



Addendum 1  
Sweeney Water Treatment Plant Boiler Replacement  
May 8, 2019

**BID DATE:** Tuesday, May 21, 2019 at 11:00 AM (as originally advertised)

**DEADLINE FOR QUESTIONS:** TUESDAY, MAY 14, 2019 AT 3:00 PM

Inquiries concerning the bid shall be directed to the CFPUA Purchasing Division by email to [bids@cfpua.org](mailto:bids@cfpua.org). Deadline for questions is Tuesday, May 14, 2019 at 3:00 PM. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. (00211-6.01)

**TO ALL BIDDERS:**

Below are changes and or clarifications to the bid documents for this project. This Addendum forms a part of the Contract Documents and modifies the original bidding documents as noted below. Acknowledge receipt of this Addendum as required in the bid documents. Failure to do so may subject Bidder to disqualification.

**DRAWING REVISIONS (Plans have been revised to add a dedicated controller for the boiler system. Changes are noted in the Revision Block of each sheet and by “clouding” around the change(s)):**

1. G-001 – Cover Sheet/Drawing Index
2. M-101 – Partial First Floor Plan Demolition
3. M-601 – Schedules
4. M-602 – Controls and Sequences of Operation (Additional Sheet)
5. E-001 – Electrical Legend, Abbreviations, Panel Schedules and Load Summaries
6. EP-101 – First Floor Plan Power
7. EP-102 – Second Floor Plan Power (Additional Sheet)

**SPECIFICATION REVISIONS (Specifications have been amended to cover a dedicated controller for the boiler system):**

1. Table of Contents has been Updated.
2. Add Section 230913 - Instrumentation and Control Devices for HVAC
3. Add Section 230923 - Direct Digital Control System for HVAC
4. Add Section 230924 - Direct Digital Control System for HVAC (Orig. Equip. Manuf. OEM Controls)

**QUESTIONS RECEIVED:**

Q1. A substitution request was made for the use of **Patterson Pumps** and a **Spirotherm Air-Dirt Separator**. Reference attachments.

A1. Substitutions for submitted Manufactures are acceptable.

**ACKNOWLEDGEMENT BY BIDDER.** Bidder shall acknowledge receipt of this Addendum No. 1 in the space provided in the Bid Form.

All other terms & conditions remain unchanged.

Julia Faircloth  
Cape Fear Public Utility Authority  
Procurement Manager  
End of Addendum 1

Kurt Evers  
Cape Fear Public Utility Authority  
Project Manager

# SWEENEY WATER TREATMENT PLANT BOILER REPLACEMENT

FOR  
CAPE FEAR PUBLIC UTILITY AUTHORITY

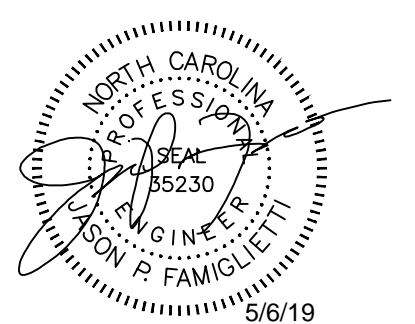
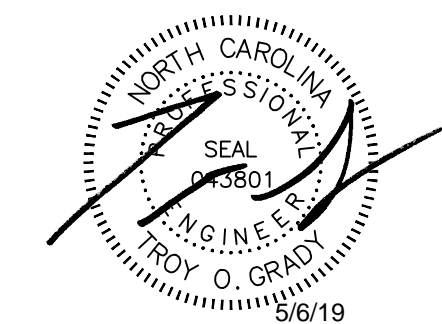
at  
1833 N. 5th Avenue  
Wilmington, NC 28401



**2246 Yaupon Drive**  
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NC# P-0506

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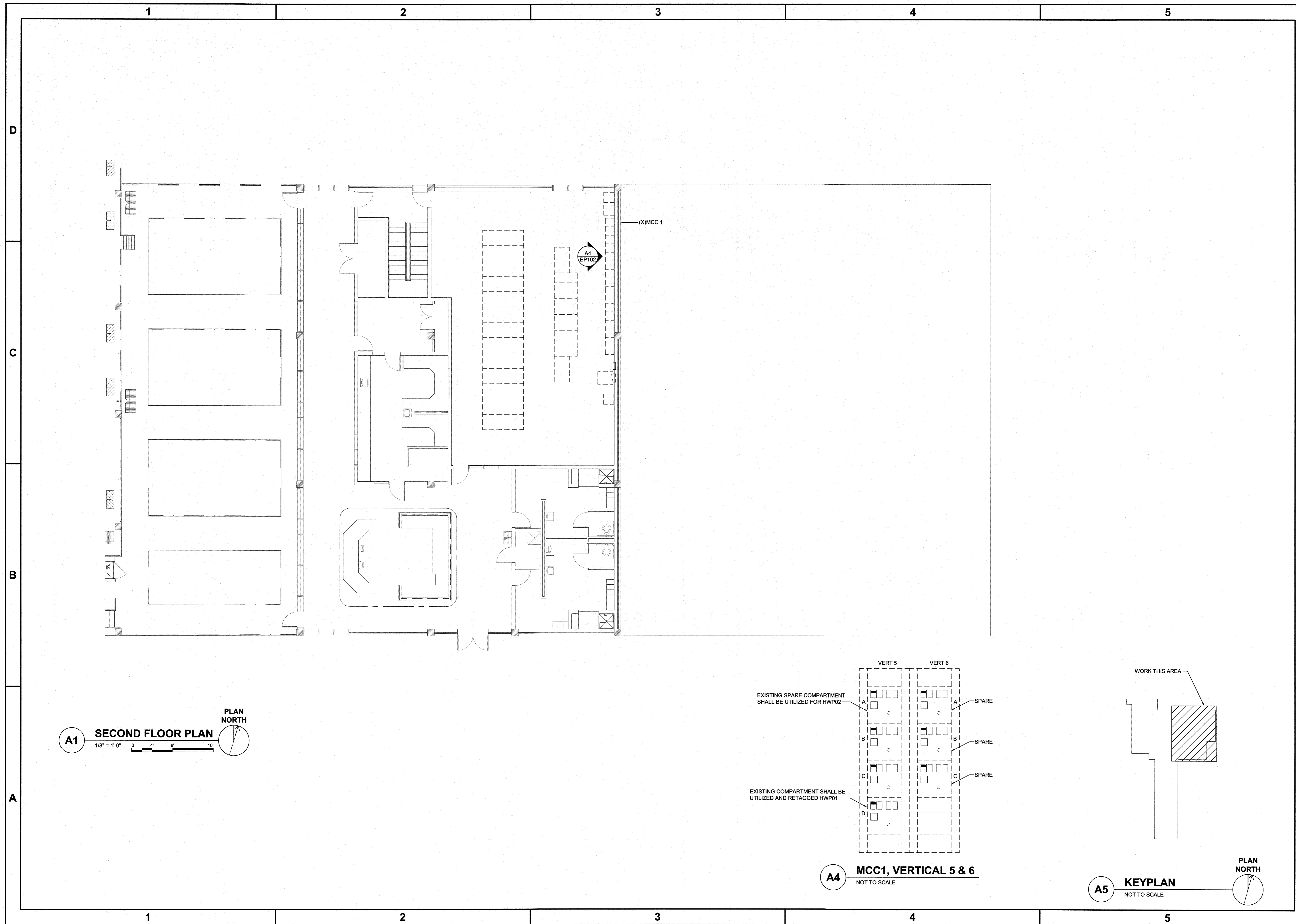


## DRAWING INDEX

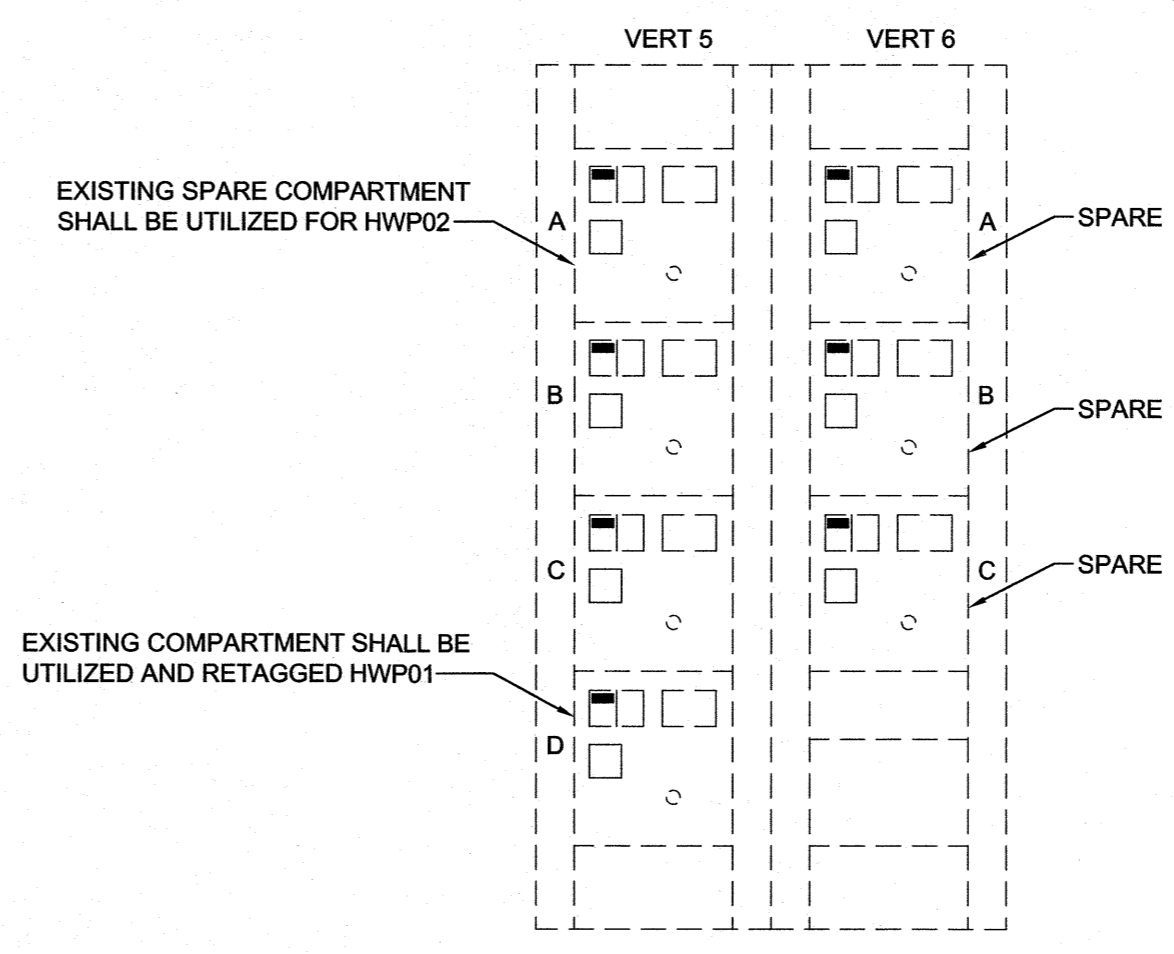
<b>GENERAL</b>	
COVER SHEET	
G001	DRAWING INDEX
<b>MECHANICAL</b>	
M-001	GENERAL NOTES, LEGEND, ABBREVIATIONS AND DEMOLITION NOTES
MD101	PARTIAL FIRST FLOOR PLAN DEMOLITION
M-101	PARTIAL FIRST FLOOR PLAN
M-501	DETAILS
M-601	SCHEDULES
M-602	CONTROLS AND SEQUENCES OF OPERATION <sup>1</sup>
<b>ELECTRICAL</b>	
E-001	ELECTRICAL LEGEND, ABBREVIATIONS, PANEL SCHEDULES AND LOAD SUMMARIES
E-002	ELECTRICAL GENERAL NOTES
ED101	FIRST FLOOR PLAN DEMOLITION
EP101	FIRST FLOOR PLAN POWER
EP102	SECOND FLOOR PLAN POWER <sup>1</sup>

1	5/6/19	ADDENDUM 1
0	4/22/19	ISSUED FOR CONSTRUCTION
REVISION	DATE	REVISION DESCRIPTION

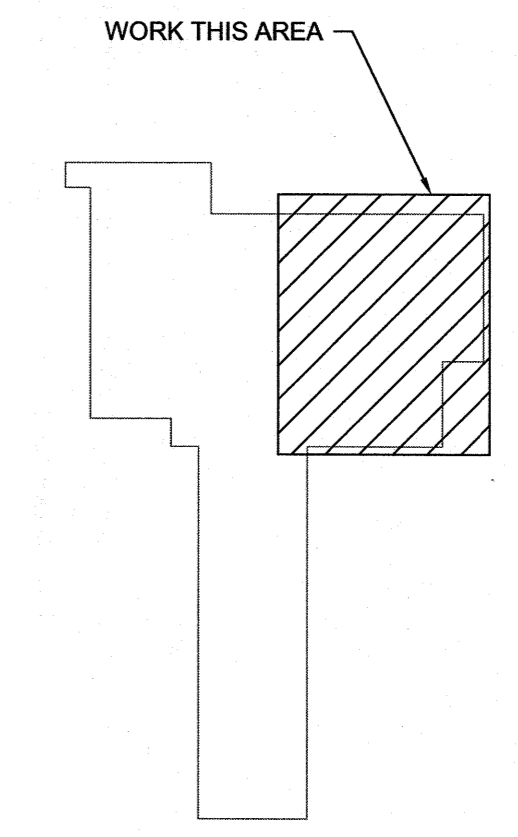
**SWEENEY WTP  
BOILER REPLACEMENT**  
CAPE FEAR PUBLIC UTILITY AUTHORITY  
235 GOVERNMENT CENTER DRIVE  
WILMINGTON, NC 28403  
OFFICE: 910-332-6560



