ALL	BUR	DI	33 05 01	RESTRAINED	Per Spec	50 – H	None	Also noted as ‘UV EFFL”
WASTE	WS	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	G	Per Spec	
VENT	V	ALL	EXP	DI OR STEEL	40 27 00	FLANGED, GRVD CPLG	Per Spec	G	Per Spec	
CHEMICAL FEED	CF	ALL	EXP, BUR*	PVC	40 27 00	W	None	100-H	Per Spec	BUR=inside cover pipe
GAC INFLUENT	GI	ALL	BUR	DI	33 05 01	RESTRAINED	Per Spec	50-H	None	Also noted as “GAC INFL”
STORM SEWER	SD	ALL	BUR	RCP PVC OR DI AS NOTED	33 05 01	HU	Per Spec	G	None	Also noted as “STM SEWER”

Piping Schedule										
Service	**Legend**	**Size(s) (In.)[1]**	**Exposure**	**Piping Material**	**Specification Section**	**Joint Type**	**Lining/ Coating [2]**	**Test Pressure and Type (psig-x), x = Type indicated in Legend**	**Pipe Color and Label**	**Remarks**
SANITARY SEWER	SS	ALL	BUR	DI	33 05 01	HU	Per Spec	G	None	Also noted as "SAN SEWER"

[1]">" Greater Than
"<" Less Than
"<=" Less Than or Equal To
">=" Greater Than or Equal To
"All" All Sizes

2Line and shop coating (if any) system as specified in Section 40 27 00; final coating, color code and label as specified in Section 09 90 00

VALVE SCHEDULE

Tag No.	Location	Valve Type No.	Size (inches)	Flowstream	Max. Oper. Flow (gpm)	Max. Oper. Press. (psi)	Motor Actuated	Travel Time	Voltage (V)	Phase	Service	Notes
FT-DR-BFV-001	GAC pump well drain pump isolation valve	V500	4	DR	400	26	NO	-	-	-	-	
FT-DR-CV-001	GAC pump well drain pump check valve	V608	4	DR	400	26	NO	-	-	-	-	

Note: See Legend for Tag No. format and codes.

SUBMERSIBLE PUMP DATA SHEET, 44 42 56.04-_____

Tag Numbers: FT-SPD-P-1

Pump Name: GAC Pump Well Drain Pump No. 1

Manufacturer and Model Number: (1) FLYGT (ITT CORP)
(2) Approved Equal

SERVICE CONDITIONS

Liquid Pumped (Material and Percent Solids): FILTER EFFLUENT WATER

Pumping Temperature (Fahrenheit): Normal: ____ Max 90 Min 32

Specific Gravity at 60 Degrees F: 1

pH: 6.5 TO 8.0

Abrasive (Y/N) NO Possible Scale Buildup (Y/N): NO

Min. NPSH Available (Ft. Absolute): _____

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Rated: 400

Total Dynamic Head (Ft): Rated: 35

Maximum Shutoff Pressure (Ft): 60

Min. Rated Pump Hydraulic Efficiency at Rated Capacity (%): _____

Max. Pump Speed at Rated Capacity (rpm): 1185 Constant (Y/N): Y
Adjustable (Y/N): N

DESIGN AND MATERIALS

Pump Type: Heavy-Duty Nonclog (Y/N) Y

Volute Material: Cast Iron ASTM A48

Pump Casing Material: Cast Iron ASTM A48

Motor Housing Material: Cast Iron ASTM A48

Wear Rings Case (Y/N) Y Material: Cast Iron

Wear Ring Impeller (Y/N): Y Material: Stainless steel

Elastomers: Nitrile Rubber

Fasteners: Stainless Steel

Impeller: Type: Double-Shrouded Non-Clog (Y/N): Y Other:
Material: Cast Iron ASTM A48

Shaft Material: Type 431 stainless steel

Base Elbow: Cast Iron ASTM A48

Double Mechanical Seal (Y/N): Y Bearing Life (Hrs): 100,000

DRIVE MOTOR (See Section 26 20 00, Low-Voltage AC Induction Motors)

Horsepower: 5 Voltage: 460 Phase: 3 Synchronous Speed (rpm): 1185

Enclosure: SUB

Constant Speed

Moisture Detection Switches (Y/N): Y

Thermal Protection Embedded in Windings (Y/N): Y

REMARKS: Provide vibration sensors

SAMPLING PUMP DATA SHEET 44 42 56.17- 001

Tag Numbers: FT-FWSP-001; FT-FWSP-002

Pump Name: Finished Water Sampling Pump

Manufacturer and Model Number: (1) Moyno, Inc. 1000 Series, Model BZE
(2)Continental Pump Co. Model 2CL6
(3) Or approved equal

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): 100% water

Pumping Temperature (Fahrenheit): Max 90 Min 35

Inlet Pressure at Pump (psig): suction lift under all conditions

Min. Net Positive Suction Head Available at 16 gpm: 6.37 psia for FWSP-001

Min. Net Positive Suction Head Available at 16 gpm: 6.15 psia for FWSP-002

PERFORMANCE REQUIREMENTS, FT-FWSP-001:

Rated Capacity: 16 US gpm at 23.7 psi discharge pressure.

Max. Pump Speed (rpm): 400 Constant (Y/N): Yes Adjustable (Y/N): No

PERFORMANCE REQUIREMENTS, FT-FWSP-002:

Rated Capacity: 16 US gpm at 28.2 psi discharge pressure.

Max. Pump Speed (rpm): 400 Constant (Y/N): Yes Adjustable (Y/N): No

DESIGN AND MATERIALS

Pump Body Material: Cast iron Pump Stages: Two

Connections: Suction: Flanged; Discharge: Flanged

Stator Material: Buna N Stator Thermal Protection (Y/N): No

Rotor Material: Chrome plated steel

Shaft Seal: Mechanical

Drive Type: Direct-Coupled

Baseplate: Design: By Pump Mfr. Material: Carbon Steel

DRIVE MOTOR

Horsepower: 1 ½ Voltage: 460 Phase: 3 Base Speed (rpm): 1,800 max.

Service Factor: 1.0 min. Inverter Duty (Y/N) No

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure: TEFC

OTHER REQUIREMENTS

Orientation and Rotation: Suction port shall be at end of pump body opposite of motor and gear box

Mounting Position: Vertical with motor and gear box on top

Mounting Conditions, FWSP-001: Pump manufacturer shall design and provide pump base plate and frame suitable for installing the pumps vertically on a concrete wall

Mounting Conditions, FWSP-002: Pump manufacturer shall design and provide pump base plate and steel frame suitable for installing the pump in a vertical position with the steel frame attached only to a horizontal concrete slab-on-grade. Pump, base and mounting frame must fit inside a 3’ x 4’ x 8.5’ pre-engineered enclosure.

SECTION 44 44 73
UV SYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of references which may be found in this section:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   a. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
3. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
4. U.S. Environmental Protection Agency (USEPA):
   a. Final UV Disinfection Guidance Manual (UVDGM) - 2006 UVDGM.

1.02 DEFINITIONS

A. UV Dose (Fluence): Shall indicate the UV power incident onto an infinitesimally small sphere of cross-sectional area d*A*, divided by d*A*, for a given contact time in seconds. The units of UV dose are millijoules per square centimeter (mJ/cm^2). The term "UV dose" shall only include the UV energy with germicidal properties, and the contributions shall be weighted according to the relative spectrum of germicidal effectiveness for the challenge organism utilized by the Supplier in Validation Testing.

B. UV Transmittance (UVT): Shall indicate the transmittance of ultraviolet light at a wavelength of 254 nanometers through the water across a path length of 1 centimeter. UVT shall be expressed as a percentage.

C. Intensity: Shall indicate the intensity of UV energy and shall be defined as the UV power incident onto an infinitesimally small sphere of cross-sectional area d*A*, divided by d*A*. The units of intensity are milliwatts per square centimeter (mW/cm^2).

D. Reduction Equivalent Dose (RED): Shall indicate the dose necessary, with the full-scale UV System to provide a level of inactivation of a specific organism (e.g. MS-2 bacteriophage) 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 nanometers, on a water sample collected at the same time.

E. Validation Factor (VF): As defined by the UVDGM, an uncertainty term that accounts for the uncertainty and bias associated with validation testing.

F. As defined in Section 00 72 00, General Conditions.

1.03 SYSTEM DESCRIPTION

A. The existing water treatment system includes chemical treatment, settling and sand filtration.

B. The UV System will be installed downstream of granular activated carbon (GAC) adsorption. The GAC adsorption is being newly installed at the same time as the UV system.

C. The UV System will be installed inside a new AT (Advanced Treatment) Building. The Main and Local Control Panel will be installed in the same room as the UV Reactors. The temperature inside the building is expected to be maintained between 50 and 95 degrees F.

D. The maximum, minimum, and average flow rates are shown in the UV Data Table at the end of this Section.

E. Estimated characteristics of the GAC effluent water are based on measured parameters for finished water, and are shown in the UV Data Table at the end of this Section.

1.04 SUBMITTALS

A. The following specific information shall be provided in accordance with the General Requirements:

1. Shop Drawings:
   a. Catalog information and cuts for all system components, including the control system components and control panels.
   b. Detailed shop drawings of all system components and all interconnections and interface requirements (piping, power, control, instrumentation, data), dimensions of all major elements of the UV System, critical clearance requirements, and weight of equipment.
   c. Input power requirements; clearly specify whether 480V, 3-wire or 480/277V, 4-wire is required as well as ampacity. Also state the maximum time duration of AC power loss that the local control panel (LCP) can ride through before functional shutdown as well as equipment power operating range, voltage and frequency.
   d. Information on the details of sensor calibration and traceability, sensor uncertainty (including uncertainty from linearity, temperature response, spectral response, angular response, and long-term drift), polychromatic bias, working range, detection limit, sensor life and sensor calibration interval showing compliance with the 2006 UVDGM. Also provide expected variations among online sensors readings.

e. Complete description of sensor locations within reactor and accessibility for calibration and routine maintenance.
f. A list of all system components along with their expected replacement frequencies, and duration of life warrantees. Include a list of special tools required for checking, testing, parts replacement, and maintenance.
g. Lamp data, including, watt rating, initial lumen output, lamp loss factors, average lumens and life expectancy (in hours).
h. Complete description of the manual or automatic lamp cleaning mechanism and its maintenance requirements. The level of details should be sufficient for Owner to evaluate lamp cleaning mechanism reliability and its maintenance requirements.
i. Operator Interface Units (OIU) example screens and Programmable Logic Controller (PLC) programs on CD in Rockwell Automation and pdf formats.
    1) Fully documented ladder logic listings, function listings for function blocks not fully documented by ladder logic listings, cross-reference listings and operator interface configuration documentation.
j. Complete description of UVT monitor. Include operation and maintenance requirements necessary for compliance with the 2006 UVDGM requirements.
k. Control Approach: written description of control approach.
l. Validation Testing: Completed checklists 5.1, 5.2, 5.3 and 5.4 from the 2006 EPA UVDGM. Note: The State reviewing agency will be performing its review in accordance with Checklist 5.5 of the 2006 UVDGM. The UV System manufacturer shall provide all information necessary to satisfy the requirements listed in Checklist 5.5 and any additional information requested from the State reviewing agency that is referenced as required documentation in the 2006 UVDGM. The UV System shall have been validated at the operating conditions described in the Contract Documents as assembled herein.
m. Headloss information on proposed reactor at maximum and average flow rates. Headloss shall be calculated from the inlet flange to the outlet flange of the reactor, including any baffling or flow conditioner plates.
n. Third-party certification of lamp aging and quartz sleeve fouling factors.
o. Harmonic distortion data, up to the 35^{th} harmonic, and power factors at ballast's minimum, medium, and maximum power settings. Include test data showing that the available short circuit current at the Main LCP input power terminals to be 30,000 amps symmetrical at 480 volts and include distortion by harmonic table. 3^{rd} party off-site test results are acceptable.

p. Data on harmonic filters, or active filters, used to mitigate harmonics to IEEE 519 levels.
q. Detailed engineering calculations showing efficiencies of electrical components and power requirements per each Local Control Panel (LCP) provided.
r. Wiring and control diagrams, and the overall electrical design of the UV System (both control and power).
s. Specifications for all interconnecting cables between the UV equipment, including voltage ratings, insulation type, conductor material and cable/conductor outside diameter.
t. Interconnecting cable termination data, including termination type and quantity.
u. Control panel construction and panel layout Drawings.
v. Control panel interconnection wiring diagrams that include numbered wire and terminal designations showing all external interfaces.
w. Special shipping, storage and protection, and handling instructions.
x. Provide structural calculations for the UV System and the UV System supports and anchoring, designed and provided by the Supplier. Supplier shall design and provide all supports directly supporting the UV Reactors (does not include supports for upstream and downstream piping). All structural calculations shall meet the requirements of the local building code and signed by a registered Professional Engineer in the Structural or Civil discipline.
y. Manufacturer's printed installation instructions.
z. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

2. Quality Control Submittals:
   a. Documentation of lamp outputs prior to shipment of equipment. Supplier will verify the output of up to four (4) lamps for MP systems.
   b. Factory test procedures and data sheets.
   c. Factory Witness Test Report: Provide report as indicated; UV equipment may not be shipped until the report is approved by the Engineer.
   d. Detailed proposed procedure for conducting the functional and performance field tests.
   e. Functional Testing Report: Provide a narrative of the Functional Testing discussing each element requiring testing, the tests performed, and the results. Functional Testing is not complete until this report is submitted and approved by the Engineer.
   f. Performance Testing Report: Provide a narrative of the Performance Testing discussing each element requiring testing, the tests performed, and the results. This test shall be performed

when the plant systems are operational and there is water available for testing. Performance Testing is not complete until this report is submitted and approved by the Engineer. As part of the UV Performance Testing, power monitoring shall be conducted by the UV Equipment Supplier to indicate total power consumptions in kW-hr, power factors, and harmonic distortions at ballast's minimum, medium and maximum power settings.

g. Harmonic testing results showing UV system performance measured at 50 percent, 75 percent and 100 percent of rated load with harmonics (Voltage and Current) measured to the 35^{th} harmonic. Results shall show that the harmonics are below IEEE 519 standards with a Point of Common Coupling (PCC) at the input terminals of the UV Local Control Panel.

h. Power Factor tests results showing that the UV reactor maintain a 0.90 or greater power factor throughout the full operating range.

3. Contract Closeout Submittals:

a. Provide PLC and Operator Interface programs on CD in both Rockwell Automation software and PDF format.

1) Fully documented ladder logic listings, function listing for function blocks not fully documented by ladder logic listings, cross-reference listings and operator interface configuration documentation.

b. Service records for maintenance performed during construction.

1.05 AUTHORITY HAVING JURISDICTION APPROVAL

A. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to State of Kentucky in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories (UL), Inc. shall conform to those standards and shall have an applied UL listing mark or label. Control panels shall also be UL 508 Labeled.

1.06 OPERATION AND MAINTENANCE DATA

A. Complete set of user manuals for all equipment, instruments and devices provided, including the programmable controllers.