**A1** SECOND FLOOR PLAN  
 1/8" = 1'-0"  
 PLAN NORTH



**A4** MCC1, VERTICAL 5 & 6  
 NOT TO SCALE

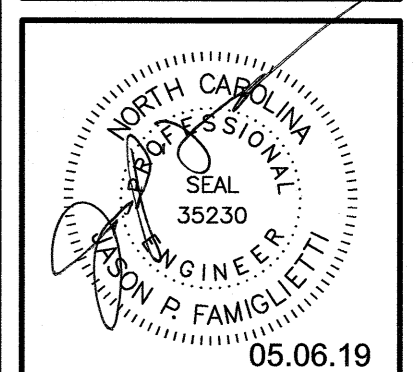


**A5** KEYPLAN  
 NOT TO SCALE  
 PLAN NORTH

Revision No.	0	ISSUED FOR APPENDIX 1	Date:	05.06.19
DESCRIPTION:				REVISIONS

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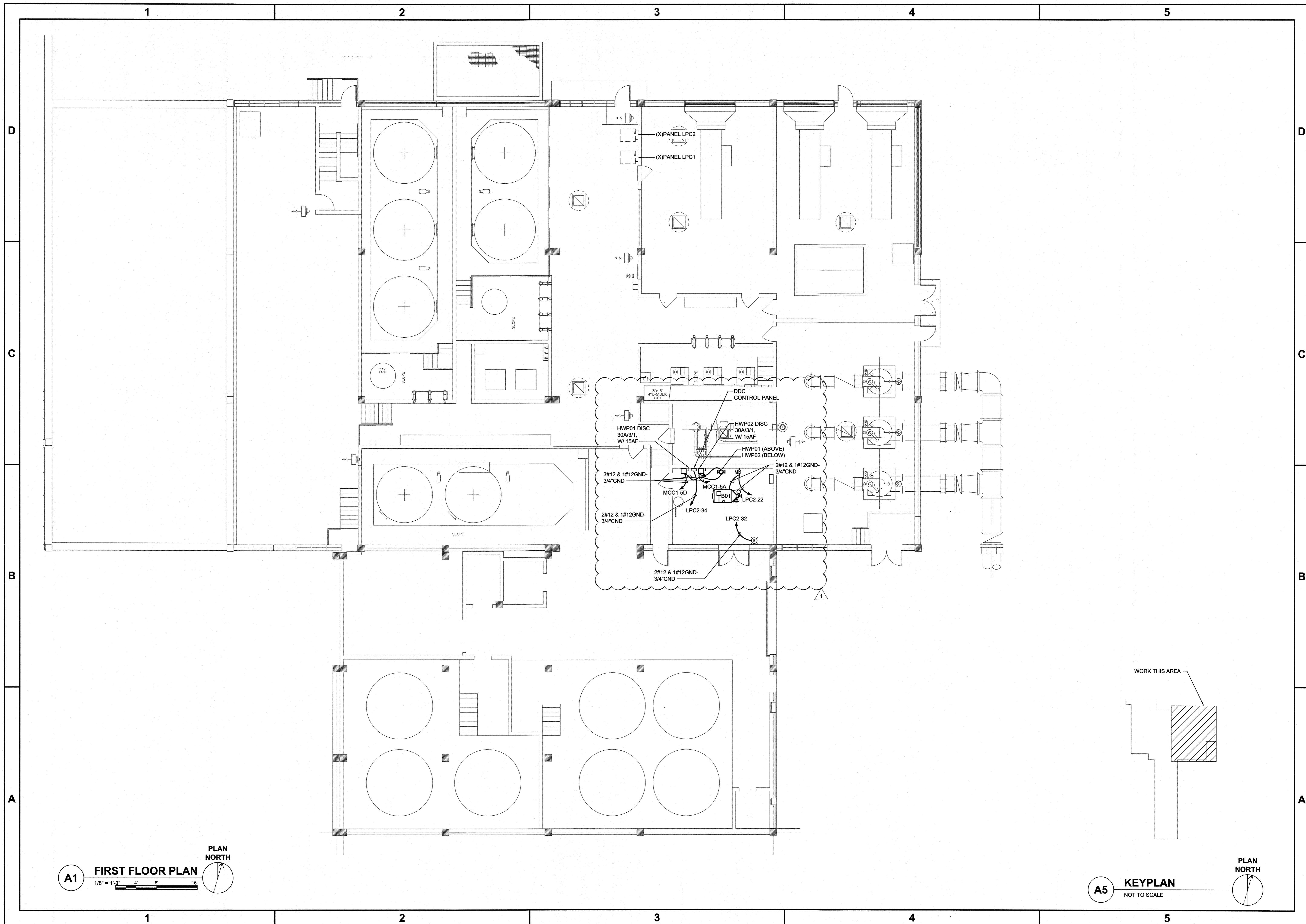
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**SECOND FLOOR PLAN  
 POWER**

JOB NO.:	18134
DRAWN:	MDM
DESIGNED:	MDM
CHECKED:	JPP
DRAWING NO.:	<b>EP102</b>
REVISION:	0

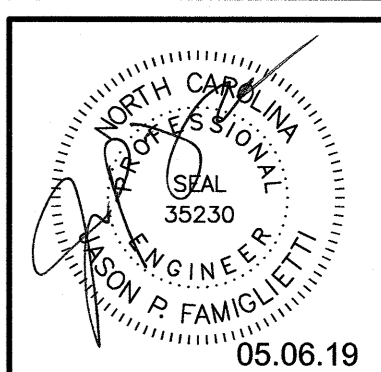


**A1** FIRST FLOOR PLAN  
 1/8" = 1'-0"  
 1" = 8'-0"  
 PLAN NORTH

**A5** KEYPLAN  
 NOT TO SCALE  
 PLAN NORTH

05.06.19	ISSUED FOR ADDENDUM 1
04.22.19	ISSUED FOR CONSTRUCTION
0	REVISION NO.
	DESCRIPTION
	REVISIONS

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CAPE FEAR PUBLIC UTILITY AUTHORITY  
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 1833 N. 5th Avenue  
 Wilmington, NC 28401  
**FIRST FLOOR PLAN**  
**POWER**

JOB NO.:	18134
DRAWN:	MDM
DESIGNED:	MDM
CHECKED:	JPF

DRAWING NO:  
**EP101**

REVISION:  
 1

**ELECTRICAL LEGEND**

SYMBOL	DESCRIPTION
	RECEPTACLE, DUPLEX, 120VAC, 20A, MOUNTED 16" AFF, UNLESS OTHERWISE NOTED. (SEE ELECTRICAL MOUNTING HEIGHT DETAIL) WP - LISTED WEATHER-RESISTANT TYPE DEVICE WITH WEATHERPROOF IN USE COVER GFI - GROUND FAULT CIRCUIT INTERRUPTER TYPE, 120VAC, 20A, MOUNTED 24" AFF LOCATE GFI TEST SWITCH IN A READILY ACCESSIBLE LOCATION TR - TAMPER RESISTANT RECEPTACLE, DUPLEX, 120VAC, 20A, MOUNTED 6" ABOVE COUNTER TOP OR BACK SPLASH. *##" - INDICATES MOUNTING HEIGHT OF DEVICE IN INCHES AFF (IF GIVEN) (SEE ELECTRICAL MOUNTING HEIGHT DETAIL)
	DISCONNECT SWITCH, FUSED, HEAVY (GENERAL) DUTY. SIZE AS INDICATED ON DRAWINGS (SIZE AS INDICATED IN THE EQUIPMENT CONNECTION SCHEDULE) ##A = DISCONNECT SIZE / # = NUMBER OF POLES / # = NEMA RATING, ##AF = FUSE SIZE
	VARIABLE FREQUENCY DRIVE (VFD)
	COMBINATION STARTER WITH CIRCUIT BREAKER DISCONNECT, FULL VOLTAGE, NON-REVERSING, (600V, 3P, NEMA) SIZE AS INDICATED ON DRAWINGS
	MANUAL MOTOR STARTER, ELECTRICAL CONTRACTOR SHALL COORDINATE POLES AND SIZE WITH EQUIPMENT ## = AMPERAGE RATING WHEN INDICATED ON DRAWING
	PANELBOARD, SURFACE OR RECESSED MOUNTED AS SHOWN. SIZE, RATINGS, AND MOUNTING AS INDICATED ON PANEL SCHEDULE. CONTRACTOR IS RESPONSIBLE FOR REQUIRED CLEARANCE IN FRONT OF ELECTRICAL PANEL. SEE NEC TABLE 110.26 WORKING SPACES FOR ADDITIONAL CLEARANCE CONDITIONS.
	TRANSFORMER, SIZE AS INDICATED ON DRAWING
	CONDUIT, HOME RUN TO PANEL BOARD
	HATCHING INDICATES ITEMS TO BE DEMOLISHED. REMOVE DEVICE, EQUIPMENT, FIXTURE INDICATED, CIRCUIT, AND CONDUIT BACK TO SOURCE UNLESS OTHERWISE NOTED.
	<p>ENLARGED PLAN</p> <p>DETAIL, SECTION OR PLAN NUMBER</p> <p>DRAWING SHEET PLAN, DETAIL OR SECTION APPEARS ON</p> <p>ELEVATION</p>

**TYPICAL ABBREVIATIONS:**

A, AMP	AMPERE	LP	LIGHTING PANEL, LIGHT POLE
AFF	ABOVE FINISHED FLOOR	LTG	LIGHTING
AFG	ABOVE FINISHED GRADE	MCC	MAIN CIRCUIT BREAKER
AHU	AIR HANDLING UNIT	MCCB	MOTOR CONTROL CENTER
AIC	AMPERE INTERRUPTING CAPACITY	MCP	MOTOR CIRCUIT PROTECTOR
ATS	AUTOMATIC TRANSFER SWITCH	MDF	MAIN DISTRIBUTION PANEL
AWG	AMERICAN WIRE GAUGE	MFR	MANUFACTURER
BOF	BOTTOM OF FIXTURE	MH	MANHOLE
BRKR	BREAKER	MLO	MAIN LUGS ONLY
C, CND	CONDUIT	MTD	MOUNTED
CAB	CABINET	MTG	MOUNTINGS
CAT	CATALOG	MTS	MANUAL TRANSFER SWITCH
CL	CHLORINE	MV	MEDIUM VOLTAGE
CB	CIRCUIT BREAKER	N, NEUT	NEUTRAL
CCTV	CLOSED CIRCUIT TELEVISION	NA	NOT APPLICABLE
CKT	CIRCUIT	NC	NORMALLY CLOSED
CLG	CEILING	NEC	NATIONAL ELECTRIC CODE
CP	CONTROL PANEL	NIC	NOT IN CONTRACT
CR	CONTROL RELAY, CORROSION RESISTANT	NL	NIGHT LIGHT
CS	CONTROL SWITCH	NO	NORMALLY OPEN
CV	CONTROL VALVE	NTS	NOT TO SCALE
CT	CURRENT TRANSFORMER	P	POLE
CU	COPPER	PA	PUBLIC ADDRESS
EF	EXHAUST FAN	PB	PULL BOX, PUSH-BUTTON
EMER	EMERGENCY	PF	POWER FACTOR
EMT	ELECTRICAL METALLIC TUBING	PH, φ	PHASE
ENCL	ENCLOSURE	PLC	PROGRAMMABLE LOGIC CONTROLLER
EQUIP	EQUIPMENT	PNL	PANEL
EWC	ELECTRIC WATER COOLER	PP	POWER PANEL, POWER POLE
EWH	ELECTRIC WATER HEATER	PT	POTENTIAL TRANSFORMER
EPRF	EXPLOSION PROOF	PWR	POWER
FA	FIRE ALARM	RECP, RCP	RECEPTACLE
FAAP	FIRE ALARM ANNUNCIATOR PANEL	REQD	REQUIRED
FACP	FIRE ALARM CONTROL PANEL	RGS	RIGID GALVANIZED STEEL CONDUIT
FBO	FURNISHED BY OTHERS	RM	ROOM
FLA	FULL LOAD AMPS	RTU	REMOTE TELEMETRY UNIT
FLUOR	FLUORESCENT	SCR	DC MOTOR DRIVE
FLR	FLOOR	SH	SHEET
FWE	FURNISHED WITH EQUIPMENT	SM	SURFACE MOUNTED
GEN	GENERATOR	SPEC	SPECIFICATION
G, GND	GROUND	SS	SELECTOR SWITCH
GFCI	GROUND FAULT CIRCUIT INTERRUPTER	SST	STAINLESS STEEL
HH	HANDHOLE	SW	SWITCH
HID	HIGH INTENSITY DISCHARGE	SWBD	SWITCHBOARD
HOA	HAND-OFF-AUTO	SWGR	SWITCH GEAR
HP	HORSE POWER	TEL	TELEPHONE
HPF	HIGH POWER FACTOR	TPS	TWISTED PAIR SHIELDED
HPS	HIGH PRESSURE SODIUM	TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSER
HTR	HEATER	TYP	TYPICAL
HV	HIGH VOLTAGE	UGND	UNDERGROUND
HZ	HERTZ	UH	UNIT HEATER
IMC	INTERMEDIATE METALLIC CONDUIT	UON	UNLESS OTHERWISE NOTED
INCAND	INCANDESCENT	UTL	UTILITY
JB	JUNCTION BOX	V	VOLTS
K	THOUSAND	VFD	VARIABLE FREQUENCY DRIVE
KCMIL	THOUSAND CIRCULAR MILLS	W	WIRE, WATT
KVA	KILOVOLT AMPERE	WH	WATT-HOUR
KW	KILOWATTS	WP	WEATHERPROOF
KWH	KILOWATT-HOURS	XFMR	TRANSFORMER
		(X)	EXISTING

**LOAD SUMMARY**

VOLTAGE	PHASE
480	3
LOADS REMOVED THIS PROJECT	
EQUIPMENT	
(X)BOILER	1,656 VA
(X)PUMP	3,991 VA
(X) UNITS HEATERS (2)	693 VA
TOTAL EQUIPMENT REMOVED THIS PROJECT	6,340 VA
TOTAL EQUIPMENT REMOVED THIS PROJECT	8 AMPS
EQUIPMENT	
B01	1,248 VA
HWP1 & HWP2 (REDUNDANT PUMPS)	2,827 VA
SUB-TOTAL EQUIPMENT DEMAND	4,075 VA
SUB-TOTAL EQUIPMENT DEMAND	5 AMPS
ADD FOR LARGEST MOTOR	AMPS
TOTAL EQUIPMENT DEMAND	5 AMPS
TOTAL LOAD ADDED THIS PROJECT	
TOTAL LOAD ADDED THIS PROJECT	5 AMPS
TOTAL LOAD ADDED THIS PROJECT	4,075 VA
NET LOAD CHANGED THIS PROJECT	
NET LOAD CHANGED THIS PROJECT	-3 AMPS
NET LOAD CHANGED THIS PROJECT	-2,285 VA

**EXISTING PANEL: LPC2**

LOAD SERVED	LOAD VA	CKT #	CKT #	208 V, 3 PH, 4 WIRE			LOAD VA	LOAD SERVED	
				A	B	C			
LTGS: STAIRS TO FILTER GALLERY		201	1				2	201	FAN F-12
REC, CHEMICAL FEED OUTSIDE		201	3				4	201	FAN F-13
UNIT HEATERS PIPE GALLERY		201	5				6	201	FAN F-18
EXIT LTGS THRU TS-2		201	7				8	201	ELEC. WATER COOLER
LOLVERS		201	9				10	201	FAN F-27
SPARE TO RCP GEN ROOM		201	11				12	201	UNIT HEATERS CHEMICAL FEED
LTGS: ALUN & SODIUM TANKS		201	13				14	201	SPARE
SPARE		201	15				16	201	FAN F-24
LTGS: STARWAY		201	17				18	201	UNIT HEATER GEN & PUMP ROOM
LTGS: GENERATOR ROOM		201	19				20	201	RCP BOILER AND PUMP ROOM
LTGS: PUMP ROOM		201	21		1,248		22	201	B01 (SEE NOTE 1)
LTGS: AMMENIA & ACID ROOM		201	23				24	201	HVAC-CP
SPARE		201	25				26	201	FAN F-14
SPARE		201	27				28	201	BOILER ROOM EXHAUST FAN
SITE LIGHTING		302	29				30	201	FAN F-26
SPARE		201	31	200			32	201	EMERGENCY GAS SHUT-OFF (SEE NOTE 2)
SPARE		201	33		300		34	201	DDC CONTROLS (SEE NOTE 2)
SPARE		201	35				36	201	SPARE
SPARE		201	37				38	502	SPARE
SPARE		201	39				40	1	SPARE
SPARE		201	41				42		SPACE
NOTES:				200	1,543		TOTAL VOLT AMPS	225	A. BUS (COPPER)
1. REUSE EXISTING BREAKER MADE SPARE DURING DEMOLITION.				2	13		CONN. AMPS	225	A. MAIN CIRCUIT BREAKER
2. CONTRACTOR SHALL USE EXISTING SPARE BREAKER FOR THIS LOAD.									