B. List of spares and test equipment for the programmable controllers.

C. O&M Manuals: Content, format, and schedule for providing as specified in Section 01 78 23 Operation and Maintenance Data.

1.07 PERFORMANCE AND PRICE GUARANTEES

A. Equipment:

1. As part of the UV System shop drawing submittal, the Supplier shall furnish to the Owner an equipment guarantee certificate assuring that the UV System will meet the service standards specified in this Section.
   a. The UV System shall deliver the design UV dose or a higher dose at the design UV transmittance under peak flow rate conditions with one reactor out of service under the water quality conditions identified and taking into account the Combined Derating Factor for aging and fouling.
   b. The Supplier shall guarantee satisfactory performance of the equipment and UV lamp modules and ability of the UV System to achieve specified performance and water quality objectives.
   c. The measured power consumption, calculated as the sum of measurements at the energy monitoring unit (EMU) of each CPP, shall not exceed the guaranteed total maximum UV System power consumption submitted by the Supplier in the Supplements to Bid Form. The measured power consumption shall include lamps (including ballast losses) plus any power requirement of all accessory equipment including, but not limited to, control system, fans, cooling, and motors.
   d. Harmonic distortion shall not exceed the requirements of paragraph 3.02 D of the Section. The Supplier shall be responsible for providing and installing all harmonic mitigation equipment including active or passive filters, isolation transformers, conduit, wire, filter control interlocks, etc. as required to meet the harmonic limitations as specified herein at no additional cost to Owner.
2. If the UV System does not achieve the specified performance standards, the Owner will notify the Supplier of the deficiencies in meeting the performance standards. The Owner shall make available to the Supplier electronic records for review. The Supplier shall be given 15 days to develop a plan to correct the performance of the UV System.
3. Should the UV System fail to meet the required operating conditions after the necessary corrective measures are implemented, corrective actions shall be taken as documented in Article 13 of Section 00 72 00, General Conditions.

B. Guaranteed Parts Prices:

1. The Supplier shall provide certification that the cost of replacement lamps, ballasts, and intensity sensors is guaranteed for a minimum period of 25 years from the date of acceptance after performance testing signed by an officer of the Supplier of the UV System. During the 25 years, the percent increase in prices shall not exceed the percent

increase in the Consumer Price Index (CPI) published by the US Department of Labor, Bureau of Labor Statistics, applicable on the anniversary of the date of UV system acceptance.

2. The parts prices guaranteed for lamps, ballasts, and UV intensity sensors shall not differ from the prices listed for those parts in the Supplements to the Bid Form for the life cycle analysis. If requested, the Supplier shall provide support documentation (purchase orders) showing that the lamp, ballast, and sensor prices listed are similar to, or lower than, prices charged to other Owners of the Supplier's equipment.

1.08 EXTRA MATERIALS

A. Spare Parts: Provide the following for the UV System:

1. UV Lamps: 10 percent of total of all lamps in all reactors, with minimum of four lamps.
2. Sleeves: 10 percent with minimum of two sleeves.
3. Ballasts: one unit.
4. Ballast Cooling Fan: One unit.
5. Duty UV Sensor: Two (2) per reactor.
6. Reference UV Sensor: Three (3) Sensors.
7. Complete set of cleaning system wiper rings for one reactor.
8. Complete set of special tools to disassemble or adjust the UV System.
9. Complete set of O-rings seals for one reactor.
10. One year's supply of cleaning chemicals, (if applicable).
11. Spare parts for 1 year's operation of the UVT analyzer.
12. Spare parts for programmable controllers:
    a. One of each type rack power supply used.
    b. One of each type PLC processor used.
    c. One of each type of I/O module used.
    d. One of each type of mounting rack used
13. Three (3) pairs of eye protective goggles.

PART 2 PRODUCTS

2.01 UV SYSTEM MANUFACTURER (SUPPLIER)

A. The UV System Supplier shall be:

1. Trojan Technologies.
2. Calgon Carbon Corporation.
3. No substitutions or "or equal" will be allowed.

2.02 EQUIPMENT

A. Design Conditions:

1. The UV System shall be designed to provide a minimum of 2.5-log inactivation of Giardia and Cryptosporidium at the full range of flows and water characteristics as described in the UV Data Table at the end of this Section.
2. UV Dose:
   a. Reactor must produce a Validated Dose equal to or greater than 8.5 mJ/cm^2. The calculated RED at the design conditions, with one reactor out of service, obtained using MS-2 bacteriophage must be greater than the product of 8.5 mJ/cm^2 and the validation factor (VF) calculated per the 2006 UVDGM.
   b. The UV design dose shall be based on end of lamp life aging factor (ELAF) as provided by the UV Supplier based on the 3rd party verified lamp output as a fraction of specified new lamp output. The maximum ELAF shall be 0.80 and if no 3rd party certification is submitted the maximum ELAF shall be 0.70. The quartz sleeve fouling factor (QSFF) for use in calculating the design dose shall be a maximum of 0.90 (even if a different value is used in O&M calculations as described in Paragraph c below). Therefore, the fouling-aging factor equal to the product of the ELAF multiplied by the QSFF shall be used for system design to account for sleeve fouling, lamp aging and wear. If an alternate end of lamp aging factor is used, third-party certification (signed by a registered professional engineer) of the factor and the conditions under which it was determined shall be provided in the proposal.
   c. For O&M calculations, UV Suppliers may use an alternate, third-party certified end of lamp life aging factor (ELAF), if available for the proposed system. ELAF shall be in accordance with the guidelines described in paragraph b above. A maximum QSFF of 0.9 shall be used. If a third party certified ELAF is used, the fouling-aging factor shall be the product of the UV System's third party certified ELAF as shown on the Bid Form and quartz sleeve fouling factor. If an alternate end of lamp aging factor is used, third-party certification (signed by a registered professional engineer) of these factors and the conditions under which they were determined shall be provided in the proposal.
   d. The UV Reactor validation shall confirm that the UV system, with one reactor out of service, is validated for all flow and UVT combinations within the following ranges:
      1) Flow: 10.0 to 44 mgd.
      2) UVT: 95 percent to 98 percent.

e. In addition, the UV Reactors shall be validated for a range of UVT that includes 85 percent UVT (Validated flow at 85 percent UVT may be less than the design capacity, and may be interpolated from validation greater than and less than 85 percent but not extrapolated).

3. UV System Redundancy: The UV system equipment shall be capable of 2.5-log Cryptosporidium disinfection at the design flow at the design dose with one UV reactor out of service.
4. The maximum design flow for each UV reactor shall be no less than 22 mgd at 95 percent UVT, dose for 2.5-log Cryptosporidium inactivation, and with fouled sleeves and at end of lamp life.
5. UV Reactor Headloss : Maximum of 15 inches measured from inlet to outlet flange.
6. Input Voltage: 480Vac plus or minus 10 percent.

B. All reactor components shall be designed to handle pressures of up to 50 psig and shall be fully assembled and hydrotested at 1.5 times the design pressure at the factory prior to shipment.

C. The UV System shall be comprised of the following components:

1. UV Reactors: three (2 online + 1 redundant), total.
2. Local Control Panel with an OIU: One per UV reactor.
3. UV System Master Control Panel with an OIU: one total.
4. Number of UV Intensity sensor(s):
   a. Per 2006 UVDGM requirements.
   b. The system shall be able to continue providing disinfection while the UV intensity sensor is being calibrated or checked for calibration.
   c. One UV Intensity sensor per lamp.
5. Automatic Cleaning System: 1 per reactor.
   a. The system shall be able to continue providing disinfection while the automatic cleaning system is in operation.
6. UV Transmittance Monitor, capable of meeting performance requirements of UVDGM.

D. General:

1. Products that will be in contact with potable water shall have NSF 61 certification.
2. Equipment shall fully comply with OSHA standards.
3. Electrical material and equipment shall have UL listing or be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to State of Kentucky. Complete electrical assembly shall meet requirements of National Electrical Code (NEC), National Electrical Manufactures Association (NEMA), and National Fire Protection Association (NFPA) as well as having a UL 508 label.

4. Components, including equipment, coatings and other parts of system, shall comply with AWWA standards.

E. Terminal point connections shall be ANSI standard flanges.

2.03 UV SYSTEM SUPPLIER SCOPE OF SUPPLY

A. The UV System shall be furnished by the Supplier, complete with all validated UV reactors, power supplies, line filters, transient voltage surge suppressors, ballasts/transformers, lamps, quartz sleeves, calibrated duty and reference UV sensors (validated per the 2006 UVDGM), automatic cleaning system, cleaning chemicals, electrical wiring and control systems, UV transmittance monitor, water level and temperature sensors for a complete and operable system. Installation contractor shall supply interconnect power and control wiring between the MCP/LCP and LCP / UV reactors as specified by the Supplier.

B. UV Reactor:

1. General Requirements:
   a. Materials of Construction: The UV reactor shall be welded Type 316L stainless steel, pickled, passivated, and bead blasted for uniform external finish. Each reactor shall be supplied with 150-pound ANSI flanged inlet/outlet connections. All metal parts in the reactor shall be constructed of Type 316L, pickled and passivated stainless steel. All nonmetallic materials in the reactor shall be suitable for continuous exposure to UV light.
   b. Quartz sleeves shall be high purity, rated for maximum possible UV transmittance.
   c. Each lamp shall be enclosed in an individual quartz sleeve, sealed with compressed O-rings.
   d. Each quartz sleeve shall be independently sealed within the reactor.
   e. The UV reactor shall be designed such that operating personnel at the plant can change the lamps without draining the reactor.
   f. The UV reactor shall be provided with access ports for easy maintenance of the quartz sleeves, cleaning system, and sensor calibration and maintenance.
   g. The UV reactor shall include all identical flow conditioning or baffle plate devices that were present in the validation test conditions.
2. UV Lamps:
   a. The UV lamps shall be medium pressure (MP).
   b. The filament shall be rugged to withstand shock and vibration.
   c. The lamp bases shall be resistant to UV.

d. The lamps shall be operated by electronic or electromagnetic ballasts with multiple power settings ranging from at least 50 percent to 100 percent maximum power using at least 5 power steps as validated conditions.
e. Ballasts shall be fully warranted for the period stated in the Supplements to the Bid Form on at least a pro-rata basis, and shall be designed for a 10 year minimum life span.
f. The UV lamps shall be fully warranted for the period stated in the Supplements to the Bid Form on at least a pro-rata basis. At the end of warranted lamp life, lamp output weighted for the germicidal emission spectrum (using a weighting equivalent to that used by the Supplier's intensity sensor), shall be greater than or equal to 80 percent of new lamp output, as measured in the field by the Owner using the system's UV intensity sensors. Thus, lamp life shall be determined by field tests based on intensity sensor readings. At the highest power setting, if the intensity reference sensor reading (or average of all reference sensors) for a lamp is less than or equal to 80 percent of the intensity sensor reading(s) for a new lamp, then the end of lamp life shall be considered to have been achieved. If the Supplier submits an alternative ELAF, then the submitted value shall replace "80 percent" in the previous text.

3. UV Lamp Sleeves:
   a. The UV lamp sleeves shall be manufactured from General Electric Type 214, fully annealed clear fused quartz tubing, or equal.
   b. The open end(s) of the lamp sleeve shall be sealed by means of an O-ring and Type 316 stainless steel compression plate.
   c. The UV lamp sleeves shall be warranted for a number of operation hours. The warranty shall be included on the Bid Form. At the end of warranted sleeve life, sleeve output shall be greater than or equal to 90 percent of new sleeve output.
4. Intensity Sensor(s):
   a. Intensity Sensors shall be fully warranted for the period stated in the Supplements to the Bid Form on at least a pro-rata basis.
   b. Only germidical sensors, as defined in the UVDGM, shall be allowed.
   c. A minimum of one sensor per MP lamp shall be provided. The variation in sensor readings within each reactor shall be validated and within the requirements of the 2006 UVDGM.
   d. Submittal for intensity sensors shall include details of sensor calibration and traceability, as well as information on uncertainty from linearity, temperature response, spectral response, angular response, and long-term drift, in compliance with the 2006 UVDGM.

e. Include the sensor life and sensor calibration interval in compliance with the 2006 UVDGM. The sensor calibration interval shall be the time from installation into the operating facility until a sensor check versus a reference sensor requires sensor replacement.
f. "Wet" Intensity Sensors shall not be used.

5. Cleaning System:
   a. Each UV reactor shall be equipped with an automatic quartz sleeve cleaning system.
   b. The cleaning system shall provide cleaning abilities for the lamp sleeves and UV sensor.
   c. Automatic cleaning systems shall be:
      1) Fully operational while still providing disinfection
      2) Complete with an automatically initiated and controlled cleaning cycle.
      3) Field adjustable via the operator interface. Manual cleaning system control shall be available through the operator interface.
   d. The system shall be provided with the cleaning reagents and solutions required for initial equipment testing and equipment startup.
   e. Cleaning reagents and solutions used shall be NSF 60 approved.

C. Control Panels:

1. UV Reactor Local Control Panels (LCP):
   a. Power distribution and control for each UV reactor shall be through the associated LCP. The LCP shall house all power supplies and control hardware for the reactor.
   b. Each UV reactor LCP provided shall have a PLC and local OIU.
      1) The PLC shall be interconnected to the UV system master control panel PLC through the UV treatment facility Ethernet control network.
      2) The OIU shall communicate with the LCP PLC using Ethernet.
   c. Reactor to its Associated LCP Cables: Supplier shall specify the cables and terminator for connecting the UV reactor to its associated LCP. Cable shall be supplied and installed by the Installing Contractor in either PVC coated RGS conduit or liquid-tight flexible metallic conduit. Cable shall be rated for the proper power and temperature operating conditions. Cable length will be less than 70 feet per run (refer to Contract Drawings for UV equipment layout).

d. The LCP shall include all control power transformers for all required voltages. The Supplier shall provide a complete power distribution system for the ballasts/lamps and ancillary equipment associated with each reactor. The electrical system shall comply with all requirements of NFPA 70, the National Electrical Code (NEC).

e. The LCPs of each UV system will be powered through a dedicated 480-volt, or 480/277-volt, 3-phase isolation transformer (provided by others). The UV System Supplier shall include, if necessary, any harmonic filters to limit distortion (measured on the supply side of the isolation transformer) to 5 percent THD (current) and 5 percent THD (voltage) per IEEE 519 with the Point of Common Coupling being the LCP input power terminals.

f. Disconnecting Means: each LCP shall be equipped with a main disconnect switch. This shall be interlocked with the door so that the door can not be opened with the disconnect switch in the closed or "ON" position, the disconnect switch shall also be capable of being padlocked in the OFF position. A circuit breaker shall be included for the main disconnect switch and ahead of each internal transformer, other circuit shall be fused per NEC requirements. All breakers shall be fully rated, series rating is not acceptable. Available fault current shall be 30,000 amps symmetrical at 480 volts.

g. The LCP enclosure will be located indoors and shall be minimum NEMA 12, stainless steel. The room will be ventilated and kept lower than 80 degree F during summer.

h. The LCP shall contain an Energy Monitoring Unit (EMU) per Section 26 05 04.

2. UV System Master Control Panel (MCP):

a. Control of the UV treatment system shall be provided through the MCP which shall be located adjacent to the individual LCPs. The following functions shall be provided through the MCP.

1) UV reactor start/stop and power modulation.

2) UV system communications to the Plant SCADA system.

b. The MCP shall have a PLC and local OIU.

1) The PLC shall be interconnected to the UV reactor LCP PLCs and the treatment facility PLC through the UV treatment facility Ethernet control network.

2) The OIU shall communicate with the LCP PLC using Ethernet.

c. Disconnecting Means: each MCP shall be equipped with a main disconnect switch. This shall be interlocked with the door so that the door can not be opened with the disconnect switch in the closed or "ON" position, the disconnect switch shall also be capable of being padlocked in the OFF position. A circuit breaker

shall be included for the main disconnect switch and ahead of each internal transformer, other circuit shall be fused per NEC requirements.

d. The MCP enclosure will be located indoors and shall be minimum NEMA 12, stainless steel.

3. Control Panel General Requirements (MCP and LCPs):
   a. Control wiring within each panel shall be segregated within the panel based on voltage. All voltages above 120V shall be separated by a solid metal barrier. Analog and dc wiring shall be kept separate from 120V ac and 480V ac wiring. Wiring shall be, minimum, No. 14 AWG for 120V ac control wiring and No. 16 AWG for analog wiring, minimum. In all cases, size wire for connected loads and include calculations for verification, showing appropriate derating, where needed. All wiring shall have an insulation rating of 600 volts.
   b. All panels shall be pre-wired to the maximum extent possible, requiring only field connections for power and field devices. For communication circuits, provide cable and connectors per device Supplier's recommendations. Provide measurements to certify that lead length limitations on communication circuit cabling have not been exceeded.
   c. All control panels shall be provided with electrical safety interlocks, which prevent the panel from being opened when the main panel electrical disconnect is closed (providing power to the panel). Alternatively, an interlock may be provided to disconnect power from the panel when the door is opened. Safety interlock shall be Cutler-Hammer Flex Shaft, or equal.
   d. Provided electrical safety interlocks shall be in full compliance with the NEC, applicable panel ratings (e.g., UL or approved by an NRTL-Nationally Recognized Testing Laboratory), local ordinances and requirements, and any additional plant safety rules.

D. Instrumentation and Controls - General:

1. The Supplier shall provide instrumentation and control for the UV System, which allows for the UV disinfection process to be fully automated and deliver the required UV dose under conditions of varying flow rates and varying UV transmittance. Transmittance signal shall be wired directly to the UV System Master Control Panel.
2. The Supplier shall make all program functions, I/O addresses and internal registers within their PLCs accessible by Owner's SCADA system. Coordinate all register units, ranges and conventions to facilitate data exchange.

3. Engineer shall be responsible for programming Owner SCADA system to provide supervisory control for all UV reactors, related valves, pumps, and instruments.
4. The Supplier shall provide the Owner with hard and electronic copies of the software installed in Supplier's PLCs, annotated to carefully detail all program instruction functions and purposes. Minimum control, monitoring and alarm signals/information are detailed in the Functional Requirements paragraph in this section.

E. Programmable Controllers:

1. UV control system (PLCs) shall be Allen-Bradley ControlLogix processor, as specified below.
2. Communications: On-board Ethernet port for connection to the Plant SCADA system.
3. Power Supply Modules: As required.
4. Digital Input Modules: Provide isolated inputs.
5. Digital Output Modules: Provide relay outputs.
6. Analog Input Modules: Provide 4-20 mA, isolated.
7. Analog Output Modules: Provide 4-20 mA isolated.

F. Operator Interface Unit (OIU):

1. Panel-mounted graphical operator interface capable of bi-directional communication with PLC-based control system.
2. An OIU shall be mounted in each UV reactor local control panel and in the MCP.
3. Include all cables necessary to interface with the PLC control system and to a personal computer.
4. All OIUs shall be AB Panel View Plus 1000.

G. Functional Requirements:

1. The UV Control System shall calculate the UV dosage based on validated sensor set point or dose calculation. The UV reactor flow shall be provided to the LCP from the flow meter upstream of the UV reactor (installed by Contractor). The UV transmittance signal shall be provided by the UV transmittance analyzer. UV intensity sensors located within the UV reactor shall accurately sense any change in lamp power and compensate for any reduction in the UV-C output due to sleeve fouling and lamp aging. For emergency operation, an alternative manual control system shall be available which shall be based on assumed UVT and end of life power or user selected inputs.
2. The UV Control System shall monitor for equipment failure or malfunction and shall provide an alarm in response to such a failure.

3. The UV System MCP shall send a signal to the Plant SCADA with the maximum flow per reactor based on the current UVT and validated limits.
4. For plant startup, the Plant SCADA System shall provide a signal to the UV System MCP to start a UV reactor based on an operator entered flow set point during a plant start command.
5. A permissive to start a UV reactor shall be a start command from the Plant SCADA and the position of the UV Reactor influent and cooling water drain valves. If the influent and cooling water drain valves for the reactor are in the OPEN position, the UV reactor shall be allowed to warm-up. The MCP shall determine which reactor to start. An automatic rotation process shall be used.
    a. When a reactor start command is received, the UV system MCP will open the UV reactor cooling water drain valve prior to warming up the UV Reactor.
    b. Once the UV Reactor is ready, the UV system MCP will send a Reactor ready signal to the Plant SCADA system and the Plant SCADA system will open the UV Reactor isolation valve.
    c. The Plant SCADA system will send the UV System MCP the UV Reactor flow control valve position and the UV System MCP will close the cooling water drain valve on receipt of the UV Reactor flow control valve open signal.
    d. If the UV Reactor flow control valve fails to open with in an appropriate time as determined by the Supplier, the UV Reactor shall shutdown and the MCP shall cool the reactor down through the normal cool-down sequence.
6. During normal operation, the Plant SCADA system will monitor the plant flow and determine the number of UV reactors required based on the maximum flow at the current UVT. If a second UV reactor is required, the Plant SCADA system will request an additional UV reactor from the MCP.
    a. When a reactor start command is received, the UV system MCP will open the UV reactor cooling water drain valve prior to warming up the UV Reactor.
    b. Once the UV Reactor is ready (warmed up), the UV system MCP will send a Reactor ready signal to the Plant SCADA system and the Plant SCADA system will open the UV Reactor isolation valve.
    c. The Plant SCADA system will send the UV System MCP the UV Reactor flow control valve position and the UV System MCP will close the cooling water drain valve on receipt of the UV Reactor flow control valve open signal.
7. If two UV reactors are on-line and the plant flow drops so that only one reactor is needed, one reactor will be taken off-line.
    a. The UV System MCP will send the UV Reactor minimum validated flow at the current UVT to the Plant SCADA System.

b. If the UV Reactor Flow drops below 125% of the minimum validated flow at the current UVT, the Plant SCADA System will close the UV Reactor flow control valve.
c. Upon receipt of a UV reactor flow control valve closed signal, the UV System MCP will open UV Reactor cooling water drain valve and begin the UV Reactor cool-down period.
d. At the completion of the UV Reactor cool-down period the UV System MCP will close the UV Reactor cooling water drain valve.

8. One reactor shall be in standby when the plant production rate reaches a defined set point.
9. Control and monitoring of the valves, pumps, and other devices external to the UV LCPs will be provided by the Contractor. UV supplier shall coordinate details of external interfacing and communications with them.
10. As a minimum, the UV Control System shall provide the following process monitoring and status information to the Plant Control System:
    a. Status of the UV Reactor: OFF, Warming Up, Ready (no flow), ON (water flowing), and Cooling Down.
    b. Cumulative number of ON/OFF cycles for the UV lamps.
    c. Run time for each lamp.
    d. ON/OFF status for each lamp.
    e. Reactor power setting.
    f. System Ready: UV Reactor is ready to operate and no faults or unusual conditions exist.
    g. UV dosage.
    h. UV transmittance.
    i. Power draw.
11. As a minimum, the UV Control System shall provide the following alarms to the Plant SCADA System:
    a. Lamp failure.
    b. Ballast failure.
    c. Lamp run time hours exceeded.
    d. Multiple lamp failure.
    e. Multiple ballast failure.
    f. Ballast high temperature.
    g. Lamp calibration check required.
    h. High chamber/lamp temperature.
    i. Low UV intensity.
    j. GFI breaker trip.
    k. Low reactor water level.
    l. Low UV calculated dose.
    m. Cabinet high temperature.
    n. Dose communication time out.
    o. UV sensor signal loss.
    p. UV sensor signal saturated.
    q. Calibrate UV sensor.

r. Loss of UVT signal.
s. Lamp start-up failure.
t. High/Low flow rate.
u. SCADA communication fail.
v. Control panel emergency stop.
w. Wiper jam/fault.

12. The UV Control System shall receive the following commands from the Plant SCADA System:
    a. UV reactor required to be put IN-SERVICE.
    b. Fault RESET.
    c. UV reactor remote ON/OFF.
    d. Influent valve OPEN/CLOSED.
    e. UV Reactor effluent valve position.
13. The UV Control System shall receive the following process monitoring information from the Plant SCADA System:
    a. UV reactor flow.

H. Field Instruments:

1. UV Transmittance Analyzer:
    a. Provide a continuous reading, flow-through UV transmittance spectrophotometer suitable for measurement of UV transmittance of the GAC effluent water. The unit shall be self-contained and shall include sensor and analyzer. The sensor shall consist of a UV light source, filter, sample cell, and detector.
    b. The analyzer shall be suitable for a 120V ac power supply and housed in a NEMA 4X enclosure.
    c. The analyzer shall comply with the accuracy, uncertainty, and reliability requirements defined in the 2006 UVDGM.

I. Other: refer to Part 1 and Part 3 of this Section for additional items to be furnished by the UV system Supplier.

2.04 SCOPE OF SUPPLY FOR INSTALLING CONTRACTOR

A. The Contractor (“Installing Contractor”) shall be responsible for supplying and installing all the necessary materials, equipment and appurtenances not supplied as part of the scope of supply for the UV System Supplier, but required for a complete, functional and operational UV System. Including, but not limited to:

1. Supports required to install the UV reactors that are not supplied by the UV System Supplier (supports not directly connected to the UV Reactors, i.e. pipe supports for upstream and downstream piping whether it supports the UV reactor or not. All structural calculations

shall meet the requirements of the local building code, be reviewed by the UV System Supplier and be signed by a registered Professional Engineer in the State of Kentucky with a Structural or Civil discipline.

2. All the hardware, fasteners, anchor bolts, nuts, plates and angles necessary for the installation of the UV System. All hardware, fasteners, anchor bolts, nuts, plates, angles, etc. shall be Type 316 stainless steel.
3. All mating flanges, insulating flanges, couplings, gaskets, bolts, nuts, and all necessary piping specialties to install the reactors, and analyzers, supplied by the UV System Supplier. Mating flanges shall be as required in the pipe schedule. All bolts, nuts shall be Type 316 stainless steel. Gaskets shall be EPDM.
4. All conduit, fittings, supports, hubs and wiring including wire terminations and terminators necessary for the complete installation of the UV reactors, LCPs, instruments, analyzers, devices and OUIs supplied as part of the UV System. Installing contractor shall supply interconnect power and control wiring between the MCP/LCP and LCP / UV reactors as specified by the Supplier.
5. All the equipment supports, u-bolts, and all necessary hardware to install all the ancillary equipment supplied by the UV System Supplier. Ancillary equipment shall include UVT analyzers, control and power panels, and other equipment needed for a fully functional and validated UV system.
6. Provide on-site assistance to UV System Supplier during Functional Testing as defined in the Functional Test Procedures developed by the UV System Supplier and approved by the Engineer.
7. Provide on-site assistance to UV System Supplier during Performance Testing as defined in the Performance Test Procedures developed by the UV System Supplier and approved by the Engineer.

B. Installing Contractor shall refer to the UV Supplier's Submittal's for additional requirements.

2.05 WORKSHOPS AND MEETINGS

A. UV Supplier and Installing Contractor shall attend a 2-day coordination meeting specified below at the Owner's facility, prior to start of programming.

1. Supplier shall coordinate with the Contractor, Engineer and Owner for the configuration and programming of the SCADA .
   a. Supplier shall attend a SCADA development workshop at the Owner's facility to create preliminary sketches (developed by Contractor) for all displays that will be developed for the project. This workshop shall include:
      1) Overview display design.
      2) Process graphics.
      3) Display paging and navigation.
      4) Equipment control features; pop-up windows.

5) Data entry through OIU.
6) Coordination issues with plant-wide SCADA.
7) Color conventions and symbols in compliance with Owner's standard.
8) Define all Alarms and security setup.
9) Portability of database and graphics into plant-wide SCADA i.e., ensure no conflicts in databases.
10) Memory mapping between local PLCs, OIUs and plant-wide SCADA.

2. Provide recommended overview display graphic. This can be in the form of a sketch or typical graphic and should convey to Contractor and Owner what information is important to display and monitor concerning system operation.
3. Provide recommended detail display graphics (if any). Sample graphics may include more detailed monitoring screens, data displays, increased process or equipment detail vs. the overview graphic, etc. Information is expected to be in the form of a sketch or typical graphic display, similar to above.
4. Provide memory mapping to clearly identify all registers to be used for external monitoring and control with a detailed description of the meaning and function of each register, including values expected, minimum and maximum values, engineering units of value, etc. For Boolean registers, clearly define the meaning of each state.
5. Provide recommended list of points and values to alarm, including recommended alarm set points on analog values.
6. It is the responsibility of the Contractor to schedule the above workshops with the Owner in a timely manner. The Contractor must also include the participation of the Engineer in the above workshops.

2.06 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel, with 1/4-inch engraved block type black enamel filled equipment identification number and letters shown in the Contract Drawings. Mount securely in a readily visible location. Identification Plates shall be supplied and installed by the Installing Contractor. Identification Plates shall be provided for all reactors and control panels.

B. Space Heaters: Thermostatically controlled. Locate in each panel, for operation from 120-volt power source derived internal to LCP.

C. Lifting Lugs: For equipment weighing over 100 pounds except UV reactors.

D. Anchor bolts shall be Type 316 stainless steel, supplied and installed by the Installing Contractor.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installing Contractor shall install products in conformance with UV System Supplier's shop drawings and installation instructions.

B. Installing Contractor shall energize all space heaters as soon as the equipment arrives on site.

C. Installing Contractor shall provide all interconnecting structures, equipment, piping, electrical and instrumentation work, finish painting, and appurtenances as shown on the Drawings and UV System Supplier's approved drawings, to achieve a complete and functional system.

D. Installing Contractor shall provide foundation pads for products as shown. Verify exact dimensions and configuration of all pads, including penetrations, with UV System Supplier's furnished product shop drawings.

E. Anchor Bolts:

1. Where required, Installing Contractor shall provide anchor bolts, fasteners, washers, and templates needed for installation of UV Equipment.
2. Size and locate anchor bolts in accordance with UV System Supplier's product shop drawings, calculations and installation instructions.

F. Installing Contractor shall properly align, plumb and level, with no stresses on connecting piping or conduit all mechanical and electrical equipment.