05.06.19  
04.22.19  
Date

ISSUED FOR ADDENDUM 1  
ISSUED FOR CONSTRUCTION  
REVISION: 1  
DESCRIPTION: NCH P-0506

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05.06.19

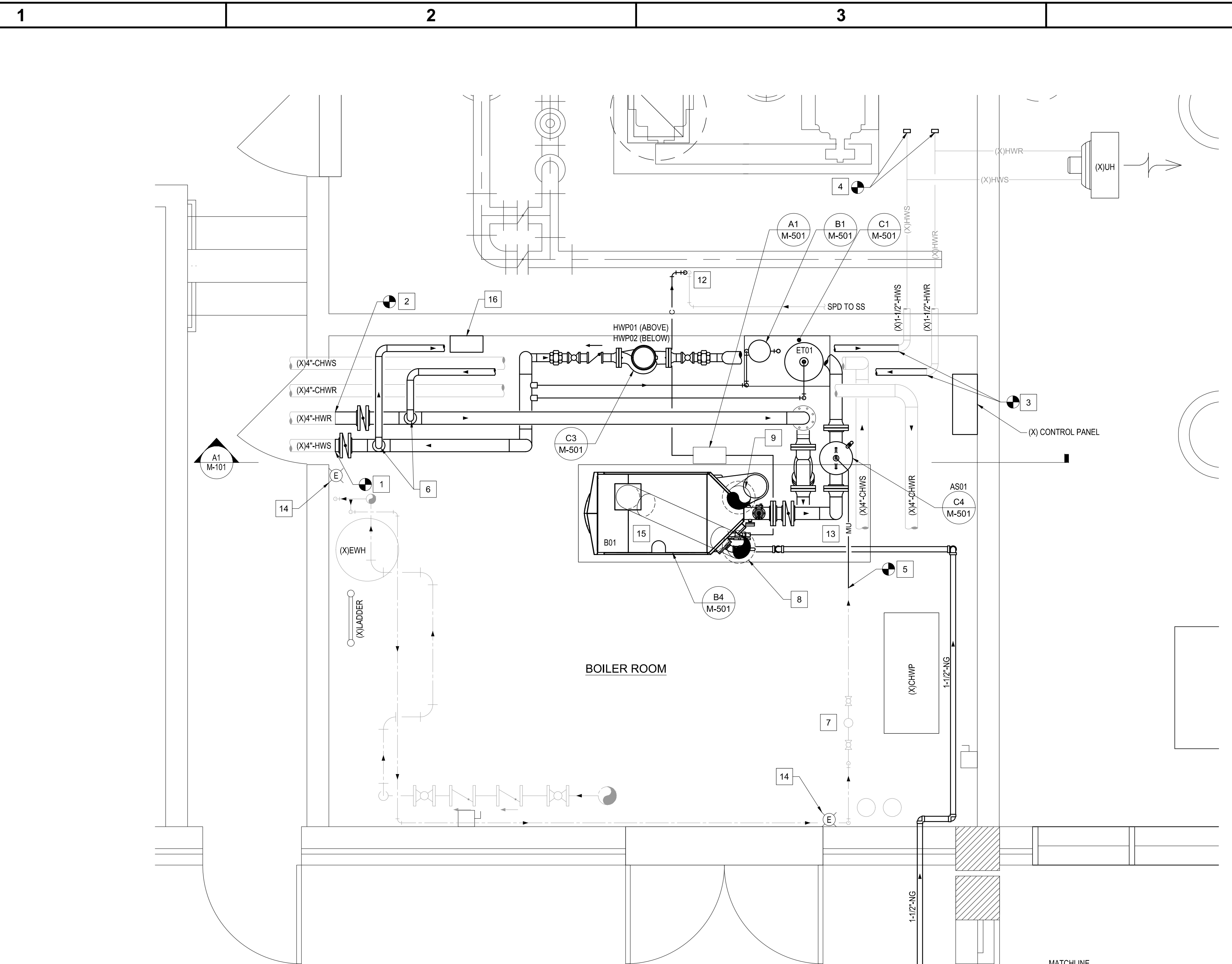
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SWEENEY WTP BOILER REPLACEMENT  
1833 N. 5th Avenue  
Wilmington, NC 28401

**ELECTRICAL**  
LEGEND, ABBREVIATIONS, PANEL SCHEDULES,  
AND LOAD SUMMARIES

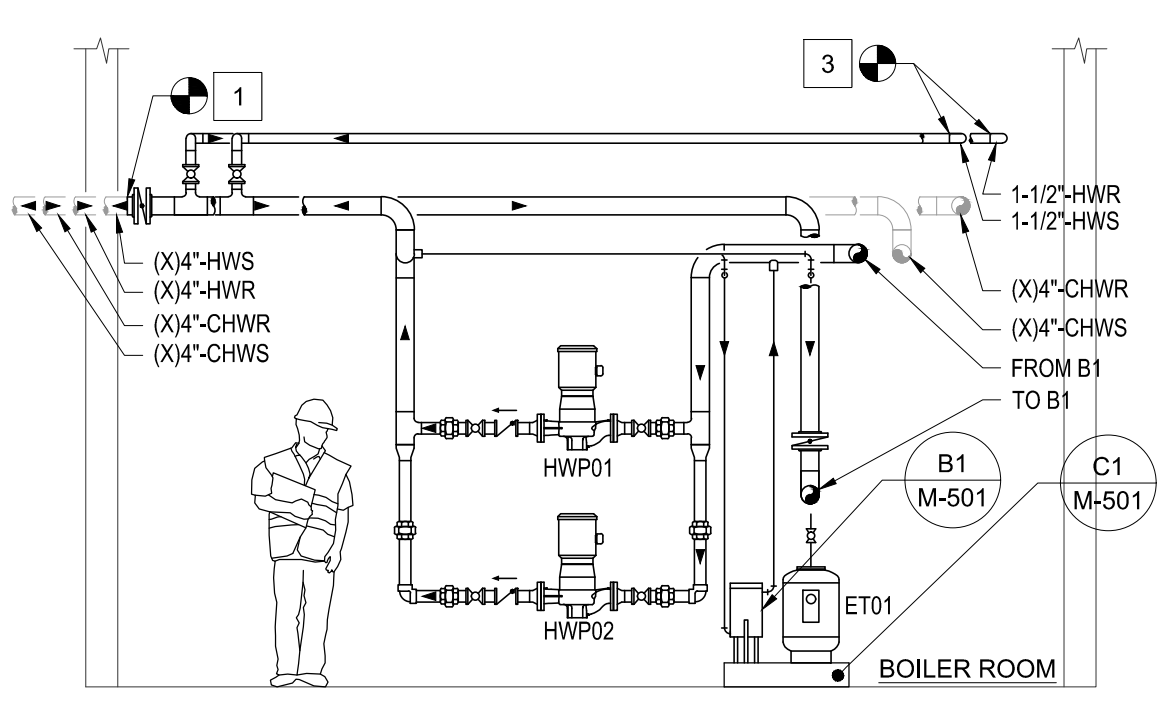
JOB NO.: 18134  
DRAWN: MDM  
DESIGNED: MDM  
CHECKED: JPF

DRAWING NO:  
**E-001**

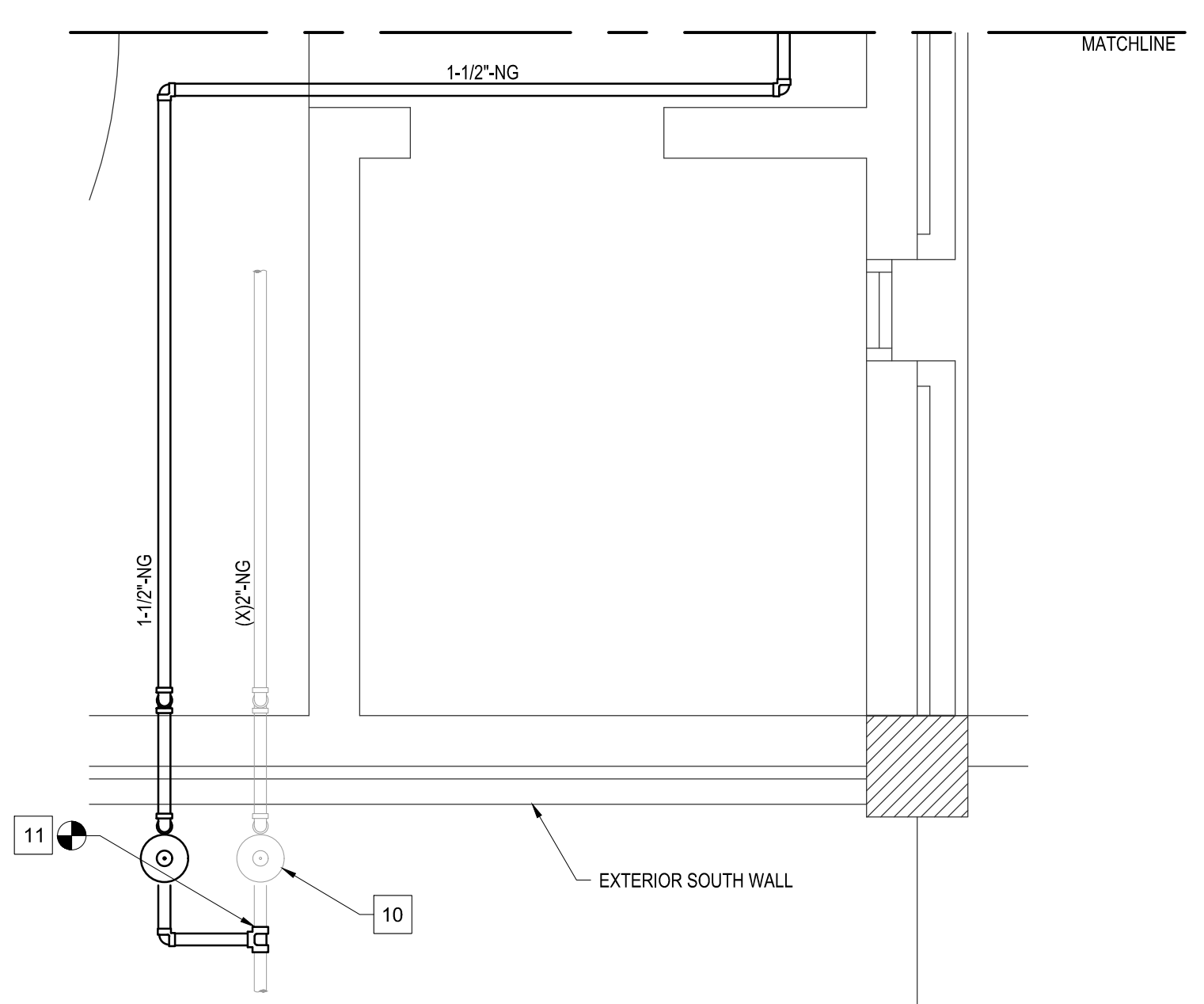
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**B1** FIRST FLOOR PLAN  
1/2" = 1'-0"



**A1** PIPING SECTION  
1/4" = 1'-0"



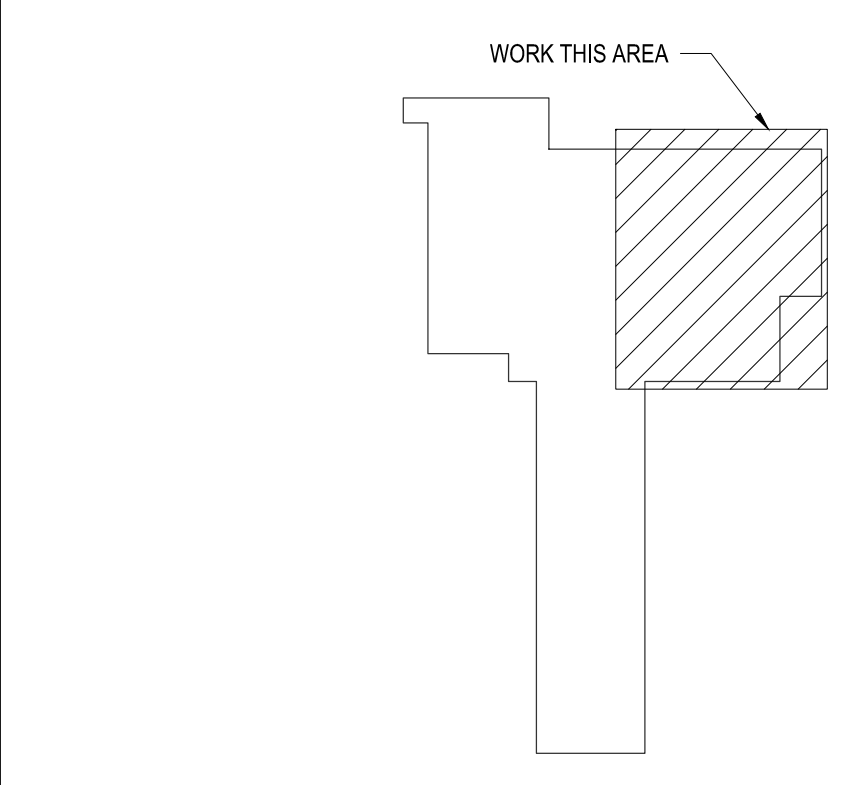
**A5** KEYPLAN  
NOT TO SCALE

**GENERAL NOTES**

- CONTRACTOR SHALL PROTECT EXISTING SYSTEMS NOT IN SCOPE.

**KEYED NOTES**

- CONNECT TO 4"-HWS PIPING.
- CONNECT TO 4"-HWR PIPING.
- CONNECT TO 1-1/2"-HWS AND 1-1/2"-HWR PIPING.
- CAP 1-1/2"-HWS AND 1-1/2"-HWR PIPING.
- CONNECT TO MAKE-UP WATER PIPING.
- PROVIDE ISOLATION VALVES IN VERTICAL.
- EXISTING MAKEUP WATER PRESSURE REDUCING VALVE.
- ROUTE BOILER B01 COMBUSTION AIR INTAKE TO NEW ROOF PENETRATION. COORDINATE PENETRATION WITH OWNER. MAKE PENETRATION WEATHER PROOF.
- ROUTE BOILER B01 EXHAUST FLUE UP THROUGH EXISTING ROOF PENETRATION. MAKE PENETRATION WEATHER PROOF.
- EXISTING 2" NATURAL GAS REGULATOR. SET FOR 6.0WC - 14.0WC.
- TIE INTO EXISTING UNDERGROUND (X)2"-NG WITH 1-1/2"-NG. PROVIDE ISOLATION VALVE.
- ROUTE CONDENSATE DRAIN THROUGH NEUTRALIZATION TANK THEN THROUGH WALL TO (X)FLOOR DRAIN. MODIFY EXISTING SPD DRAIN AS NECESSARY.
- EXISTING BOILER PAD.
- EMERGENCY GAS SHUT-OFF
- INSTALL NEW BOILER ON EXISTING CONCRETE PAD. CONTRACTOR SHALL RECONNECT BOILER ENABLE CONTROLS.
- INSTALL NEW DDC CONTROL PANEL.



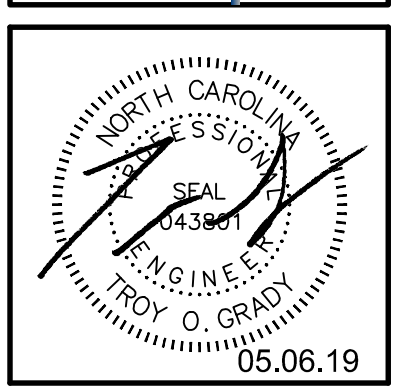
05.06.19	ISSUED FOR APPENDIX 1
04.22.19	ISSUED FOR CONSTRUCTION
0	REVISION NO.
	DESCRIPTION:
	REVISIONS

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**CAPE FEAR PUBLIC UTILITY AUTHORITY**  
SWEENEY WTP BOILER REPLACEMENT

1833 N. 5th Avenue  
Wilmington, NC 28401

**PARTIAL FIRST FLOOR PLAN**

JOB NO.:	18134
DRAWN:	RWC
DESIGNED:	RWC
CHECKED:	TOG

DRAWING NO. **M-101**

REVISION:	0
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### CONDENSING BOILER SCHEDULE

DRAWING CODE	BASIS OF DESIGN MANUFACTURER	BASIS OF DESIGN MODEL	ALTERNATIVE MANUFACTURERS	BURNER	HEATING MEDIUM	DESIGN WATER PRESSURE RATING (PSIG)	AGA INPUT (MBH)		AGA OUTPUT (MBH) MAXIMUM	CONNECTIONS				ELECTRICAL			WEIGHT (LBS.)	NOTES	ACCESSORIES	
							MINIMUM	MAXIMUM		GAS (IN.)	INLET GAS PRESSURE (IN WG)	WATER (IN.)	INTAKE (IN.)	VENT (IN.)	POWER SUPPLY (V/PH/Hz)	MCA				MOCP
B01	LOCHINVAR	KBN1501	AERCO, LARRS	NATURAL GAS	HOT WATER	160	60	1500	1443	1-1/2"	14	4"	8"	8"	120/1/60	13.0	-	2307	1,2,3,4	A,B,C,D

NOTES:  
 1. REFER TO SPECIFICATIONS FURTHER INFORMATION.  
 2. REFER TO PLANS FOR VENTING ARRANGEMENT.  
 3. ROUTE CONDENSATE THROUGH CONDENSATE NEUTRALIZATION KIT. REFER TO PLANS FOR LOCATION AND ARRANGEMENT.  
 4. MOUNT BOILER ON CONCRETE HOUSE KEEPING PAD.

ACCESSORIES:  
 A. MODBUS COMMUNICATION.  
 B. BMS BACNET MSTP INTERFACE FOR CONTROL SYSTEM.  
 C. HIGH AND LOW GAS PRESSURE SWITCHES WITH MANUAL RESET.  
 D. LOW WATER CUTOFF WITH MANUAL RESET AND TEST.

### PUMP SCHEDULE

DRAWING CODE	BASIS OF DESIGN MANUFACTURER	BASIS OF DESIGN MODEL	ALTERNATE APPROVED MFRS	PUMP TYPE	SERVICE	FLUID	CAPACITY (GPM)	TOTAL DYNAMIC HEAD (FT)	INLET AND OUTLET SIZE (IN.)	MOTOR		SPEED (RPM)	HP	ELECTRICAL V/PH/Hz	NOTES	ACCESSORIES
										ENCLOSURE TYPE	MATERIALS					
HWP01	B&G	SERIES 80-2.5X2.5X7B	TACO, ARMSTRONG, PATTERSON	INLINE	HEATING SUPPLY	WATER	120.00	41.00	2.50	ODP	CAST IRON	1800	2.0	460/3/60	1	A, B, C, D
HWP02	B&G	SERIES 80-2.5X2.5X7B	TACO, ARMSTRONG, PATTERSON	INLINE	HEATING SUPPLY	WATER	120.00	41.00	2.50	ODP	CAST IRON	1800	2.0	460/3/60	1	A, B, C, D

NOTES:  
 1. REFER TO SPECIFICATIONS FOR FURTHER INFORMATION.

ACCESSORIES:  
 A. PREMIUM EFFICIENT MOTOR.  
 B. BRONZE FITTED.  
 C. SERIES 80 STANDARD BUNA/CARBON-CERAMIC SEAL.

### AIR/DIRT SEPARATOR SCHEDULE

DRAWING CODE	DESIGN BASIS MFR	MODEL	ALTERNATE MFR	TYPE	FLOW GPM	WATER CONNECTIONS		WEIGHT (LBS)	NOTES	ACCESSORIES
						SIZE (IN)	STYLE			
AS01	TACO	4904	WESSEL, B&G, SPIROTHERM	COALESCING, LOW VELOCITY	120	4	FLANGED	110	1,2,3	A,B,C,D,E

NOTES:  
 1. REFER TO SPECIFICATIONS FOR FURTHER INFORMATION.  
 2. ASME CERTIFIED, CONSTRUCTED AND STAMPED FOR 125 PSI WORKING PRESSURE @ 240°F.  
 3. WEIGHT LISTED IS DRY WEIGHT.

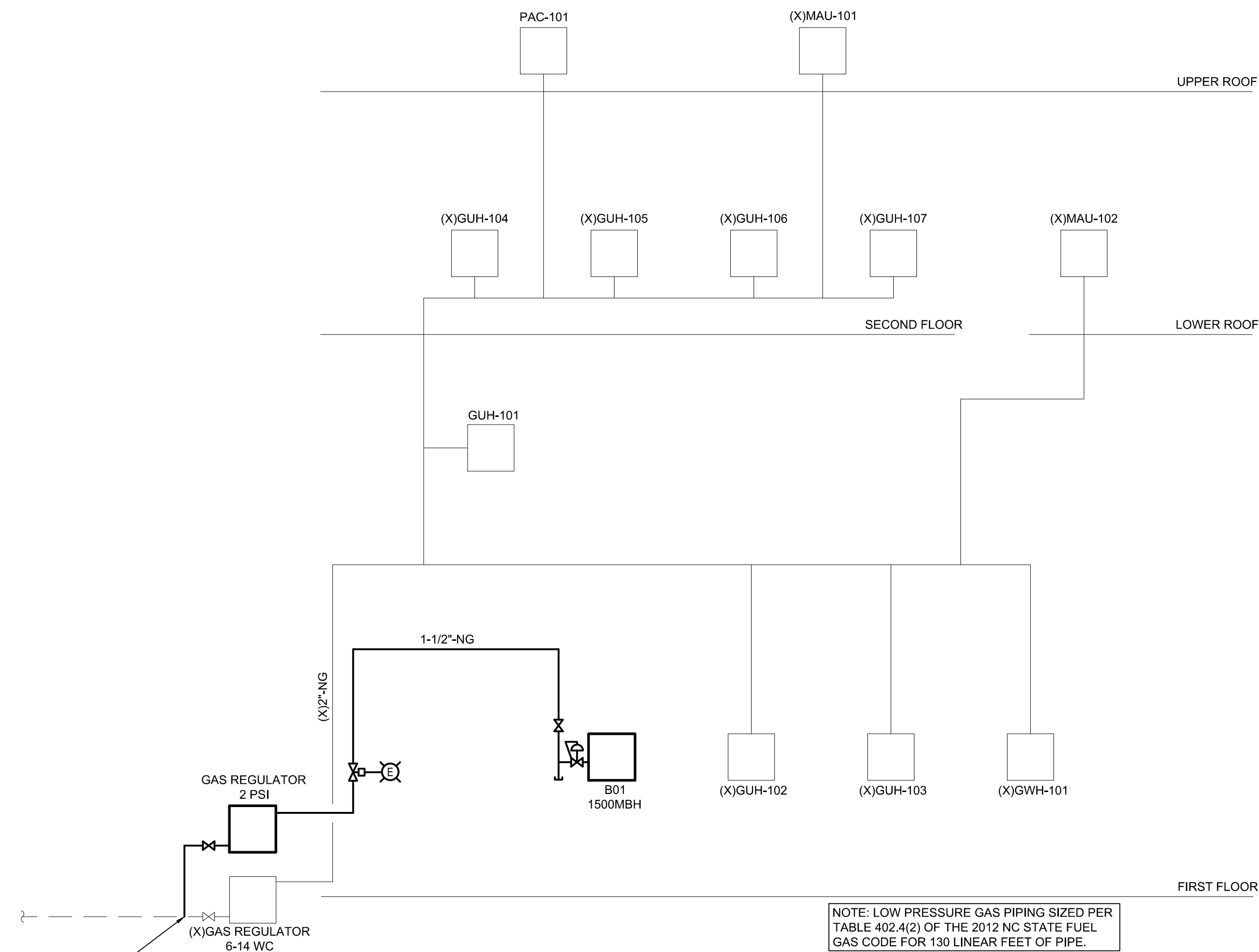
ACCESSORIES:  
 A. CARBON STEEL, PRIMER PAINTED.  
 B. 304 STAINLESS STEEL COALESCENCE PALL RINGS.  
 C. AUTOMATIC AIR VENT.  
 D. BLOWDOWN VALVE.  
 E. FLUSH VALVE.

### EXPANSION TANK SCHEDULE

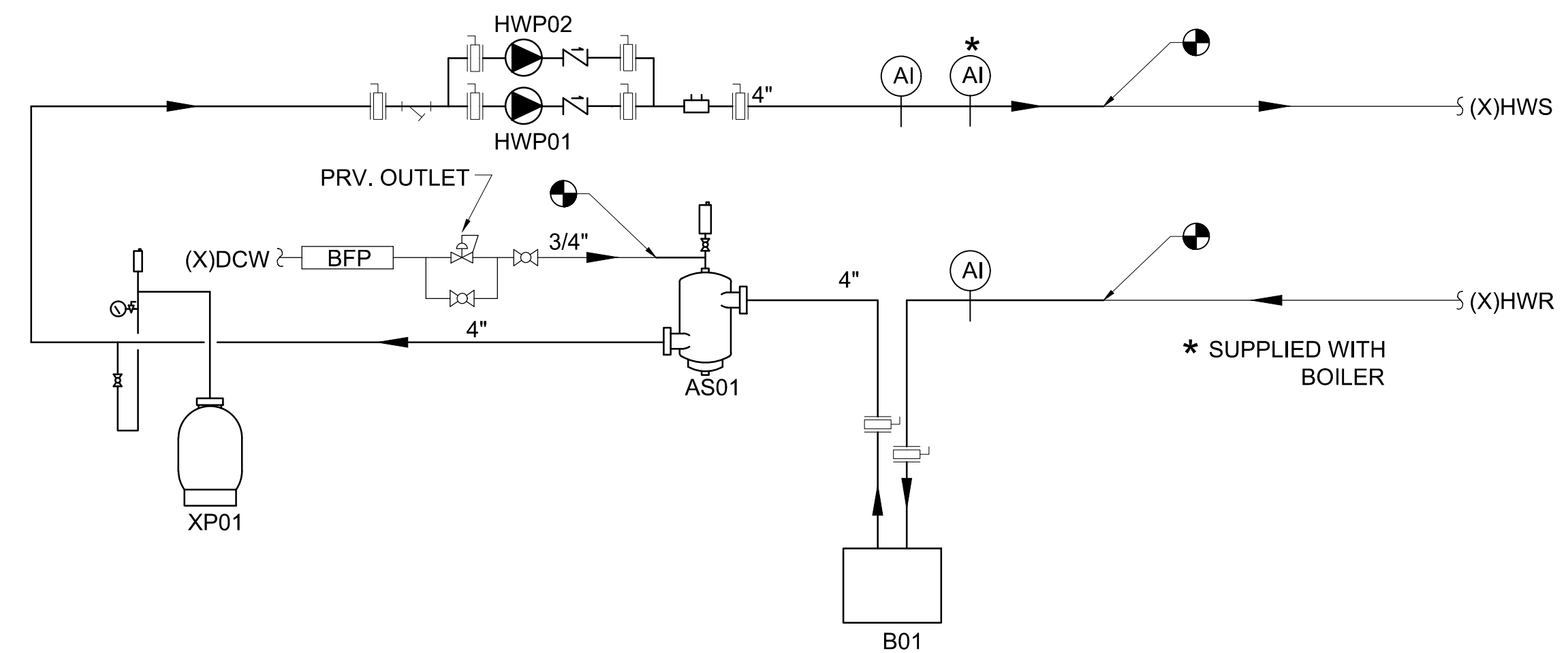
DRAWING CODE	DESIGN BASIS MFR	MODEL	ALTERNATE MFR	VOLUME (GAL)	ACCEPTANCE VOLUME (GAL)	CONFIGURATION	DIM. H/D (IN.)	WEIGHT (LBS)	NOTES	ACCESSORIES

NOTES:  
 1. FULL ACCEPTANCE EXPANSION TANK.  
 2. WEIGHT LISTED IS DRY WEIGHT.