G. Installing Contractor shall verify operability and safety of electrical system needed to operate equipment. Check electrical system for continuity, phasing, grounding, and proper functions.

3.02 TESTING

A. The UV System Supplier shall be required to complete several required tests. These tests shall include:

1. Factory Test.
2. Functional Test.
3. Performance Test.

B. Factory Test:

1. The UV System Supplier shall be responsible for the Factory Test that shall be conducted by the UV System Supplier, after the shop drawings are approved and before system is shipped to the site.

2. The UV System Supplier shall factory test all major system components of the UV System during a single test session for compliance with the construction and functional requirements specified herein.
3. The UV System Supplier shall submit a Factory Test Plan, for approval, to the Engineer that will demonstrate the full operability of UV Reactors. The test plan shall include, but is not limited to the testing of the delivery of the UV dosage, the lamps, the intensity sensors, the cleaning system, local control panel for each of the reactors, and the instrumentation and controls for each of the reactors, and operator interface units. The scope of the Factory Test shall demonstrate that each individual component of the UV System operates as specified.
4. After approval of the Factory Test Plan by the Engineer and Owner, the testing shall be performed and may be witnessed by the Engineer and Owner at the UV System Supplier's testing facility. Engineer and Owner's travel expenses to factory testing will be at Owner's expense.
5. The UV System Supplier shall submit a Factory Test Report discussing the tests performed, items witnessed, and the results for the approval of the Engineer and Owner upon conclusion of the Factory Test.
6. The UV System shall not be shipped until the Factory Test Report is approved.

C. Functional Testing:

1. The first on-site element of the required testing shall consist of Functional Testing for all UV reactors. For the Functional Testing, the Installing Contractor and the UV System Supplier shall verify operation of all system components, all control system functions, all system alarms, and communication links. The Functional Testing shall also include verifying the operation of the control system for local and remote operation. The lamp output shall be changed to verify that the sensor outputs are sufficiently sensitive to pick up the decrease in UV intensity. Functional testing shall demonstrate impacts of loss of UV transmittance signal, UV intensity signal, and flow rate signal. In addition the accuracy of the reference sensors shall be checked against the other reference sensors, and each duty sensor will be checked against a reference sensor. Any sensor not in compliance with UVDGM requirements shall be replaced.
2. The UV System Supplier shall inspect the installed UV System for proper alignment, proper equipment supports, correct operation, proper connection, and satisfactory function of all components. All signals shall be verified, and all alarms shall be tested.
3. Functional testing shall be performed in coordination with the Contractor. UV System Supplier shall test each control signal required to be communicated between the UV control system and the plant SCADA system for proper operation.

4. The UV System Supplier shall approve the installation and provide written certification that the system components have been installed properly, and are ready for operation. The Installing Contractor shall notify the Engineer and Owner of Functional Testing schedule to allow the Engineer and Owner to witness testing.
5. The Installing Contractor shall ensure all ancillary systems (valves, control system, etc.) required for Functional Testing are available for use.
6. UV System Supplier shall coordinate with Contractor for control system operation during functional test and shall lead the testing.
7. The proposed Functional Testing procedure shall be developed by the UV System Supplier, submitted to the Engineer and Owner, and reviewed by the Owner and Engineer before scheduling and performing Functional Testing. In the case of a nonconforming system, as determined by the Engineer and Owner, advancement to Performance Testing shall not commence until the UV System Supplier has made, at no additional cost to the Owner or Installing Contractor, such adjustments and modifications as are necessary to correct the system, and has demonstrated this by repeating the Functional Testing until satisfactory.
8. The UV System Supplier shall prepare a Functional Testing Report and shall submit two electronic and two hard copies of the report to the Engineer within 14 days of completion of the Functional Testing.
9. Both the UV System Supplier and the Contractor shall be onsite for the duration of the Functional Testing.

D. Performance Testing Basic Requirements:

1. The Performance Testing shall include head loss tests, power consumption tests, UVT and intensity sensor calibration checks, power factor measurements, UV System dose (based on UV System control panel readings and calculations), and operation in auto mode. The UV System Supplier shall develop performance test procedures, which shall be approved by the Engineer prior to testing. The Performance Testing shall proceed for a minimum of 3 days continuous operation.
2. Performance testing shall verify system operation without malfunction for a period of 3 continuous days. Any malfunction during this period shall be addressed and the 3-day test shall be restarted until full system performance is approved by the Owner and Engineer.
3. Performance testing shall be completed on all UV reactors. The system must operate for all 3 days, but individual reactors may go in and out of service as needed. The system will be challenged to verify correct operation (i.e., reactor failure or loss of UVT signal).
4. No off-specification operations shall be allowed during the 3-day Performance Test.

5. The test will be conducted by the UV System Supplier and Installing Contractor under the observation of the Engineer. The Owner may obtain the services of an independent consultant or testing laboratory to observe and verify procedures and test results at the option and cost of the Owner.
6. Owner will provide power and process water required to operate the system during the performance test.
7. At least 30 days prior to the proposed testing date, Contractor shall notify the Engineer and UV System Supplier of the testing date and shall submit a report from the UV System Supplier detailing the proposed performance testing equipment and schedule. This submission shall include the following:
    a. Instruments to be used for measurements.
    b. Relative precision of the instruments, and methods of calibration.
    c. Data sheets for recording measurements.
    d. Procedures for making calculations, including example calculations.
    e. Procedures for documenting compliance.
8. UV System Supplier shall provide all instruments and other supplies necessary for conducting the tests.
9. UV System Supplier shall collect all data and compile the performance test results, including the calibration data, and submit four copies of the report to the Engineer. Within 14 days after completion of the performance test, two hard copies and two electronic copies of the raw data shall be provided to the Engineer.
10. UV System Supplier shall use portable, factory calibrated kilowatt hour meters with accuracy of 0.25 percent of reading. Factory calibration reports shall be provided to the Engineer for all power meters not less than 10 days prior to the scheduled performance tests.
11. The flow and water temperature shall be measured with the installed Water Treatment Plant instruments. These instruments shall be calibrated, but readings will not be corrected to account for errors inherent in the equipment. Direct readings will be used.
12. Except as specifically required, herein, the system shall be operated during the performance tests as intended for normal, long-term operation under the conditions specified.
13. UV System Supplier and Installing Contractor shall observe the requirements of the Operation and Maintenance Manual, the Plant Safety and OSHA rules at all times.
14. The power draw and power factor of the system shall include all reactors, sensors, control panels, and other appurtenances.
15. Power draw shall be measured for each reactor individually and shall be based on each individual reading.

16. Perform sensor calibration checks of duty and reference sensors and provide uncertainty calculations based on field evaluations. Compare sensor uncertainty based on field evaluations with that provided in the third-party validation report and compliance with the 2006 UVDGM requirements.
17. Perform UVT monitor calibrations and reading stability checks, with the use of the Owner's laboratory spectrophotometer, and prepare documentation on its compliance with the 2006 UVDGM requirements.
18. Both the UV System Supplier and the Installing Contractor shall be onsite for the duration of the Performance Testing.
19. With plant load connected to normal utility source, measure the following to show parameters within specified limits:
    a. Total and individual current harmonic distortion (up to and including 35th harmonic) at location identified as PCC, under the following load conditions:
        1) UV reactors operating at full load and half load.
        2) Half of the specified UV Reactors operating at full load and half load.
    b. Power factor at input side of each UV Reactor.
    c. Test Equipment: Use Dranetz, Model No. 626-PA, harmonic distortion monitor and Series 626 disturbance analyzer or equivalent instrument to document results.
20. With plant load connected to standby power source, measure the following to show parameters within specified limits:
    a. Total and individual current harmonic distortion (up to and including 35th harmonic) at location identified as: PCC, with UV Reactors running at:
        1) Full load.
        2) Half load.
    b. Test Equipment: Use Dranetz, Model No. 626-PA, harmonic distortion monitor and Series 626 disturbance analyzer or equivalent instrument to document results.
21. Power Consumption: Power consumption shall be measured at each energy monitoring unit (EMU) for the 3-phase feeder entering the CPP under average daily flow conditions. Measured power consumption for use in paragraph 3.06 shall be the sum of all EMU readings for operating CPPs. Instantaneous power draw (kilowatts), kilowatt-hours and power factor shall be measured for three one-hour periods and recorded. The meter shall have been calibrated immediately preceding this test. Each one hour period will be averaged and reported. If the difference between the highest and lowest values exceeds 30% of the highest value, then power consumption will be measured for three four-hour periods. The three values will be averaged to determine whether liquidated damages for excess power consumption apply per paragraph 3.06.

22. During performance testing, the following will be observed and recorded:
    a. Lamp status (on/off)
    b. Verification of system operation within validated limits of flow rate and UV Transmittance
    c. Measured UV irradiance (sensor output) over time
    d. Verification of on-line sensor operation with reference sensors
    e. Ballast temperature and cooling system performance
    f. Monitor fouling and impact on system performance, if any
    g. Electrical service, voltage, current, and power consumption
    h. Monitoring system operation
    i. Alarm system operation
    j. Monitoring flow rate
    k. Flow distribution between UV reactor trains
    l. Lead / lag operation
    m. Control of system operation including variable intensity operation
    n. Download of operational data
    o. Interfacing with the plant SCADA system

3.03 TRAINING

A. UV System Supplier shall provide a minimum of the following training classes to the Owner at the Owner's project site (note the times stated below exclude travel time):

1. 4 person-days (24 hours) of operational training.
2. 2 person-days (12 hours) of maintenance training.
3. 6 days of Owner support through 6 trips in the first 12 months of operation. Support shall be provided at Owner's request.

B. UV System Supplier shall provide the Owner with written training course outlines 1 month before the first training session. Owner shall be able to comment on course material, and UV System Supplier shall revise as requested.

C. Training times shall be as determined by Owner. Session schedules shall be adjusted to account for interruptions in operability of equipment.

D. The Owner may choose have the training sessions video recorded per Section 01 43 33 at the owner's discretion and expense.

E. Training shall comply with Section 01 43 33, Manufacturer's Field Services, except as modified in this Section.

3.04 INSTALLATION ASSISTANCE AND TESTING

A. All times stated below exclude travel time.

B. UV System Supplier shall provide a minimum of 2 days unloading and equipment inspection upon UV System arrival onsite.

C. UV System Supplier shall provide a minimum of 8 days in 4separate trips (2-day trips) for installation assistance to the Installing Contractor. The UV System Supplier shall coordinate the site visits with the Installing Contractor. UV System Supplier shall provide a Manufacturer's Certificate of Proper Installation.

D. UV System Supplier shall provide a minimum of 6 days in two separate trips (3-day trips) for Functional and Performance Testing. The UV System Supplier shall coordinate the site visits with the Installing Contractor and Owner.

E. Supplier shall provide an anticipated maximum of 60 hours of remote engineering support to the Owner and Engineer.

F. Owner will approve schedule for all trips.

3.05 COMPONENT / LAMP WARRANTIES

A. In addition to other warranties provided, the UV System Supplier shall warrant the component / lamp replacement frequency of the UV System as provided in this Paragraph. The warranties provided in this Paragraph are cumulative and do not supersede any warranties provided elsewhere in the Contract Documents.

B. The component / lamp warranty shall consist of two parts: (1) a full replacement warranty period, and (2) a pro-rata warranty period. The component / lamp warranty period shall be the period established in the Supplements to the Bid Form.

1. The full replacement warranty period shall last for a period of at least 1,000 hours of actual operation after the date of Substantial Completion as defined in Section 00 73 00.
2. The pro-rata warranty period shall commence with the end of the full replacement period and last until the end of the pro-rata warranty period as submitted by the Supplier in the Supplements to the Bid Form for the UV System.
3. The Supplier warrants that the UV components / lamps will be free from defects in:
    a. Materials
    b. Workmanship
4. Limitation of Warranty: Owner recognizes that the occurrence of any of the following shall void the UV component / lamp warranty.
    a. Physical Damage or Faulty Installation of the UV lamps by others.

b. Unauthorized alteration of components manufactured by the Supplier.
c. Use of cleaning procedures other than procedures approved by the Supplier.
d. Improper maintenance of equipment.
e. Failure of the Owner to maintain electronic operational logs as required by the Supplier. The Owner will not be responsible for the maintenance of manual (handwritten) operational logs. The maintenance of electronic logs is subject to the following conditions:
    1) The Supplier is responsible to provide to the Owner a listing of the operational data points that are to be electronically logged.
    2) The Supplier is responsible for the PLC programming of data points that are to be electronically logged.
    3) The Supplier shall identify minimum frequencies of logging of all operational data points required by the Supplier to maintain UV component / lamp warranty provisions.
    4) The Supplier shall establish the alarms limits that would result in the operation of the equipment outside of Supplier established limits.
    5) The Supplier shall be solely responsible for the identification and programming of system interlocks that would result in the operation of the system outside of the parameters required by the Supplier. The Owner will not be responsible for errors in Supplier developed programming that would result in operation of the system outside of the Supplier established limits.
f. In the event of a warranty claim, failure of the Owner to provide the Supplier with electronically logged operational parameters.

5. Changes in the Supplier established operational and maintenance guidelines shall not be applied retroactively to invalidate the warranty.
6. UV Component / Lamp Replacement Costs:
    a. The Supplier shall establish the initial UV component / lamp replacement prices in the Supplements to the Bid Form and guarantee that the respective UV components / lamp replacement prices shall not increase by more than the prevailing Consumer Price Index (CPI) over a twenty-five (25) year period.
    b. During the full replacement warranty period, the Supplier shall provide replacement component / lamps at no cost to the Owner.
    c. Component / Lamp Replacement Price during the pro-rata warranty period shall be calculated as follows:

$$\text{Pro Rata Replacement Price} = \frac{\text{Replacement Price} \times \text{Period of Beneficial Use}}{\text{Component / Lamp Replacement Warranty Period}}$$

1) The pro-rata component / lamp life will be capped at the warranted life entered in the Supplement to the Bid Form.

7. Definition of Component / Lamp Failure.
   a. UV lamps shall be deemed to have failed when they:
      1) Fail to light when struck.
      2) Fail to achieve performance requirements for disinfection.
      3) Fail to meet other requirements in paragraph 2.03 B 2 of this section.
   b. UV ballasts shall be deemed to have failed when they:
      1) Fail to properly operate UV lamps.
   c. UV intensity sensors shall be deemed to have failed when they:
      1) Are not able to be calibrated properly at the factory.
      2) Drift out of calibration more than twice per year when checked with the reference intensity sensor per USEPA guidelines.
8. The Supplier shall ensure disposal of returned lamps (old/used) at no costs to the Owner upon receipt of the returned lamps at the manufacturing headquarters. Shipping costs however shall be borne by the Owner.

3.06 GUARANTEED POWER CONSUMPTION

A. The Supplier shall guarantee for a period of one year that UV System will achieve the disinfection requirements specified in this section without exceeding the Guaranteed Maximum Total UV System Power Consumption at Average Daily Flow set forth by the Supplier in the Supplements to the Bid Form. The one-year guarantee period will not begin to run until the successful completion of all testing required by the Contract Documents and the issuance by the Owner of the Notice of Substantial Completion. If the UV System consumes more power than guaranteed, the Supplier will be assessed liquidated damages pursuant to this Section.