ACCESSORIES: A, N/A



**A1 GAS RISER**  
NOT TO SCALE



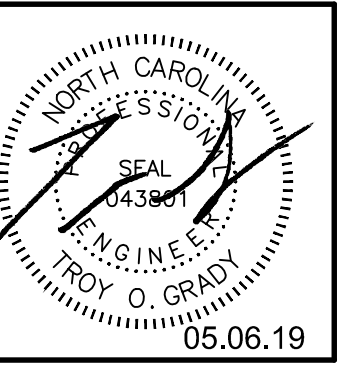
**A4 HEATING HOT WATER FLOW DIAGRAM**  
NOT TO SCALE

ISSUED FOR ADDENDUM 1	05.06.19
ISSUED FOR CONSTRUCTION	04.22.19
REVISION NO.	1
DESCRIPTION:	REVISIONS

**CBHF**  
Engineers, PLLC

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Wilmington, NC 28401

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CAPE FEAR PUBLIC UTILITY AUTHORITY  
SWEENEY WTP BOILER REPLACEMENT  
1833 N. 5th Avenue  
Wilmington, NC 28401

**SCHEDULES**

JOB NO.:	18134
DRAWN:	RWC
DESIGNED:	RWC
CHECKED:	TOG

DRAWING NO. **M-601**

REVISION: 1

1

2

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4

5

D

D

C

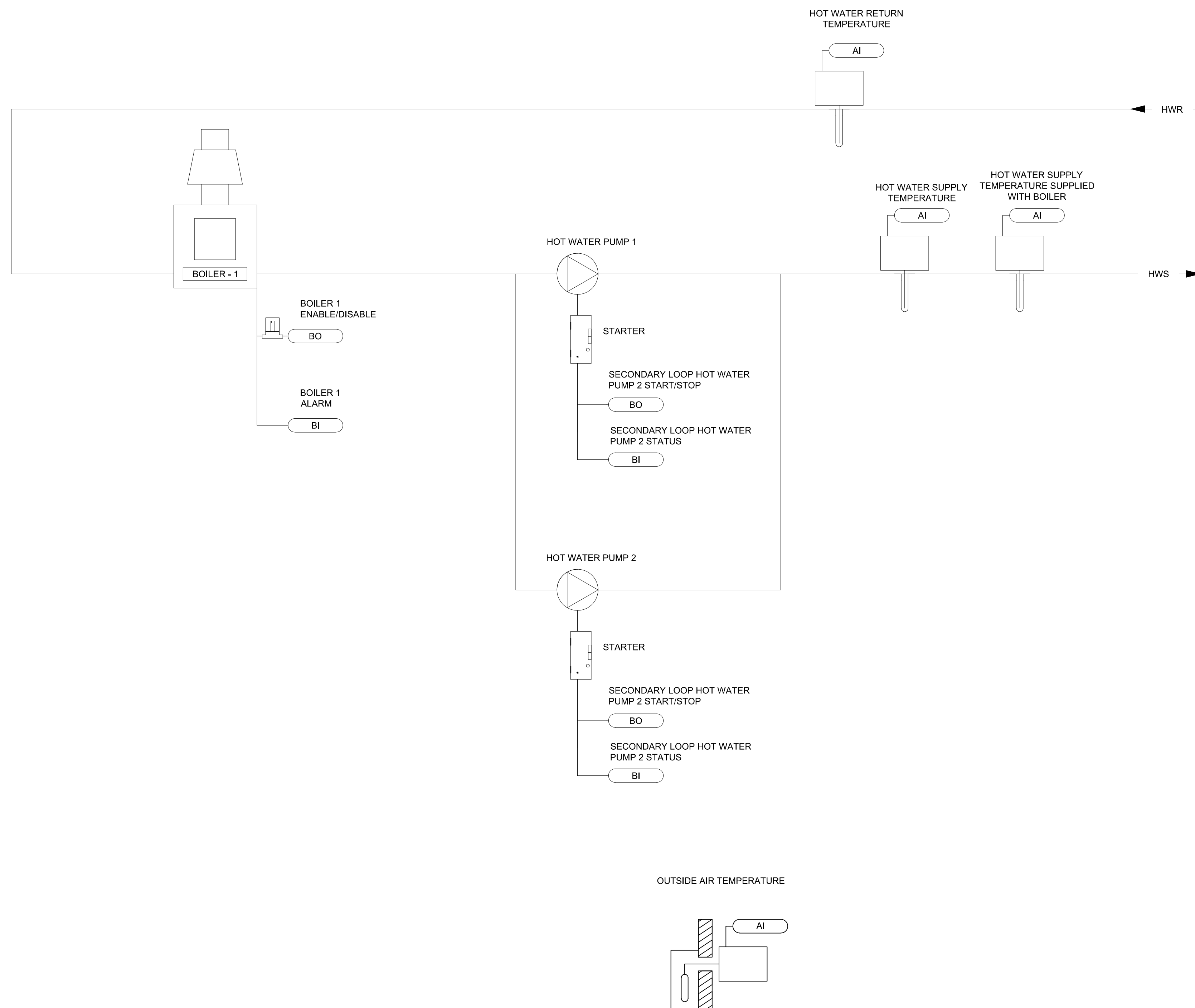
C

B

B

A

A



### BOILER PLANT SEQUENCE OF OPERATION

#### CONSTANT FLOW BOILER PLANT

##### GENERAL DESCRIPTION:

THE HOT WATER SYSTEM CONSISTS OF (1) BOILER AND (2) HOT WATER DISTRIBUTION PUMPS, LEAD AND STANDBY. THE BUILDING AUTOMATION SYSTEM (BAS) CONTROLLER SHALL PROVIDE STAND-ALONE CONTROL OR BAS WORKSTATION CONTROL OF THE SUPPLY HEATING WATER TEMPERATURE SETPOINT (ADJ.) BY CONTROLLING THE BOILER'S ENABLE/DISABLE BOILER SIGNAL. ONLY (1) HOT WATER DISTRIBUTION PUMP SHALL RUN AT A TIME.

##### HEATING SYSTEM ENABLE/DISABLE:

THE HEATING SYSTEM SHALL BE ENABLED MANUALLY VIA SWITCH ON CONTROL PANEL WITH THE FUNCTIONS OF MANUAL ON, OFF AND AUTO. IN AUTO THE HEATING SYSTEM SHALL BE ENABLED WHEN THE OUTSIDE AIR TEMPERATURE FALLS BELOW 50.0 DEG. F (ADJ.). WHEN ENABLED, THE BAS CONTROLLER SHALL START THE LEAD HOT WATER DISTRIBUTION PUMP AND THE BOILER. THE BOILER FACTORY CONTROLS SHALL OPERATE THE BOILER TO MAINTAIN ITS LOCAL SUPPLY SETPOINT.

THE BOILER SHALL RUN SUBJECT TO ITS OWN INTERNAL SAFETIES AND CONTROLS.

THE BOILER SYSTEM SHALL ALSO RUN FOR FREEZE PROTECTION WHENEVER THE OUTSIDE AIR TEMPERATURE IS LESS THAN 38°F (ADJ.).

HEATING SHALL BE DISABLED SWITCH IS SET TO OFF OR WHEN IN AUTO MODE WHEN THE OUTDOOR AIR TEMPERATURE IS ABOVE 55.0 DEG. F (ADJ.). WHEN HEATING IS DISABLED, THE HOT WATER DISTRIBUTION PUMPS AND BOILER SHALL BE COMMANDED TO OFF.

##### BOILER CONTROL:

THE BOILER SHALL OPERATE WHEN CALLED TO RUN AND FLOW IS PROVEN.

IF THE HOT WATER DISTRIBUTION SYSTEM SUPPLY TEMPERATURE FALLS MORE THAN 25.0 DEG. F (ADJ.) BELOW SETPOINT FOR A PERIOD LONGER THAN 15 MINUTES (ADJ.), OR IF AN ACTIVE BOILER SIGNALS A FAILURE ALARM, THE BAS CONTROLLER SHALL SEND AN ALARM TO THE BAS WORKSTATION.

THE HOT WATER DISTRIBUTION PUMPS LEAD/STANDBY SEQUENCE SHALL BE BASED ON A WEEKLY SCHEDULE. FROM THE BAS CONTROLLER.

##### BOILER ALARMS SHALL BE PROVIDED AS FOLLOWS:

- FAILURE: COMMANDED ON BUT THE STATUS IS OFF.
- RUNNING IN HAND: COMMANDED OFF BUT THE STATUS IS ON.
- RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.

##### HOT WATER DISTRIBUTION PUMP LEAD/STANDBY OPERATION:

THE TWO HOT WATER PUMPS SHALL OPERATE IN A LEAD/STANDBY FASHION. THE LEAD PUMP SHALL RUN FIRST. ON FAILURE OF THE LEAD PUMP, THE STANDBY PUMP SHALL RUN AND THE LEAD PUMP SHALL TURN OFF.

THE SECONDARY HOT WATER DISTRIBUTION PUMP LEAD/STANDBY SEQUENCE SHALL BE BASED ON A WEEKLY SCHEDULE. FROM THE BAS CONTROLLER.

##### HOT WATER DISTRIBUTION PUMP ALARMS SHALL BE PROVIDED AS FOLLOWS:

- FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- RUNNING IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.
- RUNTIME EXCEEDED: STATUS RUNTIME EXCEEDS A USER DEFINABLE LIMIT.

##### HOT WATER SUPPLY TEMPERATURE RESET:

THE HOT WATER SETPOINT SHALL BE RESET ACCORDING TO OUTSIDE AIR TEMPERATURE SUCH THAT WHEN THE OAT IS 30°F (ADJUSTABLE) THE HWS SHALL BE 180°F (ADJUSTABLE) AND WHEN THE OAT IS 60°F THE HWS SHALL BE 140°F (ADJUSTABLE). THE BOILER SHALL ENABLE PUMP.

##### HOT WATER SUPPLY TEMPERATURE MONITORING:

- HOT WATER SUPPLY.
- HOT WATER RETURN.

##### ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH HOT WATER SUPPLY TEMP: IF GREATER THAN 200°F (ADJ.).
- LOW HOT WATER SUPPLY TEMP: IF LESS THAN 100°F (ADJ.).

##### FREEZE PROTECTION:

WHEN THE OUTDOOR AIR TEMPERATURE FALLS BELOW 35.0 DEG. F (ADJ.), THE HOT WATER DISTRIBUTION PUMP SHALL OPERATE CONTINUOUSLY TO PROVIDE HOT WATER CIRCULATION TO ALL ASSOCIATED HOT WATER COILS.

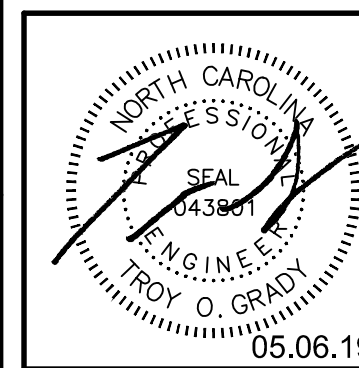
05.06.19	DATE
0	REVISION NO.
ISSUED FOR ADDENDUM 1	DESCRIPTION:
	REVISIONS

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CAPE FEAR PUBLIC UTILITY AUTHORITY  
SWEENEY WTP BOILER REPLACEMENT  
1833 N. 5th Avenue  
Wilmington, NC 28401

CONTROLS AND SEQUENCES OF OPERATION

JOB NO.:	18134
DRAWN:	RWC
DESIGNED:	RWC
CHECKED:	TOG

DRAWING NO:  
**M-602**

REVISION:  
0

Sweeney Water Treatment Plant  
Boiler Replacement

CBHF Engineers, PLLC

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# CFPUA SWEENEY WTP BOILER REPLACEMENT

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SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work of this section.

Section 230923, which specifies the DDC system that utilizes sensors, devices, actuators, and final control elements specified in this section.

SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not comply fully with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific.

Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for all components including the following to demonstrate compliance with the contract documents:

Catalog cut sheets of all equipment used. This includes, but is not limited to sensors, actuators, valves, and dampers.

Catalog cut sheets of air measuring stations used for the volumetric control system. Include as a separate volumetric control section velocity transmitters, static pressure transmitters, and flow chart for sequence of operation.

Control air supply components, and sizing computations for compressors, receivers and main air piping.

Operation and Maintenance (O/M) Manuals: O/M manuals shall include the following, at a minimum, elements:

General description and specifications for all sensors and final control elements.

Complete troubleshooting procedures and guidelines for all sensors and final control elements.

Documentation of all required maintenance and repair/replacement procedures.

PART 2 -PRODUCTS

ELECTRONIC SENSORS

General: Provide all remote sensors and instrumentation as required for the control system. All sensors shall have accuracies as stated hereinafter. Electronic sensors shall include integral transmitter and provide input analog input signal as either 4-20 mA or 0-10 VDC over the full range specified below.

Sensor Accuracy and Range: Each sensor, as hereinafter specified, shall have accuracy and range as follows:

Sensed/Measured Variable	Sensor Characteristics Required	
	Measurement Accuracy	Range
Outside Air Temperature	±2°F	-30°F- +130°F
Water Temperature		
- Hot Water	±1°F	+50°F- +250°F

Temperature Sensors: The following shall apply to temperature sensors:

Hydronic Pipe Insertion Sensors: Stem or tip sensitive types, as required. Sensing elements shall be hermetically sealed. Stem and tip construction shall be 304 stainless steel, copper, glass or epoxy. All external trim material shall be corrosion resistant designed for the intended application. Sensor pipe wells shall be of bronze, stainless steel, copper, or Monel materials. Heat transfer compounds shall be compatible with the sensors.

Motor Status Sensor: Status of pumps and fans shall be proven by adjustable current sensing relays. Provide user adjustable time delays (10 seconds default) to prevent false alarms during starting/stopping of motor.

Flow status of pumps and fans, 1/2 hp and larger, shall be proven by adjustable current sensing relays. Provide software resident time delays to prevent false alarms during starting/stopping, including printout and application programs.

## CFPUA – SWEENEY WTP BOILER REPLACEMENT

### ELECTRIC CONTROLS ELEMENTS

Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

Selector Switch: Integral, manual on-off-auto.

Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

Bulbs in water lines with separate wells of same material as bulb.

Bulbs in air ducts with flanges and shields.

Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.

Scale settings and differential settings are clearly visible and adjustable from front of instrument.

On-Off Thermostat: With precision snap switches and with electrical ratings required by application.

Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

Hydronic Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

Hydronic Surface-Mounted Thermostat ("Aquistat"): Snap-acting, single-pole, single-throw, auto-reset switch that opens if temperature rises above adjustable high temperature setpoint or falls below adjustable low temperature setpoint, as indicated by the application.

Emergency Break Glass Station: Station shall consist of wall-mounted 120/1/60 switch normally held in a depressed position by a glass disc mounted in a NEMA 4X enclosure, complete with hammer, retention chain, and spring clip retainer. Switch shall include four (4) SPST contactors, two (2) NO and two (2) NC. Include five (5) replace glass discs. Label station "BOILER ROOM EMERGENCY STOP SWITCH," as applicable, in accordance with Section 230553.

### PART 3 - EXECUTION

#### INSTALLATION

Sensors and Controls:

## CFPUA – SWEENEY WTP BOILER REPLACEMENT

Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

Label or code each field wire at each end. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-code cable with cable diagrams may be used to accomplish cable identification.

### Temperature Sensors:

Install all sensors and instrumentation according to manufacturer's written instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.

Mount sensors rigidly and adequately for the environment within which the sensor operates.

Pipe-mounted temperature sensors shall be installed in wells completely filled with thermal conducting material.

All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor reading.

## FIELD TEST AND INSPECTIONS

Upon completion of installation of each sensor or final control element, field inspect and mechanically and electrically test for proper function.

## OWNER INSTRUCTION AND TRAINING

Provide Owner instruction and training in accordance with Division 1 of these specifications.

END OF SECTION 230913

## CFPUA – SWEENEY WTP BOILER REPLACEMENT

### 230923 – DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

#### PART 1 - GENERAL

##### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

Section 230913, which specifies the requirements for sensors utilized by the DDC system.

Section 230993, which specifies the required I/O points and sequences of operation for systems and components.

##### QUALITY ASSURANCE

Single Source Responsibility of Supplier: The controls system vendor shall be responsible for the complete installation and proper operation of the control system. The vendor shall be in the regular and customary business of design, installation and service of computer-based building environmental control systems similar in size and complexity to the system specified. **The vendor shall be the manufacturer of the primary DDC system components.** The vendor must be licensed as an “unlimited electrical contractor” in the state of North Carolina, shall have a factory-certified trainer on staff, and provide 5 day per week technical support. *Acceptable vendors and DDC systems are limited to the following:*

Johnson Controls, Inc. (395 North Green Meadows Drive, Wilmington, NC 28443) “Metasys” architecture.

##### Exceptions:

Controllers shall have the capability of utilizing any non-proprietary sensor and operator complying with Section 230913.

Use of “adaptive control” algorithms for automatic PID “loop tuning” is prohibited.

Equipment and Materials: Equipment and materials shall be catalogued products of manufacturers regularly engaged in production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

##### GUARANTEE PERIOD SERVICES

Maintenance of Control Hardware: The Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the file server/workstation(s), associated peripheral equipment, and control units. The Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all software is functioning correctly.

Maintenance of Control Software: The Contractor shall maintain all software. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost to the Owner.