B. The Owner and the Supplier agree that, in the event the UV System does not perform as guaranteed with regard to power consumption, the Owner will suffer damages over the course of the useful life of the Project, but that such damages will be extremely difficult or impossible to measure. Therefore, the Owner, the Installation Contractor, and the Supplier agree that the Owner's damages in the event the UV System does not perform as guaranteed with regard to power consumption will be liquidated and calculated as provided in this Paragraph and paid by the Supplier to the Owner.

C. Liquidated Damages for Breach of Performance Guarantee

1. Liquidated damages for breach of the UV Supplier's performance guarantee for the UV System will be based on the present worth of the difference between the measured power consumption and the maximum power consumption guaranteed by the UV Supplier in the Supplements to Bid Form.
2. Liquidated damages shall be limited to the total Lump Sum Bid Price as listed in the Supplements to Bid Form Guaranteed Present Worth Table (Attachment 6A or 6B, as appropriate to vendor).
3. Liquidated damages for excess power consumption shall be calculated as shown in Equations No. 1 through No. 5 below. Equations are provided for the following:
    a. Equation No. 1 Measured Power Consumption
    b. Equation No. 2 Guaranteed Power Consumption
    c. Equation No. 3 Excess Annual Power Consumption
    d. Equation No. 4 Excess Annual Power Consumption Cost
    e. Equation No. 5 Liquidated Damages for Excess Power Consumption

Liquidated Damages for Breach of Performance Guarantee
Power Consumption Worksheet

Equation No. 1	Measured Power Consumption
Measured Power Consumption (kW)	= Measured Power Consumption at the UV System Submeter (at Average Daily flow per 3.02 D of the Section)
Equation No. 2	Guaranteed Power Consumption
Guaranteed Power Consumption (kW)	= Guaranteed Maximum Total UV System Power Consumption (per Supplement to Bid Form)
Equation No. 3	Excess Annual Power Consumption
Excess Annual Power Consumption (kW-hr/yr)	= [Measured Power Consumption (Equation No. 1) – Guaranteed Power Consumption (Equation 2)] x 8,766 hrs/yr *(Note: liquidated damages apply if the Excess Annual Power Consumption > 0)*
Equation No. 4	Excess Annual Power Consumption Cost
Excess Annual Power Consumption Cost ($/yr)	= Excess Annual Power Consumption (Equation No. 4) x $0.08/kW-hr
Equation No. 5	Liquidated Damages for Excess Power Consumption
Liquidated Damages for Excess Power Consumption ($)	= Excess Annual Power Consumption Cost (Equation No. 4) x 13.41

Notes:
1) Measured and Guaranteed Power Consumptions are at average annual flow rate identified in this Section.
2) Present Worth Factor of 13.41 (25 years at 5.5%).

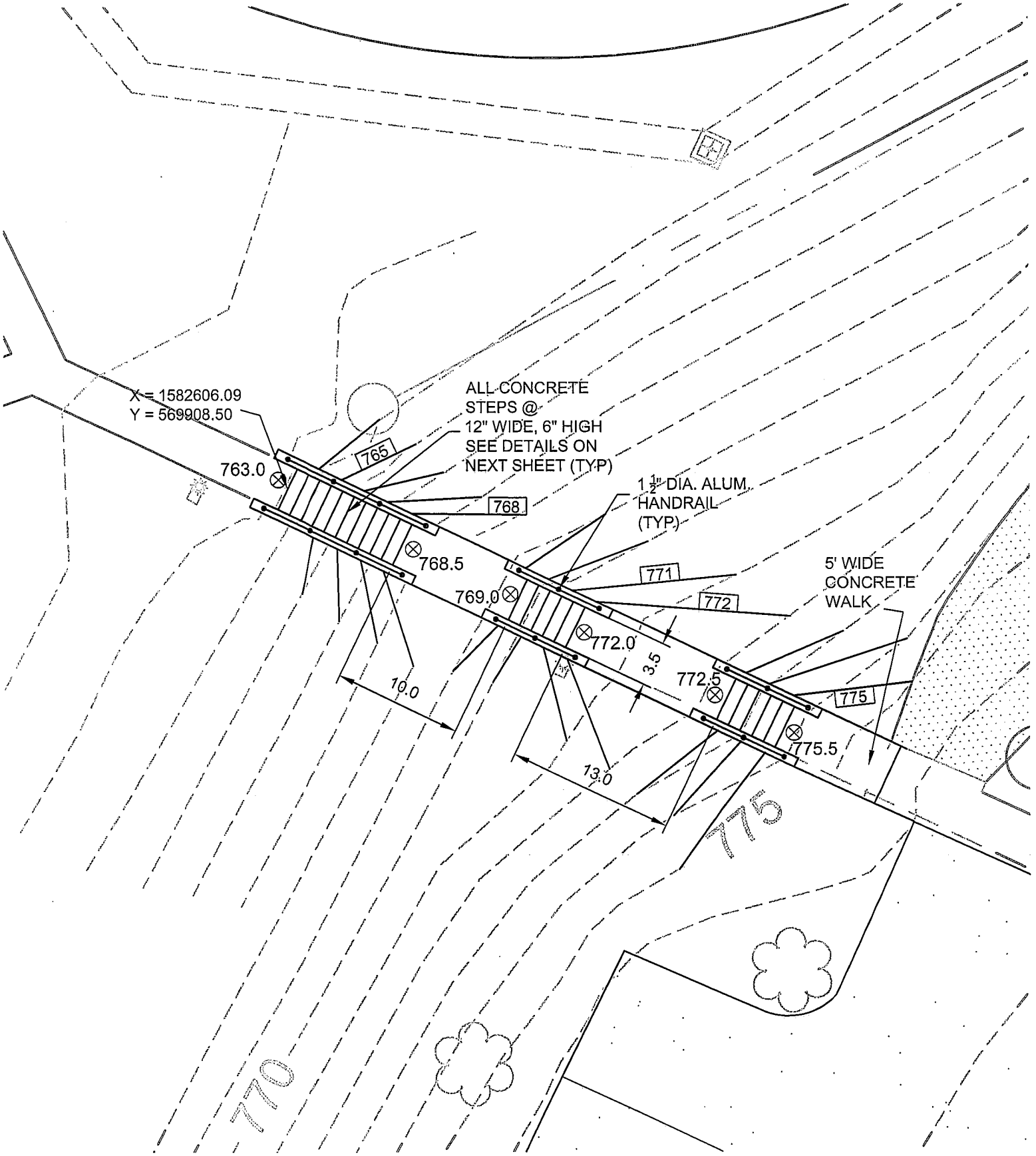
3.07 UV DISINFECTION SYSTEM DATA SHEET

A. Following table summarizes data for the UV disinfection system:

Description	Data	Units
UV Lamp technology	Medium pressure	
Total number of UV reactors	3	each
Minimum no. of duty reactors	1	each
Maximum no. of duty rectors	2	each
Number of standby reactors	1	each
Water temperature range	36 to 88	degrees F
Ultraviolet transmittance (UVT 254)	85 to 100	%
Turbidity	0.03 to 0.21	NTU
Hardness	75 to 183	mg/l as $CaCO_3$
pH	6 to 9	std units
Alkalinity	29 to 101	mg/l as $CaCO_3$
Iron (90^{th} percentile value)	.032	mg/l
Manganese (90^{th} percentile value)	.014	mg/l
Peak flow rate	44	MGD
Peak flow rate per reactor	22	MGD
Average flow rate	23.5	MGD
Minimum flow rate	10.0	MGD
Minimum validated UV dose	8.5	mj/cm^2

Design UV transmittance (95th percentile)	95	%
Minimum validated UV transmittance	80	%
Lamp percent output defining end of lamp life (EOLL)	70	%
System operating pressure range	2 to 20	feet of water
System design pressure	50	Psig
Maximum headloss through reactor	15	Inches

END OF SECTION



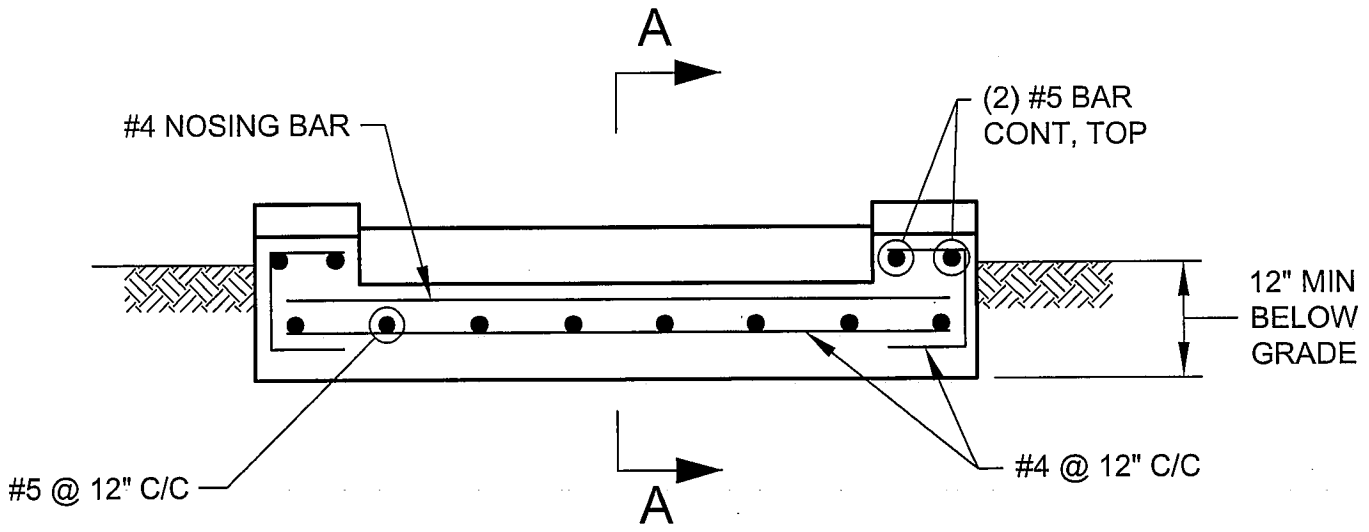
CONCRETE STEP REPLACEMENT PLAN

SCALE: 1"=10'

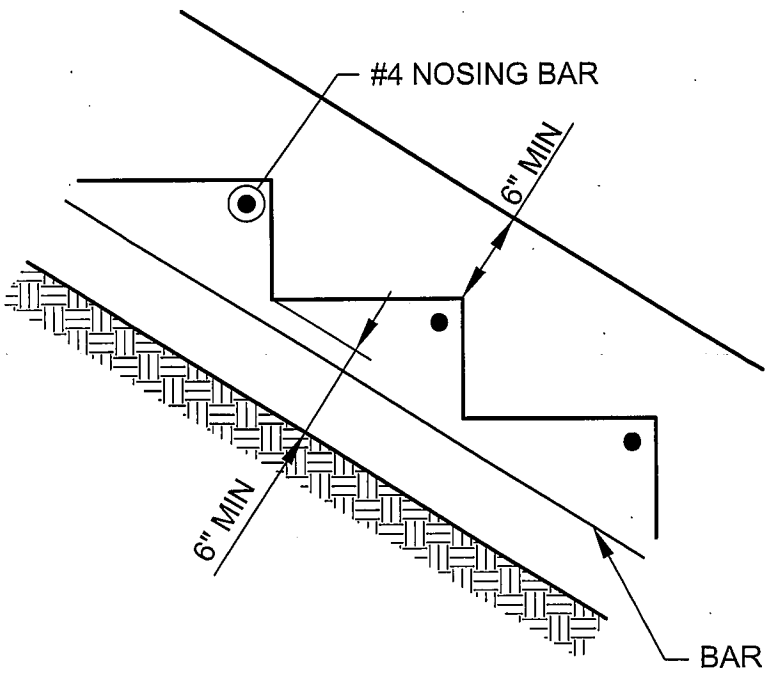
MAG NORTH

N

PROJECT NORTH



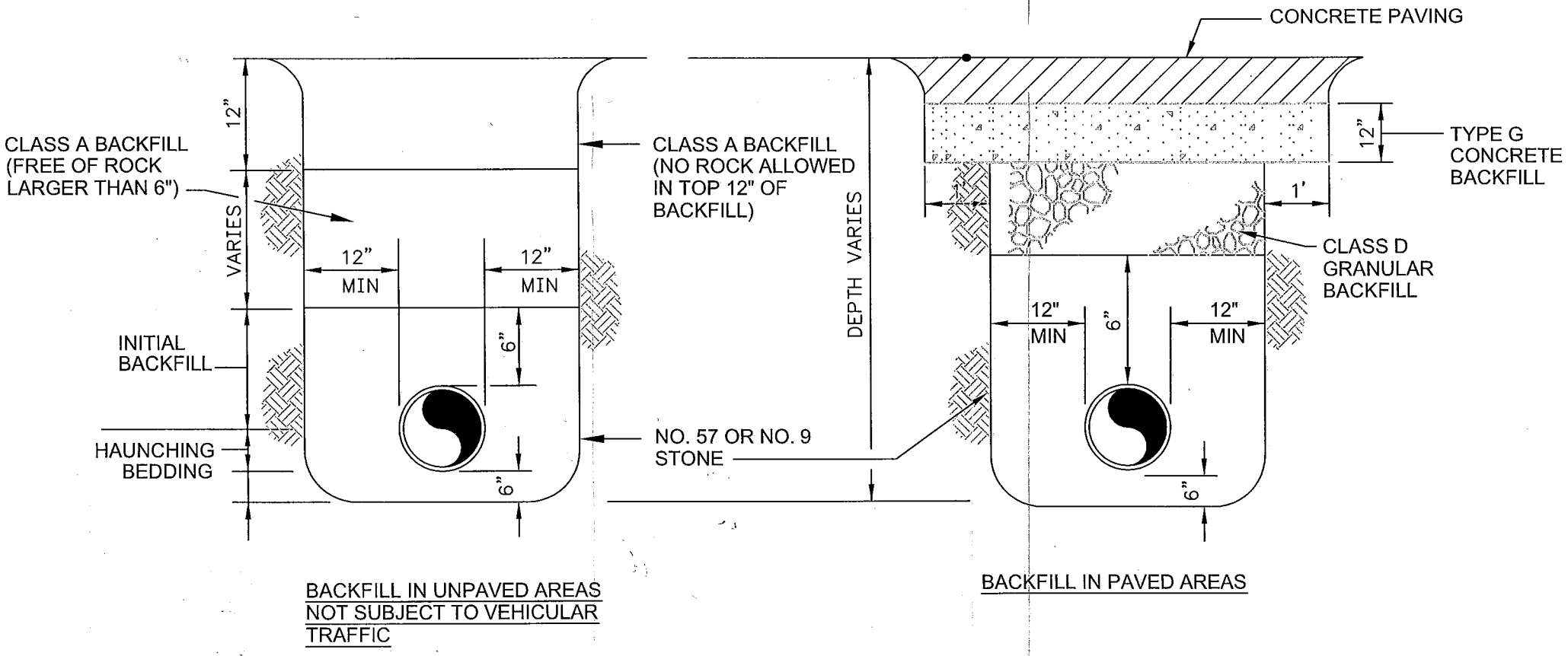
CROSS SECTION



SECTION A-A

CONCRETE STEP DETAILS

NTS

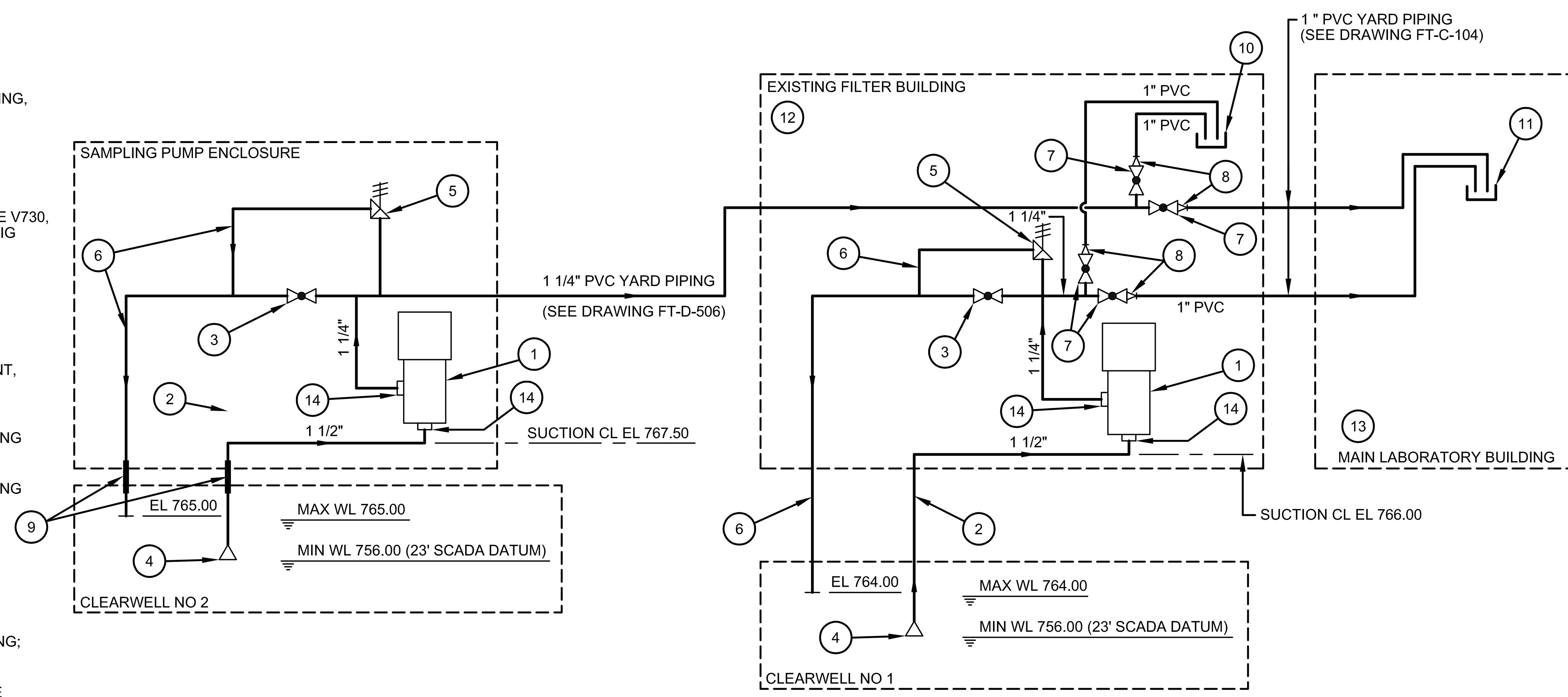


BEDDING AND BACKFILLING DETAILS FOR WATER, STORM AND SANITARY SEWER

NOT TO SCALE

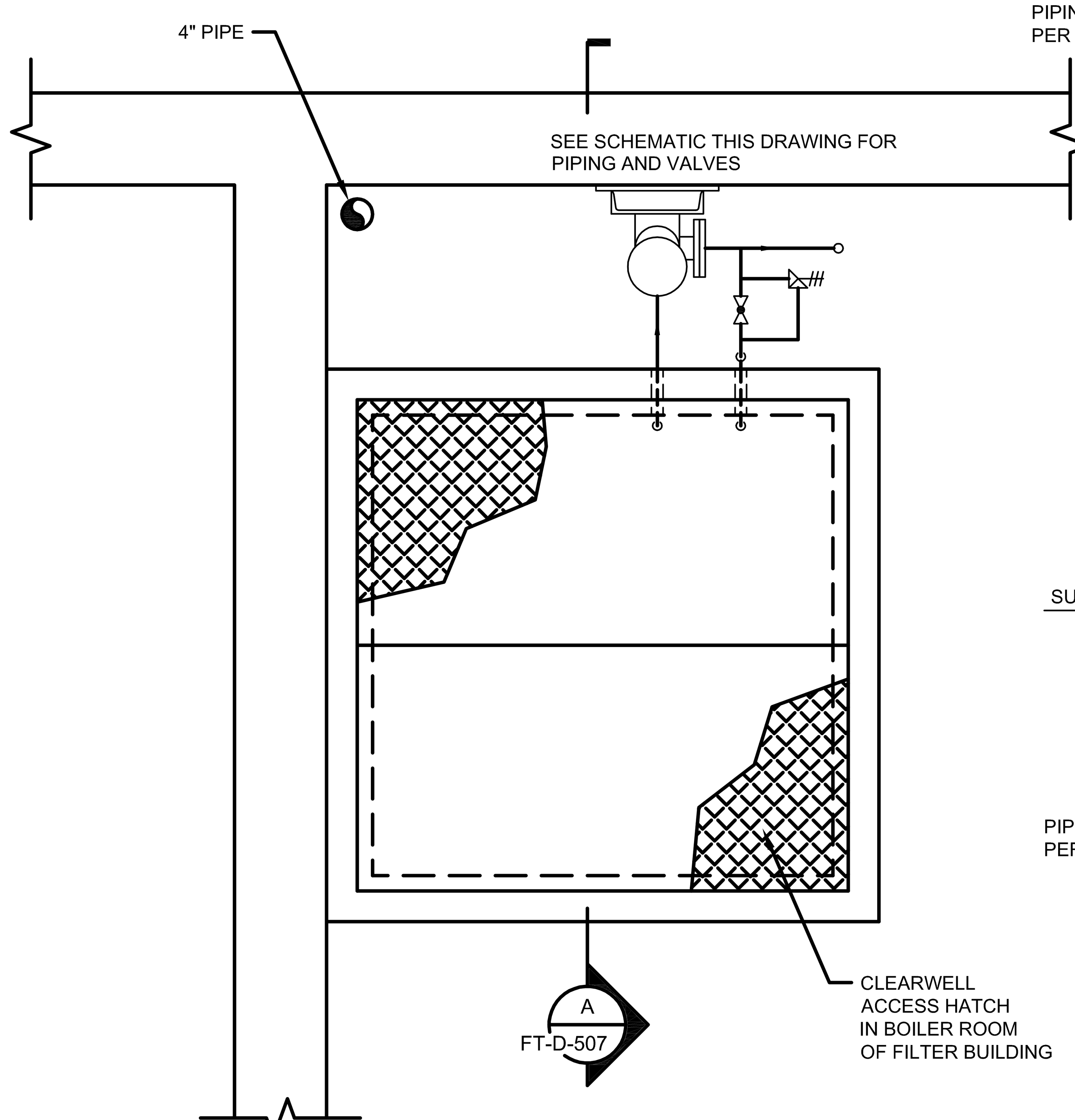
KEYED NOTES

1. PROGRESSIVE CAVITY SAMPLING PUMP
2. 1 1/2" WIRE REINFORCED PVC SUCTION TUBING, CAPABLE OF 28" HG VACUUM
3. 1 1/4" GLOBE VALVE, V200
4. WEIGHT (2 POUNDS)
5. 1 1/4" ADJUSTABLE PRESSURE RELIEF VALVE V730, MINIMUM ADJUSTMENT RANGE 20 TO 100 PSIG
6. 1 1/4" PVC RETURN TO CLEARWELL
7. 1 1/4" BRONZE BALL VALVE, V300
8. 1 1/4" x 1" REDUCER
9. INSULATED & HEAT TRACED PIPING SEGMENT, FROM INSIDE ENCLOSURE TO EL 766.00 IN CLEARWELL
10. TWO NEW GOOSE NECK FAUCETS AT EXISTING SINK IN OPERATORS LAB
11. TWO NEW GOOSE NECK FAUCETS AT EXISTING WET CHEMISTRY LAB SINK
12. COORDINATE WITH OWNERS STAFF ON EXPOSED PIPE ROUTING IN PIPE GALLERY AND TO LAB SINK; PROVIDE PIPE SUPPORTS PER SPECS
13. COORDINATE WITH OWNERS STAFF ON EXPOSED PIPE ROUTING INSIDE LAB BUILDING; PROVIDE PIPE SUPPORT PER SPECS
14. BLIND FLANGE, TAPPED WITH BRASS NIPPLE AND ADAPTER FOR TRANSITION TO PVC PIPE