Service Period: Routine system service shall be provided on a monthly basis for the first six (6) months of the guarantee period and at least every three months during the second six (6) months. Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

Service Documentation: A copy of the service report associated with each routine service visit or Owner-initiated service call shall be provided to the Owner and the A-E with 10 days after the date of each service call.

## SUBMITTALS

General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations.

Submittals required by this sub-section, and the required dates for each submittal, shall be finalized at a pre-submittal meeting, to be scheduled within 30 days of the date of the Notice to Proceed, and shall be provided in three phases:

Phase I submittals shall consist of DDC engineering shop drawings, including control system schematics, and sequences of operation, including setpoints, alarm limits, and schedules; product data for all control devices required under Section 230913; DDC system hardware and software as required below; and any other submittals determined during the pre-submittal conference. **Phase I submittals must be submitted and reviewed as early in project schedule as possible to avoid delays in actual installation.**

Phase II submittals shall consist of the graphic displays as required below. Phase II submittals are required at least 30 days prior to the date of the Substantial Completion inspection.

Phase III submittals shall be the close-out submittals as required below. Phase III submittals are required before the date of Final Completion inspection.

Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and start-up instructions for each type of product indicated.

DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

DDC System Software:

## CFPUA – SWEENEY WTP BOILER REPLACEMENT

Include technical data for operating system software, operator interface, color graphics, and other third-party applications.

List of graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

### Shop Drawings:

Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Bill of materials of equipment indicating quantity, manufacturer, and model number.

Schematic diagrams of each controlled system with control points labelled and control elements graphically shown, with wiring.

Details of control panel faces, including controls, instruments, and labelling.

Written description of sequences of operation.

Schedule of dampers including size, leakage, and flow characteristics.

Schedule of valves including flow characteristics.

### DDC System Hardware:

Wiring diagrams for control units with termination numbers.

Schematic diagrams and floor plans for field sensors and control hardware.

Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.

Graphic Displays: Include color prints or "screen shots" of each proposed graphic display proposed, complete with clear indication of (1) static components and dynamic components and (2) "on"/"off"/"alarm" condition designation convention.

Samples for Initial Selection: For each color available for each type of thermostat, sensor, etc. cover exposed to view with factory-applied color finishes.

Data Communications Protocol Certificates: **Certify that each proposed DDC system component complies with ASHRAE Standard 135-2012 and is BACnet Laboratory tested and certified.**

## CFPUA – SWEENEY WTP BOILER REPLACEMENT

### Closeout Submittals:

Operation and Maintenance Data: Include the following:

Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.

Interconnection wiring diagrams with identified and numbered system components and devices.

Keyboard illustrations and step-by-step procedures indexed for each operator function. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

Calibration records and list of set points.

Software and Firmware Operational Documentation: Include the following:

Software operating and upgrade manuals.

Program Software Backup: On a magnetic media or compact disc, complete with data files.

Device address list.

Printout of software application and graphic screens.

Software license.

## PART 2 - PRODUCTS

### SYSTEM DESCRIPTION

Provide a peer-to-peer networked, stand-alone, distributed processing global Direct Digital Control (DDC) System utilizing flat communications scheme. DDC system shall be BACnet/IP based, complying with ANSI/ASHRAE Standard 135-2012 protocol, and communicating using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected by a Local Area Network (LAN) to distributed processing, standalone control units (CUs) operating in a multiuser, multitasking environment and programmed to control HVAC and other systems, as shown on the Drawings.

The system shall include at least one Building Level Control Unit (BLCU) to provide interface to the Owner's file server and network located at the NHCS Maintenance Office and/or to a remote user using a standard Web browser as hereinafter specified.

## CFPUA – SWEENEY WTP BOILER REPLACEMENT

DDC system shall use ANSI/ASHRAE Standard 135-2012 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol. Comply with ANSI/ASHRAE Standard 135-2012 for all controls hardware and software.

### MAINTENANCE OFFICE FILE SERVER AND WORKSTATIONS

The DDC system, through a site Building Level Control Unit as hereinafter specified, shall be connected to the Owner's wide area network (WAN) with a compatible communications interface as a client to the Owner's server. Communications between the any operator and the DDC system over the Owner's WAN shall be accomplished through either of the following:

PC or laptop workstations directly connected to the WAN.

Laptop, notebook, tablet, or other remote device connected to the WAN through a browser-based Internet connection using Barracuda SSL VPN Agent, a Java client that provides secure access to the WAN from remote locations.

Access to the Owner's WAN by the DDC system vendor, except via supervised access using Join.me Basic, is *prohibited*.

Via either access method specified above, the following functions shall be provided:

Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.

Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any control unit.

Server shall include a master clock service for its subsystems and provide time synchronization for all network components.

Network Software: Software shall include the following capabilities:

I/O capability from any network operator workstation. The system operator interface shall be an easy to use, self-guiding, menu-penetration, windowing approach. Key features that shall be included in the interface are as follows:

Full English language data addressing and presentation: BACnet objects/points shall be identified within a particular BACnet device by a 32-bit numeric "object identifier" defined in accordance with ANSI/ASHRAE Standard 135-2012. Each object/point shall also be referenced by individual writable "object name" of 50 characters or less assigned by the Contractor utilizing the following naming convention:

Format object/point names in terms of "**FACILITY.SYSTEM.POINT.**" "Facility" shall be the name or identifying abbreviation for the facility as provided by the Owner. "System" shall be the name or identifying abbreviation for the HVAC system, subsystem, or component matching **exactly the system**,

**subsystem, and component identifier used within the Contract Documents.**

"Point" name abbreviations shall be as follows:

<b>Point Description</b>	<b>Point Name</b>
Mixed Air Temperature, Humidity, Enthalpy	MATemp MAHum MAEnth
Outdoor Air Temperature, Humidity, Enthalpy	OATemp OAHum OAEnth
Percent Open	PctOpn
Power	kW
Space Temperature, Humidity, Enthalpy	SpaceTemp SpaceHum SPEnth
Status, Alarm or Failure	Alarm
Status, Occupied/Unoccupied	Occ or Unocc
Status, On/Off	On or Off
Status, Open/Closed	Open or Closed
Supply Air Temperature	SATemp

Where a required point name abbreviation or identifier is not readily show within the Contract Documents, the Contractor shall submit a Request for Information to the A/E.

Object/point descriptions used for applications such as graphics, reports, alarms, etc. shall be same as the object/point name as specified above.

Engineering units shall be the English ("inch-pound") system.

Interactive operation and help messages.

Organization of points into logical groups or "systems" and an information penetration scheme that provides quick and simple method for maintenance staff to determine HVAC conditions and problems at any school, as follows:

Initial facility information display will be one or more "floor plans" that include basic site information and specific room by room data. Each of these data points are displayed as "hot buttons" so that selecting any data display takes the user to next, more detailed information level. The floor plan display(s) shall provide display of temperature and humidity conditions in each space. Designation of the HVAC unit or system serving each space shall also displayed and selecting that hot button shall take the operator to the detailed system points display for that unit or system.

At the HVAC system, subsystem, or component level, a graphical display or "tree structure" structure display may utilized, as selected by the user. Typically, since all graphical displays tend to be less detailed and slower to respond than

tree structure displays, graphics tend to be rarely used by experienced operators (but, graphics play an important role for educating less experienced operators).

Fill-in-the-blanks programming.

On-line data file programming.

Multi-level system access for security, as follows:

<b>Level</b>	<b>Access Privileges</b>
1	View only.
2	Same as Level 1, plus acknowledge alarms
3	Same as Level 1, plus allow temporary schedule modifications.
4	Same as Level 2, plus temporary or permanent schedule modifications, establish and view trend logs.
5	Same as Level 4, plus space temperature setpoint adjustment
6	Not assigned.
7	Not assigned.
8	Unlimited.

Pictorial representation of data on color graphic terminals with dynamic data.

Capability to alternate between graphic and text displays for the same logical group.

Automatic system diagnostics; monitor system and report failures of both controlled equipment and control system components.

Database creation and support.

Automatic and manual database save and restore.

Dynamic color graphic displays with multiple screen displays at once.

Custom graphics generation and graphics library of HVAC equipment and symbols.

Alarm and event processing.

Provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box upon receipt of an alarm irrespective of the foreground application. Alarms assigned for printout shall be routed to the destination printer. In addition, alarms shall be capable of being routed to specified personnel by means of pager or mobile telephone.

User-defined alarm messages shall be generated and delivered in conjunction with the alarm notification.

Alarms shall be routed to the appropriate destination device(s), based on time and other conditions. An alarm shall be able to initiate sequences, print, be logged in the event log, generate custom messages, and automatically display an associated system graphic.

Any object in the system shall be configurable to generate alarms on transition in and out of normal state. The operator shall be able to configure the alarm category, alarm limits, alarm limit differentials, states, alarm message, states and reporting actions for each alarm in the system.

Minimum alarm categories required are notification, maintenance, critical and security.

BACnet object and property status and control.

Automatic restart of field equipment on restoration of power.

Data collection, reports, and logs. Include standard reports for the following:

Current values of all objects.

Current alarm summary.

Disabled objects.

Alarm lockout objects.

Logs:

Retrieve and display default logs, including "all points log", "system points log", "alarm log", etc.

Create, retrieve, and display trend logs, in real time, of historical object data stored in remote CUs.

Maintain trend log files saved to hard disk for subsequent use in spreadsheet or database programs.

Dynamically graph the trend logged object data by creating two-axis (x, y) graphs that simultaneously display values relative to time for up to eight objects in different colors.

It shall be possible to trend log any number of points at least equal to twice the number of connected physical points. Any object in the system (physical or calculated) may be logged.

Once established, trend logs shall continue until deleted by user. Data storage sufficient for at least 30 days shall be provided for each trend log.

Custom report development.

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Utility and weather reports.

Application editors for controllers and schedules.

### WEB BROWSER CLIENT ACCESS

In addition to networked workstation access as specified above, provide access to all data at the facility site and allow a remote user to operate the site control system using any Java-enabled browser (e.g., Firefox, Internet Explorer, Google Chrome, etc.) without requiring proprietary interface and/or configuration. The system shall be capable of supporting multiple clients using a standard Web browser.

Web browser shall provide the same view of the system, in terms of graphics, schedules, logs, etc., and provide the same interface methodology as provided by a workstation directly connected to the file server network.

Web browser client access shall support the following functions, at a minimum:

User log-on identification and password shall be required as hereinbefore specified. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for direct system access shall be the same screens used for the web browser client. Any animated graphical objects supported by the control system shall be supported by the Web browser interface.

HTML/XML programming shall not be required to display system graphics or data on a web page. HTML editing of the web page shall be allowed if the user desires a specific look or format.

Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.

Provide the capability to specify a user’s home page as determined by the log-on user identification. Provide the ability to limit a specific user to just the defined home page. From the home page, links to other views or pages in the system shall be possible.

*Graphic screens on the web browser client shall support hypertext links to other locations on Internet sites by specifying the Uniform Resource Locator (URL) for the desired link.*

### JOB CONDITIONS (ENVIRONMENTAL CONDITIONS OF OPERATION)

LAN hardware shall be designed to operate in ambient conditions of 65 to 90 degrees F at 20 to 80 percent RH, non-condensing.

Digital control equipment shall comply with the following:

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Digital control equipment shall be designed to operate in ambient conditions of 35 to 120 degrees F at a relative humidity of 0 to 95 percent non-condensing.

Control units as hereinafter specified shall operate properly with power fluctuations of plus 15 percent to minus 10 percent of nominal supply voltage.

Electric and electronic equipment shall be properly mounted and organized in a grounded and Listed NEMA 1 cabinet (panel). Cabinets or enclosures shall protect equipment from dust, liquids or accidental blows.

### DIRECT DIGITAL CONTROL UNITS

General: Multiple digital control units (CUs), including at least one site BLCU, shall be provided. *CUs shall be fully field programmable and the use of firmware-based application specific controllers (ASCs) is prohibited.* All control functions shall be resident in the CUs, including those involved in facility-wide strategies.

**Exception:** When approved by CFPUA for a specific application, an ASC may be utilized, provided the ASC programming, including firmware, enables the proposed ASC to fully comply with the specified I/O points and sequence of operation specified in Section 230993 for that application. *When use of an ASC is desired by the DDC system vendor, product data and other information necessary to evaluate its use shall be submitted at the pre-submittal conference hereinbefore specified.*

Control Units: Modular, comprising processor board with programmable, non-volatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

Control units shall fully comply with the system architecture and communication requirements specified hereinbefore.

Units shall monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

Stand-alone mode control functions shall operate regardless of network status. Functions include the following:

- Global communications.

- Discrete/digital, analog, and pulse I/O.

- Monitoring, controlling, or addressing data points.

- Software applications, scheduling, and alarm processing.

- Testing and developing control algorithms without disrupting field hardware and controlled environment.

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Building Level Control Unit (BLCU): Provide one or more BLCUs, as required, meeting the general requirements for control units specified above and incorporating communication interface between the control system peer-to-peer network and the Owner's WAN.

Control Modes: Control loops shall be able to utilize any of the following control modes:

Two position (e.g., on-off, slow-fast)

Proportional (P), proportional plus integral (PI), or proportional plus integral plus derivative (PID), applied as follows:

<b>Controlled Variable</b>	<b>Control Mode</b>
Space Temperature	P
Coil Discharge Temperature	PI (cooling), P (heating)
Humidity	P (PI throttling range is less than 5%)
Dewpoint Temperature	P (PI throttling range is less than 2 F)

For any unlisted application, the control mode shall be as approved by the A-E.

I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

Binary Inputs: Allow monitoring of on-off signals without external power.

Pulse Accumulation Inputs: Accept up to 10 pulses per second.

Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.

Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.

Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.

Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.

Universal I/Os: Provide software selectable binary or analog outputs.

Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

Output ripple of 5.0 mV maximum peak to peak.

Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.

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Built-in over-voltage and over-current protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

Minimum dielectric strength of 1000 V.

Maximum response time of 10 nanoseconds.

Minimum transverse-mode noise attenuation of 65 dB.

Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

Diagnostic Devices:

Each CU shall be supplied with connections to which maintenance personnel can connect a portable laptop computer for data display, setpoint modification, and reloading and modification of controller programs.

Provide software installed on Owner's laptop computers required to troubleshoot local HVAC equipment operation and control. It shall be possible for the user to completely operate the controller via the laptop and completely exercise all valves and dampers via the laptop, display values in complete engineering units for setting analog control values, reading digital status, setting control parameters, commanding digital loads, and setting analog alarm limits. Full read-write capability shall be provided.

Control Functions: All control functions shall execute within the standalone control units via DDC algorithms. The operator shall be able to customize control strategies and sequences of operations defining the appropriate control loop algorithms and choosing the optimum loop parameters. Each CU shall include the following standalone functions:

Direct Digital Control algorithms and control sequences are to be CU resident and be capable of standalone operation. All DDC programs shall be custom written as required to meet the performance criteria spelled out in the sequence of operation paragraphs for each controlled mechanical system. PID control mode shall be employed as appropriate to the application and per sequences or operation.

Enable/Disable: All CU resident DDC programs shall be capable of being enabled or disabled from any workstation. In the enable mode all DDC loops shall be active and output signals shall be routed to the final control elements. In the disable mode all DDC loop calculations shall continue but outputs to actuators shall be suppressed. (When disabled, control outputs shall stay in the same state or position as commanded from the central or until they are manually set to automatic.)