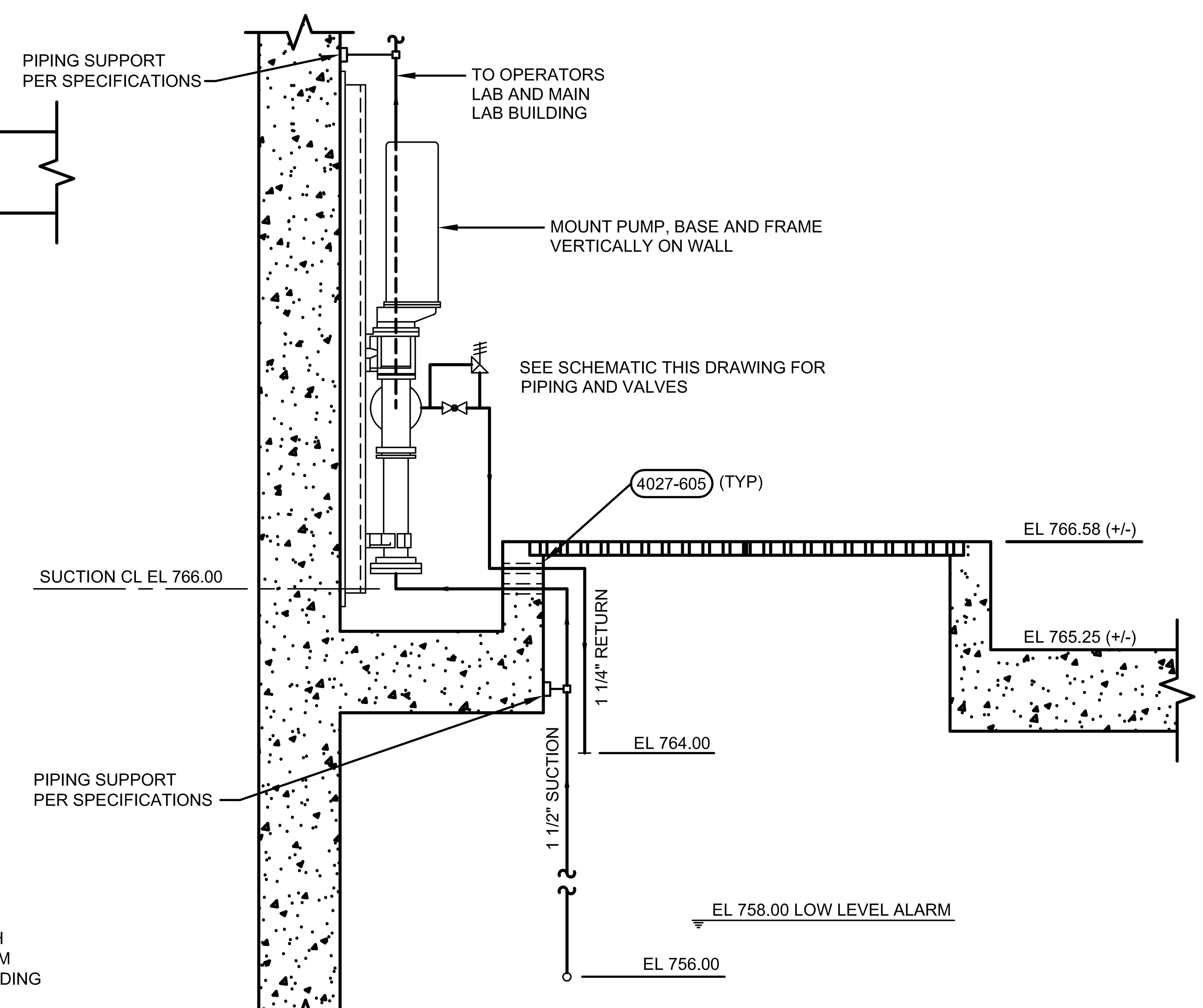


FINISHED WATER SAMPLING PUMP SCHEMATIC

NO SCALE

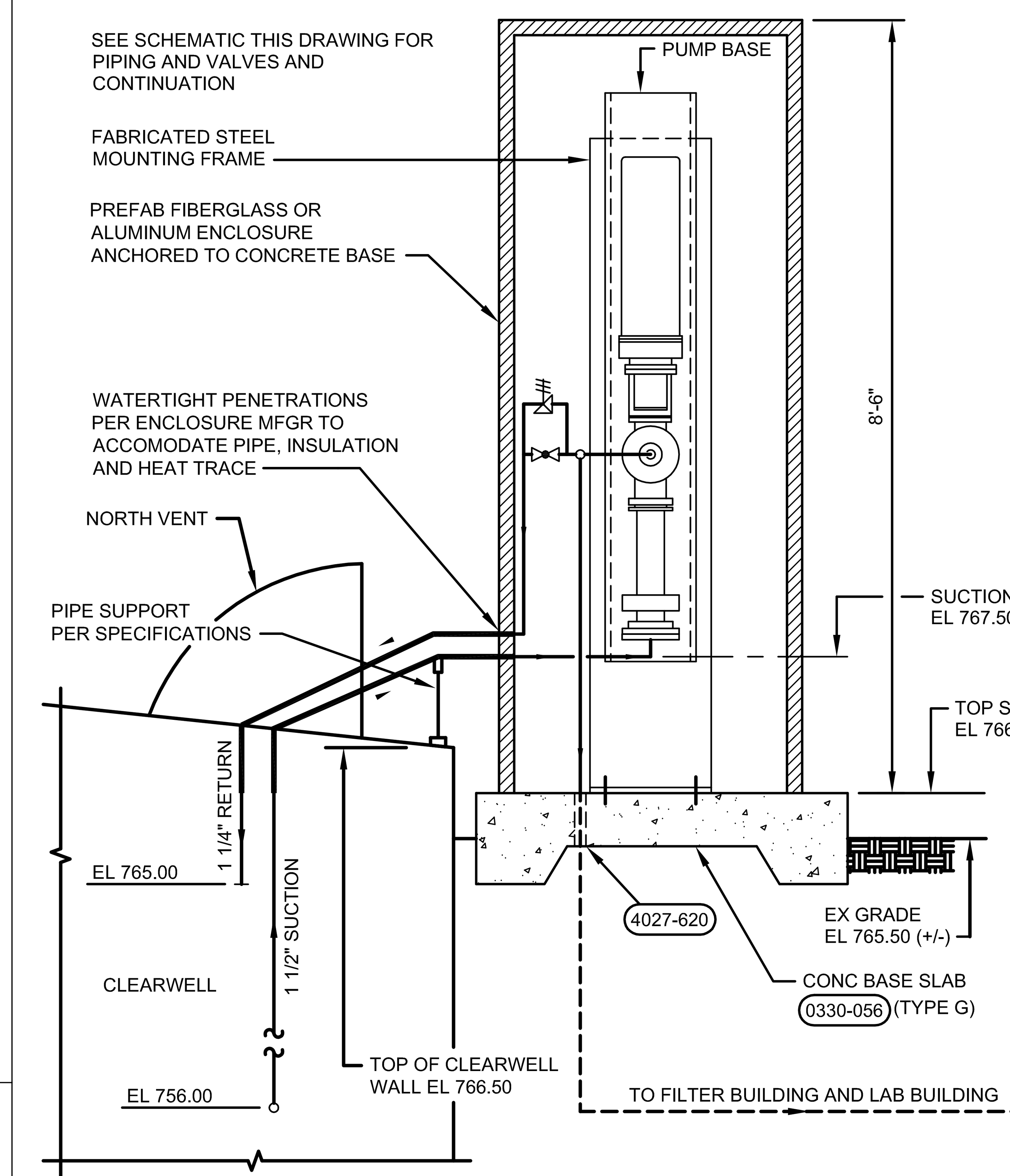


PLAN
3/4"=1'-0"
PROJECT NORTH



A SECTION
3/4" = 1'-0"
FT-D-507

CLEARWELL NO 1 SAMPLING PUMP DETAIL



B SECTION
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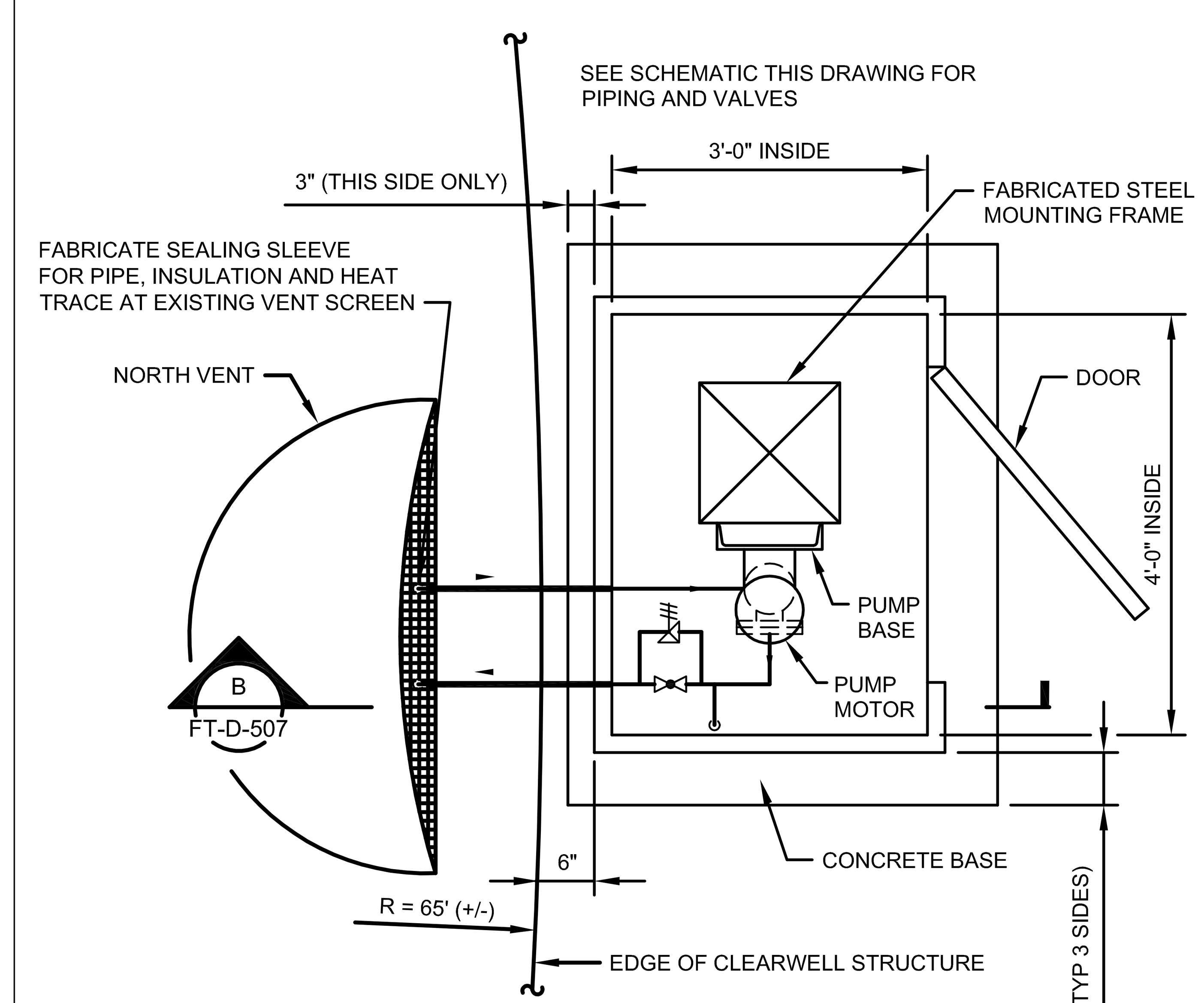
FT-D-507



PLAN
3/4"=1'-0"
PROJECT NORTH

CLEARWELL NO 2 SAMPLING PUMP DETAIL

NO.	DATE	REVISION	BY	CHK	APVD
DSGN	DR	CHK	APVD
JEL		TMA	D. RAMSEY	B. TIPPEY

ADVANCED TREATMENT
FORT THOMAS TREATMENT PLANT
NORTHERN KENTUCKY WATER DISTRICT
FORT THOMAS, KENTUCKY

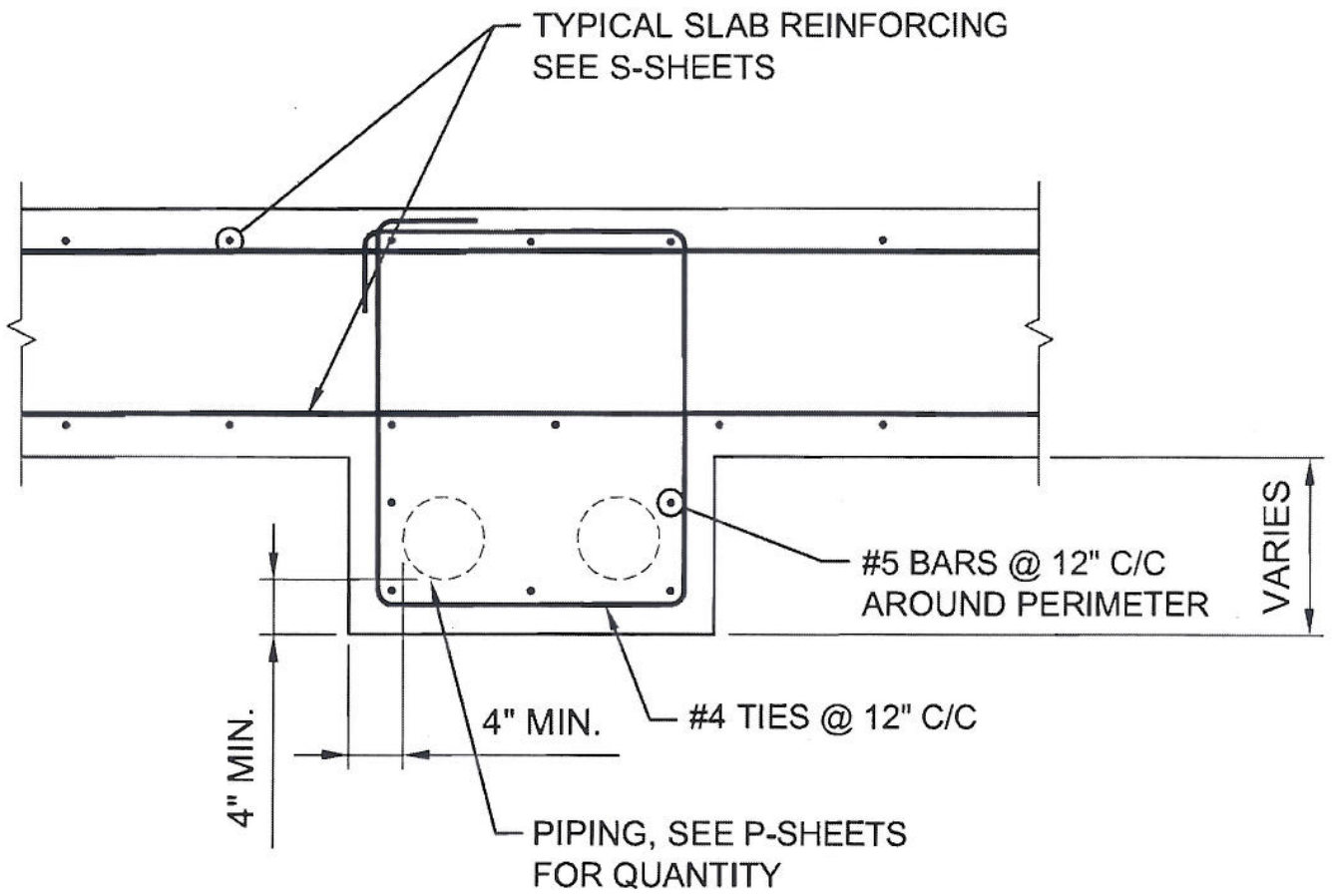
PROCESS MECHANICAL
SAMPLING PUMP DETAILS

CH2MHILL HDR

SCALE: AS NOTED
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.

DATE	12/3/09
PROJ	380723
DWG	FT-D-507
SHEET	134

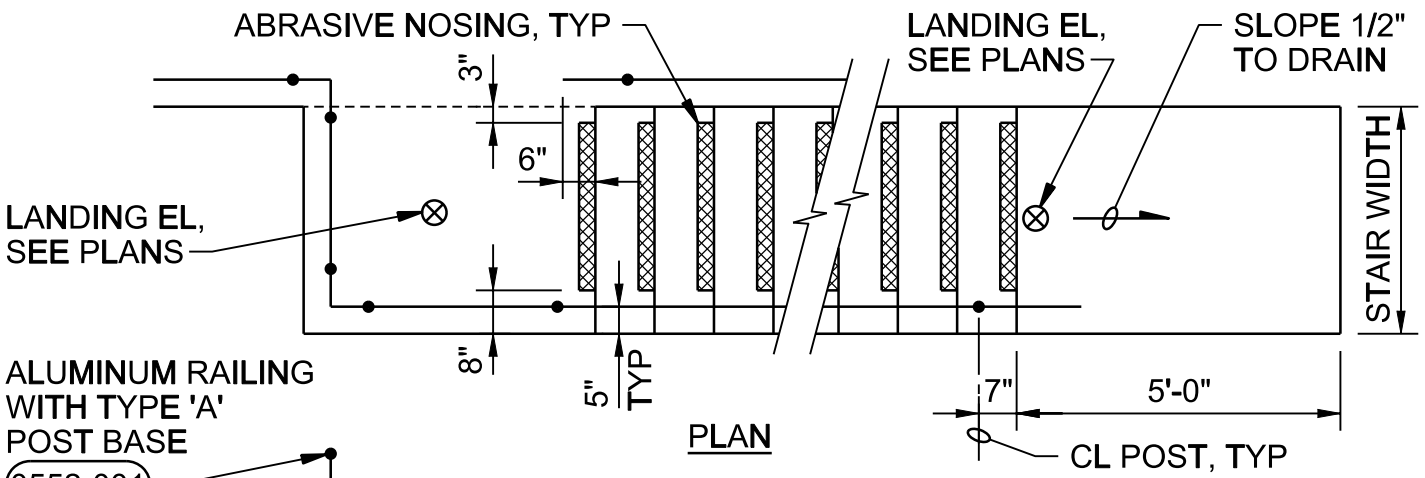
BID DOCUMENTS

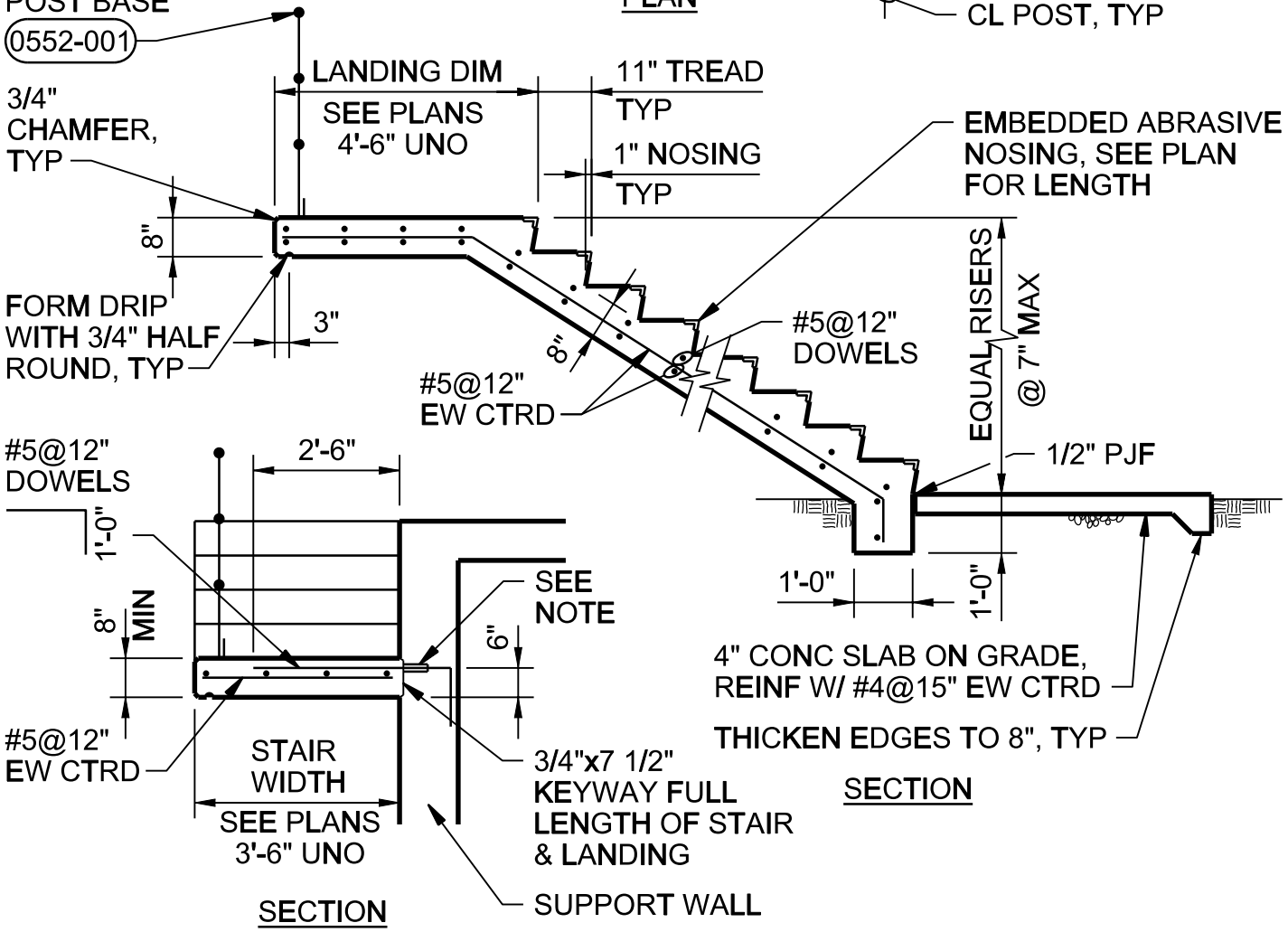


PIPING ENCASEMENT DETAIL

SECTION

3/4" = 1'-0"





NOTE:

CONTRACTOR'S OPTION TO USE THREADED REINFORCING WITH MECHANICAL THREADED CONNECTORS FOR FORMING.

CONCRETE STAIR - CANTILEVERED

NTS

NOTE TO DESIGNER:

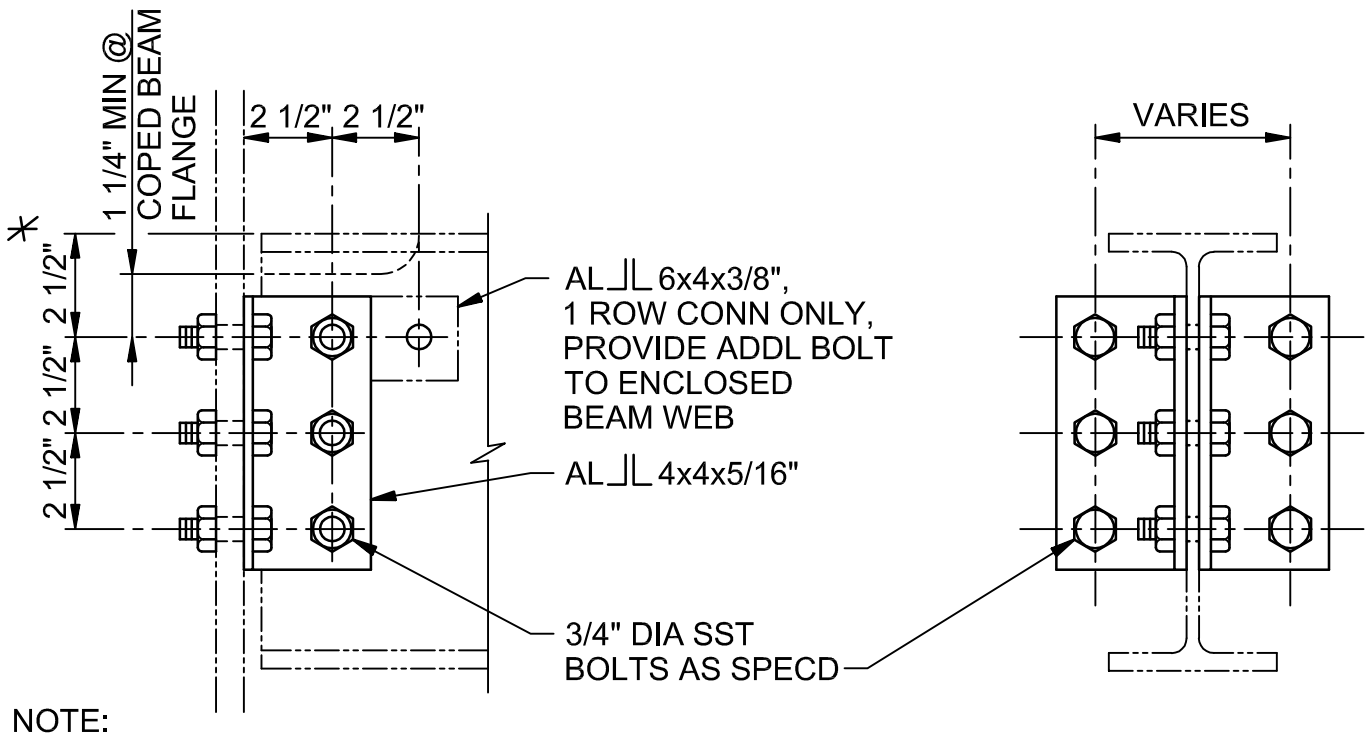
0330-046

DATE 20-AUG-08
TDC CRIVELLO
TDR SHERMAN
LCT BURTON

ALUMINUM		
NOMINAL BEAM DEPTH, INCHES	ROWS OF BOLTS	LENGTH OF ANGLE
10	3	7 1/2"
7-8-9	2	5"
5-6	1	3"
4	1	2 3/4"

NOTES:

1. NUMBER OF ROWS IS EQUAL TO NUMBER OF BOLTS TO ENCLOSED WEB.
2. ALL FRAMING CONNECTIONS SHALL CONFORM TO SCHEDULE UNLESS DETAILED OTHERWISE ON FRAMING PLANS.



NOTE:

* 2 1/2" DIMENSION TYPICAL EXCEPT 2" FOR 4" BEAM.

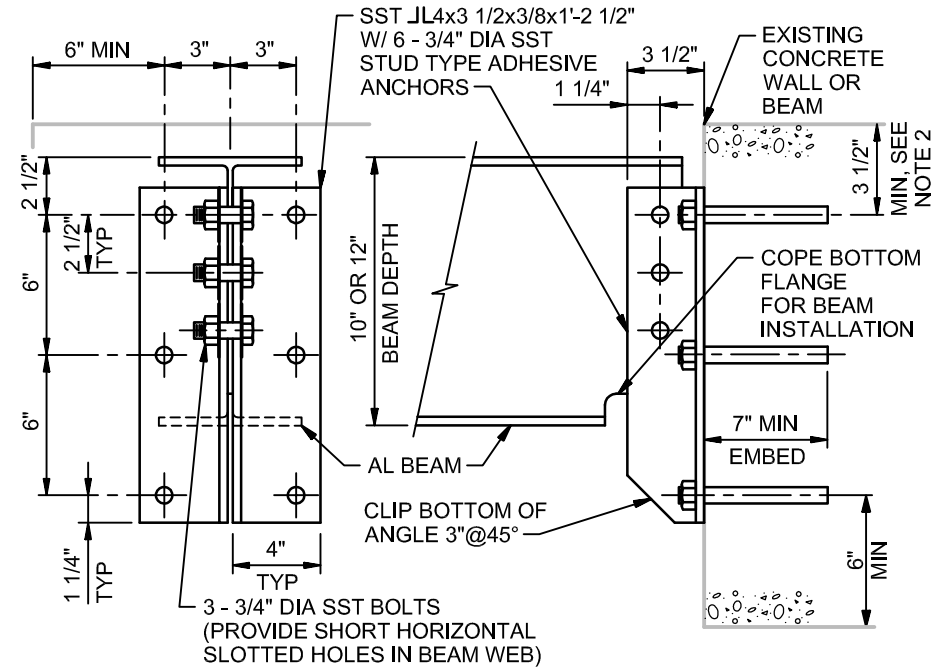
TYPICAL BEAM CONNECTION - ALUMINUM

NTS

ADVANCED TREATMENT
FORT THOMAS TREATMENT PLANT
NORTHERN KENTUCKY WATER DISTRICT
FORT THOMAS, KENTUCKY

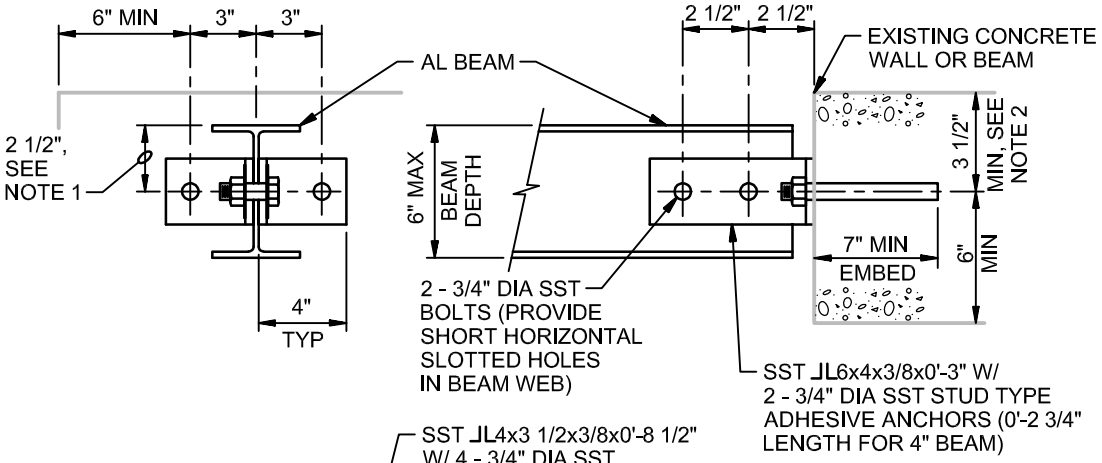
0514-020

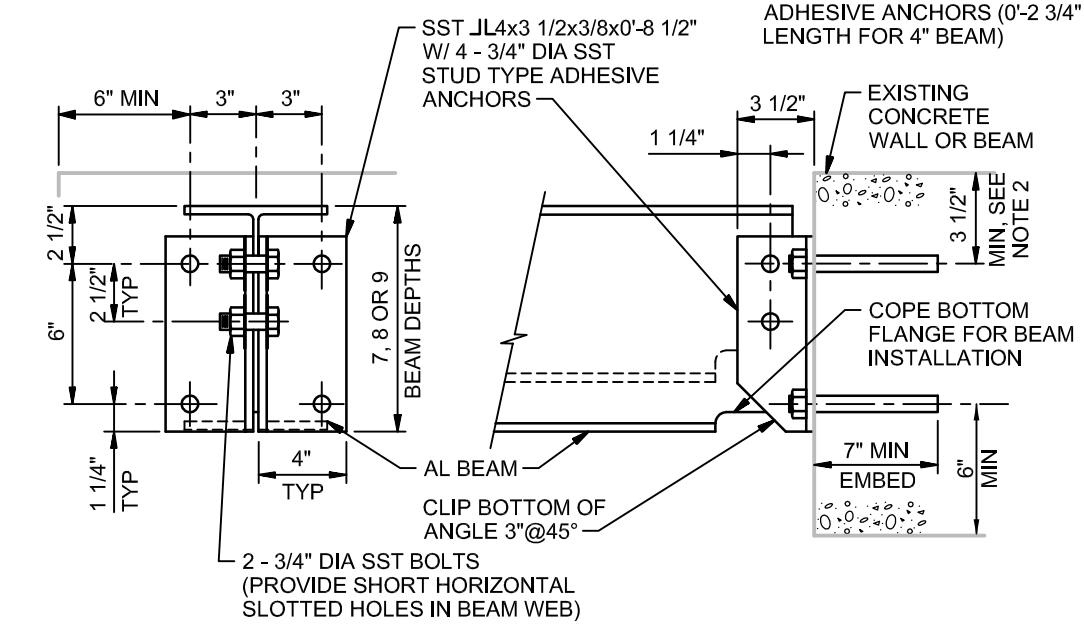
CH2MHILL



NOTES:

1. 2 1/2" DIMENSION TYPICAL EXCEPT 2" FOR 4" BEAMS.
2. DO NOT CUT EXISTING CONCRETE BEAM TOP REINFORCING DURING DRILL-IN ANCHOR INSTALLATION. FIELD LOCATE BEAM REINFORCING PRIOR TO FABRICATION. ADD LENGTH TO CLIP ANGLES AS REQUIRED TO LOWER ANCHORS TO CLEAR REINFORCING WHILE MAINTAINING SPACING AND EDGE DISTANCE AS SHOWN.
3. WHERE BOTH ENDS OF BEAM ARE ATTACHED TO A WALL, PROVIDE LONG HORIZONTALLY SLOTTED HOLES IN BEAM WEB AT ONE END. TIGHTEN NUTS SNUG TIGHT, BACK OFF 1/2 TURN, AND LOCK WITH DOUBLE NUT.





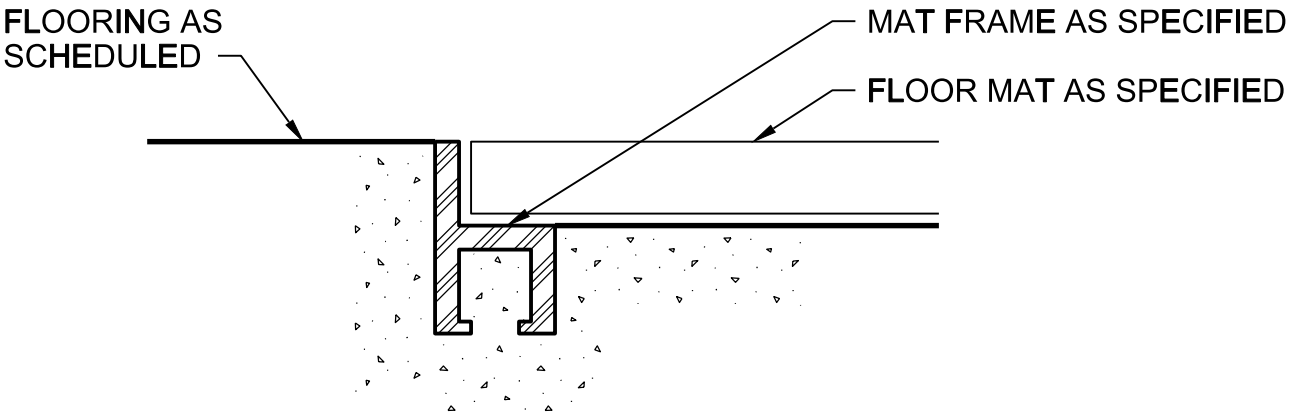
BEAM/WALL CONNECTION - ALUMINUM

NTS

ADVANCED TREATMENT
FORT THOMAS TREATMENT PLANT
NORTHERN KENTUCKY WATER DISTRICT
FORT THOMAS, KENTUCKY

0514-056

CH2MHILL



FLOOR MAT AND FRAME

NTS

NOTE TO DESIGNER:

FULL SIZE.....TYPICAL DETAIL FOR FLOOR MAT AND FRAME SPECIFIED IN SECTION 10 80 00. FLOORING OUTSIDE MAT FRAME MAY BE COMPLETED AS CONCRETE OR MODIFIED AND NOTED FOR OTHER MATERIAL(S) AS REQUIRED.

1080-002

DATE 10-OCT-08
TDC CAVE
TDR TRAUTWEIN
LCT HOSTETLER