Integral Windup Prevention: To eliminate integral windup, all PID programs shall automatically invoke integral windup prevention routines whenever the controlled unit is off, under manual control or under control of a system or time initiated program, or when the controlled unit is in the process or starting or stopping.

Default Value Operation: All CU's shall be capable of being programmed to utilize stored default values for assured fail-safe operation of critical processes. Default values shall be invoked upon sensor failure or, if the primary value is normally provided by the central or another CU, by loss of communication between CUs. Individual application software packages shall be structured to assume a fail-safe condition upon loss of input sensors. Loss of an input sensor shall result in output of a sensor-failed message at the central control and command station. Each CU shall have capability for local readouts of all functions.

## APPLICATION SOFTWARE

Provide the following programs in addition to control algorithms defined on the drawings:

Scheduled Start/Stop: Provide a calendar format for schedules required for annual time-of-day scheduling for equipment operation, trending, logging and reports, etc.

Provide the following minimum features:

Day-type schedules (Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Holiday, Pre-Holiday day, Vacation day, Special Day, etc., 24 hours per day)

Monthly schedules (allow individual assignment of day types to each day of the month).

Yearly schedules (allow schedules to be applied on an annual basis and be edited and re-applied to a following year).

Temporary override of schedules shall be allowed by operators with access levels as specified above. A temporary override shall (1) extend hours of use of HVAC systems, subsystems, and/or components up to midnight on weekdays and (2) allow use of HVAC systems, subsystems, and/or components during scheduled "off" periods for a maximum of 12 hours. When an override use period terminates, the temporary override time(s) shall be voided and affected HVAC elements shall return to their normal schedules.

Optimum Start: Optimum start program shall automatically delay equipment startup based on outdoor temperature, space temperature, and system response to assure that comfort conditions are reached exactly at scheduled occupancy time. The program is to operate in both heating and cooling cycles. An adaptive algorithm is to be employed which automatically adjusts according to past experience. Algorithm shall be tested and updated every day. The program shall automatically assign longer lead times for weekend and holiday shutdowns. Space temperature input is to be the highest value of zones served in the cooling mode and the lowest of zones served in the heating mode. It shall be possible to assign occupancy start times on a per air handler unit basis. Modification of assigned occupancy start times shall be possible via the central operator's terminal.

Event Initiated Programs (EIP): Event initiators may be any digital data point in the system, real time values, or any analog alarm limit. The EIPs shall be structured so that one initiator may set and reset the EIP as it goes from normal to off-normal and back to normal, or one initiator may set the program and a second initiator reset the program, or reset may be manual via the console keyboard. Setting an EIP shall cause a series of start or stop commands to assigned loads to be executed to EIP's points. EIP's shall have priority assignments to allow them to override other programs in the set mode when desired. The operator shall have read-write capability for initiator load and priority assignment.

Alarm Initiation and Response:

All AI points shall have user-defined upper and/or lower condition limits. If user-defined limits are not defined.

Monitor and display "status" (on/off, high/low, open/closed, etc.) of each DI point. Motor on/off status shall be indicated by current sensing relays with field-adjustable trigger point to provide DI "switch", as hereinafter specified. Monitor and display "position" of an AO point (valve or damper percent open, motor speed percent of full speed, etc.)

An alarm shall be initiated whenever any of the following conditions occur:

Any AI point high or low limit alarm setpoint is exceeded.

Any DI status condition does not correspond to the DDC command condition (i.e., damper is closed when occupied/unoccupied schedule requires damper to be open, motor is operated in "hand" rather than "auto" mode, etc.)

Any AI or DI device fails or goes "out of range".

Any AO device fails to respond to DDC command condition.

If any AO control loop continues to cycle its output more than 40% of its range (user adjustable) 3 or more times in any 60 minute interval.

For variable air volume AHUs, if any supply fan or return/relief fan speed AO output signal remains above 95% for more than 8 hours (user adjustable) accumulated per "on" period for 3 or more consecutive "on" periods.

If any AHU coil control valve(s) AO output signal remains above 95% for more than accumulated 8 hours (user adjustable) per "on" period for 3 or more consecutive "on" periods.

If any humidifier valve AO output signal remains above 85% for more than accumulated 8 hours (user adjustable) per "on" period for 3 or more consecutive "on" periods.

Automatic Restart Programming:

When a power failure is detected in any phase, the DDC system shall command all electrical equipment served by the failed power source "off".

If the associated CU is powered by normal or emergency power, it may monitor its own power source as an indication of power status.

If the CU is powered by uninterruptible power supply (UPS), or if it is not capable of monitoring its own power for use in sequences, Contractor shall provide at least one voltage transformer (three phase when applicable) for each facility for the DDC system to monitor for power status.

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When the DDC system detects normal or emergency power has been restored to the failed power source, all equipment served by that source that was commanded "off" shall be automatically restarted. Restart shall be sequenced by the CU network restart program with a 5 second interval between starts to minimize inrush current.

Preventive Maintenance Instruction (PMI) programming: A preventive maintenance alarm shall be printed indicating maintenance requirements based on run time. The log shall include all equipment listed in the runtime schedule data base that have reached limit criteria of calendar-date (month-day-year) or high accumulation of totalized run-time (for points with start/stop or run status indication). Each PMI message shall include point descriptions, limit criteria and preventive maintenance instruction assigned to that limit. PMI shall be provided for each component of units such as air handling units. All limit criteria, PMI and reset-to-zero assignments shall be operator programmable, on-line at the keyboard. Stagger initial alarms to distribute maintenance throughout the year. Program initial PM alarms as follows:

Fans, run time 4000 hours

Refrigerators/freezers calendar time 3 months

All other, calendar time 4 months

### CABLING AND WIRING

DDC Cabling: Cabling between buildings shall be fiber optic. Network cabling within buildings shall be shielded twisted pair or fiber optic. Cabling or wiring between control units and I/O point devices shall be as follows:

<b>Application</b>	<b>Cable/Wire Type and Min. Gauge (AWG)</b>
Digital Input Wiring	24 gauge, twisted pair
Analog Input Wiring	24 gauge, shielded twisted pair
Digital Output Wiring	24 gauge stranded for 24V 18 gauge stranded for 120V
Analog Output Wiring	24 gauge, twisted pair

Data Cable:

Twisted shielded cables shall have FFEP insulation in thermoplastic jacket, with #24 AWG stranded conductors, minimum. Shield shall be tinned, soft-copper strands formed into a braid or equivalent foil. Shielding coverage on conductors shall not be less than 100 percent.

Multimode fiber optic cables shall be 62.5/125 micron Class Ia Graded Index Multimode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating, FDDI Compliant.

Coating Diameter: 250 Microns

Core Eccentricity: 7.5% maximum (1.5% typical)

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Numerical aperture: .275 plus or minus .015

Attenuation: 3.5 dB/km @ 850 NM / 1.50 dB/km @ 1300 NM

Bandwidth: 160 MHz at 850 NM / 500 MHz @ 1300 NM

Fiber connectors: ST .75 dB maximum insertion loss

Cable bend radius: 10 times diameter

Single mode fiber optic cables shall be 8.3/125 micron Class IVa Dispersion-Unshifted Single-mode Optical Fiber, OFNR, OFNP, Outdoor or Indoor / Outdoor (I/O) NEC Rating, FDDI Compliant.

Coating Diameter: 250 Microns

Core Eccentricity: 7.5% maximum  
(1.5% typical)

Attenuation: 0.5 dB/km @ 1310 NM/1550 NM

Zero dispersion wavelength 1300 -1320 NM

Cable bend radius: 10 times diameter

Control and Interlock Wiring: All 24V-120V control and interlock wiring shall comply with the following:

Conductors:

All wire and conducting components shall be THWN stranded copper.

Conductors shall be continuous from device to device and no splices shall be made except within device or junction boxes. **Wire nuts and crimp slices are prohibited.** Junction boxes may be utilized where required.

Control wiring shall be color-coded in accordance with reviewed submittals.

Where conductors pass through a junction box or connect to a device, the conductor and the box shall be tagged to indicate the circuit and/or terminal number shown on the submittal drawings.

Raceway: Provide electrical metallic tubing (EMT), minimum 3/4" size. Fittings shall be steel insulated throat compression type. **Set screw fittings, fittings constructed of alloys of aluminium or fittings of the indenter type are prohibited.** Flexible metallic raceway may be utilized for the last 24" up to the connection point for devices, sensors, etc.

Routing of Raceway: Exposed raceway shall line up work true to adjacent surfaces and be placed in a workmanlike manner. Raceway shall be run at right angles to building lines; this

requirement does not apply to raceway located below concrete placed as a part of this project. Raceway shall be sturdily supported and separated in a manner satisfactory to the A/E; raceway shall not be supported by the ceiling grid or ceiling grid support wires. In general, all raceway is to be concealed and routed overhead, below the floor, or in walls except in electrical or mechanical equipment rooms. Raceway in such rooms may be surface mounted.

**Device Boxes:** Device boxes for use in sheetrock or paneled surfaces shall be of galvanized steel, 4 inches square of a depth necessary to contain the intended device(s) and associated conductors. Boxes shall be sized to have no less than the minimum volume as required by the NEC. Boxes must be flush mounted and accommodate device(s) and all wires and connections without crowding. Boxes shall be furnished with a suitable plaster ring of the depth required to match the wall (or ceiling) material. Where the surface material or covering is combustible the front edge of the plaster ring shall be absolutely flush with the surface. Where the wall material is non-combustible, the front of the plaster must be recessed into the wall no further than 3/16 inch. Device boxes for flush mounted use in masonry walls shall be of the concrete tight masonry type sized for the number of device(s) and conductors. In locations where surface mounting of device boxes is permitted on masonry walls, provide 1/2 inch raised cover and suitable plaster ring.

**Junction Boxes:** Junction boxes shall be of galvanized steel of size, type, and shape for intended use and having adequate volume as required by NEC. All junction boxes shall be concealed unless specifically permitted elsewhere in these Specifications or on the Drawings. Boxes must be supported from the building structure without dependence on support of conduit, fixture support wires, ceiling support wires, or similar items.

**Device and/or Junction Box Wall Penetrations:** All wall penetrations at device or equipment locations must be protected in such a manner that the fire rating of the wall is maintained. *It is the responsibility of the Contractor to assure that fire and smoke integrity of all walls is maintained at all penetration points.*

### PART 3 - EXECUTION

#### EXISTING DDC SYSTEM/COMPONENTS DEMOLITION

Where an existing DDC system is required to be removed to provide for installation of a new DDC system, careful attention to demolition and salvage is required. All existing DDC components, including but not limited to controllers, sensors, valve and damper operators, etc. ***shall be removed without damage and turned over to the Owner.***

Thermostats and sensors containing mercury shall be disposed in accordance with EPA Resource Conservation and Recovery Act (RCRA). Contractor shall refer to EPA web site for handling procedures for disposal and spill management of projects containing mercury.

Remove all abandoned wiring, raceway, and any related items, both exposed and concealed. Where existing raceway is concealed in concrete or masonry, remove wiring as required above and abandon in place. Cut abandoned raceway off 1/2" into wall, ceiling, or floor to allow patching to completely cover cut off end of raceway.

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Repair surfaces and finishes to match existing surrounding surfaces or finish in all areas where items are removed. After repairs are made no evidence of previous use of surfaces shall be visible.

Provide touch-up painting as required where new items are installed adjacent to existing items to remain.

Clean new, damaged, and/or disturbed areas and apply primer, intermediate, and finish coats at each location.

Surface preparation and timing of application of successive coats of paint shall be in accordance with paint manufacturer's instructions.

Use zinc-rich paint to repair damage to galvanized finishes. Follow written instructions of paint manufacturer.

Repair paint finishes for other items, surfaces, or equipment as necessary. Follow written instructions of paint manufacturer.

Provide blank cover plates to match device plates used in the adjoining areas where outlet, device, junction, or other boxes are to remain,

## INSTALLATION

Provide skilled technicians, properly trained and qualified for the work and directed by experienced engineers.

Except for short apparatus connections, run raceway parallel to or at right angles to the building structure. Conceal raceway and tubing in finished spaces. Do not run raceway concealed under insulation or inside ducts. Mount control devices, tubing and raceway located on ducts or apparatus with external insulation on standoff supports to avoid interference with insulation.

Run wire connecting devices on or in control cabinets parallel with the sides of the cabinet neatly racked to permit tracing. Rack connections bridging a cabinet door along the hinge side and protect from damage. Provide grommets, sleeves or vinyl tape to protect plastic tubing or wires from sharp edges of panels, raceway, and other items.

### Cabling and Wiring Installation:

All control cabling and interlock wiring shall be installed in raceway.

Exception: Where Class 2 wiring is located in concealed and accessible locations, including supply or return air plenums, plenum-rated cables complying with NFPA 262 may be installed without raceway, provided that:

Circuits meet NFPA 70 Class 2 (current-limited) requirements.

All cables shall be UL-listed for the application.

**Do not install Class 2 wiring in raceway containing Class 1 wiring.** Boxes and panels containing high voltage (120 V+) may not be used for low voltage wiring except for the purpose of interfacing the two via relays, transformers, etc.

Shielded, twisted pair cable shielding shall be grounded at each connection point.

Fiber Optic Cable:

Route all interior cables in raceway within walls and inaccessible ceiling spaces.

Use nylon bushings at top of conduit where stubbed in accessible ceiling spaces.

Support all cables using J type hooks where open cable is permitted.

Route all fiber optic cable in raceway with innerducts. The innerducts shall contain a pull string, if no fiber is pulled at the time of the installation of the duct.

All conduit where fiber optic cable is installed shall be sized to maintain the manufacturer's recommended bend radius of fiber optic cables. As a minimum, conduit shall be provided with long radius elbows.

All cables shall be terminated using appropriate termination equipment.

Fiber Termination Panels: Provide a rack mountable, modular cabinet capable of terminating up to 24 type ST multimode fiber cables. Panels shall be as manufactured by Ortronics, Amp, Siecor, or Superior.

Fiber Optic Testing: Upon completion of the passive optical cable system, the system must be tested to ensure compliance with the design and link loss specifications. The tests include:

Power Meter Tests: For building risers, power meter tests are required.

End-to-End Attenuation Testing: Tests shall be completed on each fiber span at both operational wavelengths:

850/1310 nm multimode

1550 nm single mode

Testing in one direction is required. Link attenuation does not include any active devices or passive devices other than cable, connectors and splices (e.g., link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers. Test results should be retained for inclusion into the documentation package.

Connector loss readings of each completed connector should be recorded using an OTDR at 850 and 1310 nm in one direction.

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Optical time domain reflectometer (OTDR) signature traces of each terminated fiber should be recorded at 850 nm and 1310 nm for fiber continuity purposes. OTDR testing is mandatory for runs longer than 2 km.

Final report shall be compiled which records system configuration, fiber labels, cable routes and “as built” details. Loss measurements with calibrated light source and power meter shall be included. OTDR traces shall also be included when requested in advance.

Smoke detectors and/or fan shutdown relays initiated by a fire alarm system shall be integrated into the control system and sequence of operation as indicated and/or required.

### FIELD QUALITY CONTROL

Perform the following field tests and inspections and prepare test reports after completion of DDC system installation:

After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

Test and adjust controls and safeties.

Test calibration of control units by disconnecting input sensors and stimulating operation with compatible signal generator.

Test each control point through its full operating range to verify that safety and operating control set points are as required.

Test each control loop to verify stable mode of operation and compliance with sequence of operation.

Test each system for compliance with sequence of operation.

Test software and hardware interlocks.

DDC Verification:

Verify that instruments are installed before calibration, testing, and loop checks.

Check instruments for proper location and accessibility.

Check instrument tubing for proper fittings, slope, material, and support.

Check temperature instruments and material and length of sensing elements.

Check DDC system as follows:

Verify that DDC controller power supply is from emergency power supply, if applicable.

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Verify that wires at control panels are tagged with their service designation and approved tagging system.

Verify that spare I/O capacity has been provided.

Verify that DDC controllers are protected from power supply surges.

Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

## CALIBRATION AND ADJUSTMENT

### General:

Make two-point calibration test for both linearity and accuracy for each analog instrument.

Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

### Control System Inputs and Outputs:

Check analog inputs at 50 and 100 percent of span.

Check analog outputs using milliamper meter at 50 and 100 percent output.

Check digital inputs using jumper wire.

Check digital outputs using ohmmeter to test for contact making or breaking.

Check resistance temperature inputs at 0 and 100 percent of span using a precision-resistant source.

### Temperature:

Calibrate resistance temperature transmitters at 0 and 100 percent of span using a precision-resistance source.

Calibrate temperature switches to make or break contacts.

Provide diagnostic and test instruments for calibration and adjustment of system.

Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating start-up procedures.

Adjust initial pressure, temperature, humidity, etc. setpoints in coordination with TAB sub-contractor.

## HVAC SYSTEMS OPERATION VERIFICATION

After installation, calibration, and adjustment of DDC system, the DDC system vendor shall verify the performance of the DDC as follows:

Verify Non-Gas Sensor Accuracy: Select at least 10% of the installed temperature, humidity, etc. sensors, including at least one of each sensor type, for testing. If calibration of 10% or more of this sample is found to be incorrect, select an additional 10% of the installed sensors for testing. **If calibration of 10% or more of this second sample is found to be incorrect, test/calibrate all sensors.**

Sensor calibrating instruments shall be used in checkout of the overall performance. The sensors of these instruments shall be placed at the proximity of DDC system sensors to indicate the conditions of the controlled media (air, etc.). If the response times of the two sensors (DDC system sensor and calibration sensor) are similar, testing may be performed with the sensors in place. If the conditions of the controlled media change slowly, testing may also be performed with the sensors in place. However, if the conditions of the controlled media change rapidly and the time responses of the two sensors vary considerably, testing shall be done with the sensors placed in a known environment such as a temperature bath.

Verification procedures: Verification of sensor accuracy shall be made using the following procedures. Compare readings for each sensor from the calibration instrument and the DDC system to determine if the measurement accuracy meets the requirements of Section 230913.

Temperature: Use a multi-point verification check at various points in the operating range (including minimum, typical, and maximum), utilizing a calibrated thermometer and Dewar flask or a calibrated portable drywell ( $\pm 0.5^{\circ}\text{F}$ ) temperature probe calibrator.

Relative Humidity: Use a single point calibrator or portable environmental chamber that has been lab calibrated with a NIST traceable dew point monitor ( $\pm 3\%$  RH).

Verify Final Control Element Functionality: Test each final control element operator to ensure performance in accordance with Section 230913 and the control sequences defined on the Drawings. Test shall include full range of movement, stability through that range, and power and/or control signal failure performance. Operators found to be non-functional in any way shall be replaced.

Verify Operator And System Functionality:

Verify DDC system command software by issuing commands at the operator's console and via browser interface and observing display, printer output, or HVAC equipment responses. The following software operation shall be verified:

Software for checking input commands and issuing error messages. Enter various correct and incorrect commands.

System and point addressing check. Enter command to display I/O data. Verify all data points defined on the drawings and/or required by the specifications.

Start-stop or enable-disable of HVAC equipment or DDC system control points. Enter commands to start/stop selected HVAC equipment, and to disable and enable selected points.

Operator override/automatic mode. Enter command to change selected automatic control under DDC system to manual and vice versa.

Display format. Enter commands to display data and graphics on terminal and graphic display. Check display content for adequacy and clarity as specified.

Ability to modify, cancel and confirm operator's commands. Verify by entering commands.

Set-point adjustment and limiting. Enter commands to adjust set points of controllers and range limits of the controlled media. Verify by display. Also enter commands to adjust set-points outside their range limits. DDC system shall display error messages.

System access and access level control. Try to log on to system with both incorrect and correct ID codes. Try to enter different commands with different access level of the operators. The responses of the DDC system shall be as specified.

Start/stop equipment. Enter command to start or stop selected equipment. Also reset time to initiate automatic mode. Verify responses by observation of equipment and DDC system display.

Change parameter of points. Enter commands to change parameters of selected points such as high and low limit alarms, scale factor, etc. to test the adequacy of software.

Verify graphic display of each HVAC system and component. Confirm that the graphic is in accordance with the design data and reviewed submittals, includes all data points required, displayed data is correct and in the correct format and units, and changes in point conditions or status are accurately updated. Evaluate the refresh rate of data display.

Verify report generation (status, profile, energy, etc.) by entering commands to generate reports such as all points, trend, total display of a system, timed display, and other specified reports. Examine the report content for general format, system/point code, time interval of reporting, point status/value/unit, energy amount/rate/unit, status of control and set time (manual or automatic), and other specification required information.

Check for proper operation of system status reports, including point status reviews which would include information such as points currently in alarm, points removed from alarm checking, points off of scan, etc.

Test alarm reporting by initiating alarm conditions of different points at different alarm levels in sequence to examine alarm reports. The reports shall show alarm location and device, alarm time, cause of alarm, current status of the point, etc. as required in the specifications. When alarm conditions are removed the printer shall print updated status report. Also verify audible alarm operations in accordance with specification requirements. Then initiate alarm conditions at different levels at the same time to check alarm priority.

Trending performance shall be tested by creating trend logs for each control sequence and monitoring the trend reports throughout the period that each control sequence is tested.

Test Control Sequences: The test procedures described below do not check the details of the software, rather, they try to verify the final output as indicated by the field equipment. Before testing, each program the required input and output of the program and those listed in the contract specifications shall be compared to make sure that the program covers the specified operations. Verification of HVAC equipment operation (such as equipment status or temperature of space air) may be done by either (1) actual observation of equipment status and test instruments, or (2) obtaining DDC system reports if the accuracy of these reports has been verified previously.

Basic Functional Tests: Through the user interface conduct the following series of tests:

Raise/lower space temperature setpoints in software to verify if the system responds in accordance with design requirements.

Raise/lower AHU discharge temperature setpoints and verify control valve and damper positions.

Raise/lower static pressure setpoints and verify variable speed drive or vortex damper control.

Initiate a high priority, off-hours alarm and verify that the remote notification procedures are carried out correctly.

Verify that the interface with system safeties allow operation of dampers, etc., if safety conditions are met.

Conduct an emergency start-up after power failure test. Verify that all systems return to automatic control.

Disconnect communication cable to the DDC system and verify if the DDC panel can control the respective system (stand-alone control).

Disconnect a sample of DDC space-temperature sensors and verify control sequence default.

Test HVAC Systems Sequences of Operation: Through the user interface very control of HVAC systems as follows:

Scheduled on/off and occupied/unoccupied control. Verify that input includes start/stop times and days for specified equipment. As applicable, verify that input includes occupied/unoccupied times and days. Verify input for time delays of specified equipment. Check holiday/vacation effect. Log operations for at least three days to confirm that systems and components start and stop in accordance with defined schedules.

Optimum start-stop control. Verify that the required input includes space temperature, outdoor temperature, occupied time and days of the week, and the response time of the air handling equipment, on an individual system by system basis. For each air handler, log space temperature for at least three days to confirm that space is at required temperature by the start of the occupied period.

Occupied-Unoccupied control. Confirm that required input data is provided. To test control, change the setback time from occupied to unoccupied time and confirm that HVAC systems respond to the setback mode. If system is an air-handling system, the outside air damper should close and the fan should cycle to maintain the setback temperature setpoint.

Change the setback temperature setpoint to 5°F higher than the actual space temperature. The system should operate to increase the space temperature to the new setpoint condition. For air-handlers, the outside air damper should remain closed.

## OWNER INSTRUCTION AND TRAINING

General: The Contractor is responsible for instructing Owner's personnel, including the following:

Instruction in the operation of HVAC systems, subsystems, and equipment via new DDC system

Training in operation, maintenance, and trouble-shooting of new DDC system.

Program Structure: Develop an instruction and training program that includes both classroom instruction and "hands-on" demonstrations.

Training Modules: Develop a learning objective and teaching outline for each instruction and training module, taking into consideration the level of proficiency of Owner's maintenance staff. Include a description of specific skills and knowledge that each participant is expected to master.

**Exception:** Training is required to be accomplished onsite. However, at the option of NHCS, some of or all the training required below may be accomplished for selected NHCS personnel at the DDC system vendor's offsite training facility. The cost for offsite training shall be the responsibility of NHCS.

For each instruction and training module, include instruction for the following, as applicable to the system, subsystem, equipment, or component:

Documentation: Review the following items in detail:

Operations manuals.

Maintenance manuals.

Project record documents.

Warranties, bonds, and guarantees.

Maintenance service agreements and similar continuing commitments.

Emergencies: Include the following, as applicable:

Instructions on meaning of warnings, trouble indications, and error messages.

Shutdown instructions for each type of emergency.

Operating instructions for conditions outside of normal operating limits.

Sequences for DDC system.

Special operating instructions and procedures.

Operations: Include the following, as applicable:

Start-up procedures.

Equipment or system break-in procedures.

Routine and normal operating instructions.

Regulation and control procedures.

Control sequences:

Safety procedures.

Normal start-up and shutdown instructions.

Operating procedures for emergencies.

Operating procedures for system, subsystem, or equipment failure.

Required sequences for electric or electronic control systems.

Special operating instructions and procedures.

Adjustments: Include the following:

Alignments.

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Routine adjustments, tightening, etc.

Noise and vibration adjustments.

Economy and efficiency adjustments.

Maintenance and Repairs: Demonstrate the following:

Inspection procedures.

Troubleshooting and diagnostic instructions.

Test and inspection procedures.

Repair instructions.

Disassembly; component removal, repair, and replacement; and reassembly instructions.

Review of spare parts needed for operation and maintenance.

Training Execution:

Owner will furnish an instructor to describe Owner's operational philosophy.

Owner will furnish Contractor with names and positions of participants to attend instruction and training, not to exceed 10 individuals.

Provide instruction at mutually agreed on times scheduled at least four (4) weeks in advance through the A/E. For systems, subsystem, and/or equipment that requires seasonal operation, provide required instruction at start of each season.

Conduct training on-site in the completed and fully operational facility in classroom/conference space provided by the Owner and using the actual systems, subsystems, and equipment installed.

Conduct training using final operation and maintenance data submittals as the training reference material. If additional training materials are utilized, they shall be incorporated as an appendix to the operation and maintenance data submittals.

Provide documentation that Owner instruction and training has taken place. Provide record of dates, topics, and duration of each training session, the names of Owner's staff who participated, and a signed review form by each participant.

END OF SECTION 230923

SECTION 230924 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC: ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLS

PART 1 - GENERAL

1.1 SCOPE

This section addresses the specific requirements for original equipment manufacturer (OEM) controllers that must interface with a facility direct digital control (DDC) system.

1.2 REFERENCE STANDARDS

FCC Part 15, Subpart J, Class A - *Digital Electronic Equipment to Radio Communication Interference*

ANSI/ASHRAE Standard 135-2012 *BACnet - A Data Communication Protocol for Building Automation and Control Networks*

1.3 SUBMITTALS

- A. General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not **comply fully** with each and every requirement of the Specifications, the submittal shall clearly indicate such deviations.
- B. Manufacturer's Data: Submit manufacturer's technical product data and installation instructions for all components including the following to demonstrate compliance with the Contract Documents.
- C. Operation and Maintenance (O/M) Manuals: See Section 23 09 23 for requirements.
- D. Data Communications Protocol Certificates: Certify that each proposed OEM controllers/gateways comply with ASHRAE Standard 135-2012 **and are BACnet Laboratory tested and certified.**
- E. Protocol Implementation Conformance Statement (PICS) for each OEM controller/gateway

PART 2 - PRODUCTS

2.1 OEM SUPPLIED CONTROLS

General: *OEM furnished, factory-installed unit controls that are required to interface with a facility DDC system, including final control elements, shall meet the requirements of Section 230913, Section 230923, and the control I/O points and sequence(s) of operation shown on the Drawings. Unit controls shall interface seamlessly with the DDC system specified in Sections 230913 and 230923.*

Native BACnet Unit Controllers: Controllers shall use ANSI/ASHRAE Standard 135-2012 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol. Comply with ANSI/ASHRAE Standard 135-2012 for all hardware and software. Controllers shall be fully user-programmable and shall comply with the requirements for "Control Units" specified in Section 230923. *"Application specific controllers" (ASCs) utilizing firmware logic are prohibited.*

Gateways: Where native BACnet controllers are not available, BACnet compatible gateways may be used as reviewed and approved by the A/E. Gateways shall include BACnet and workstation display information; bi-directional communication ability; compliance with I/O schematics and operating sequences indicated on the Drawings; expansion capacity; handling of alarms, events, scheduling and trend data; and single device capability (not depending on multiple devices for exchanging information from either side of the gateway). Gateways shall have the following capabilities for interfacing between a non-BACnet equipment controller/network and the BACnet network of the facility DDC system:

- A. Gateways shall be able to read and view all readable object properties of all indicated points/objects on the non-BACnet network to the BACnet network and vice versa, as applicable.
- B. Gateways shall be able to write to all writeable object properties of all indicated points/objects on the non-BACnet network from the BACnet network and vice versa, as applicable.
- C. Gateways shall provide single-pass translation from the non-BACnet protocol to BACnet and vice versa (only one protocol to BACnet and back without intermediary protocols and translations).
- D. Gateways shall meet the requirements of Data Sharing Read Property (DS-RP-B), Data Sharing Write Property (DS-WP-B), Device Management Dynamic Device Binding-B (DM-DDB-B), and Device Management Communication Control (DM-DCC-B) BACnet Interoperability Building Blocks (BIBBs).
- E. Gateways shall include all hardware, software, software licenses, and configuration tools for operator-to-gateway communications. Provide backup programming and parameters on electronic storage media and the ability to modify, download, backup, and restore gateway configuration.

***OEM UNIT CONTROLLERS OR GATEWAYS THAT DO NOT COMPLY WITH AND SUPPORT THE I/O POINTS AND SEQUENCES OF OPERATION INDICATED ON THE DRAWINGS AND/OR SPECIFIED IN SECTION 230923 ARE UNACCEPTABLE AND, CONSEQUENTLY, THE ASSOCIATED HVAC EQUIPMENT COMPONENT IS UNACCEPTABLE.***

## 2.2 COORDINATION

The OEM shall be responsible for coordination between the DDC system sub-contractor and OEM unit controls provided to ensure that required control interface is implemented, resulting in full interoperability between OEM unit controls and the DDC system.

***THE OEM SHALL PROVIDE TWO-YEAR EXTENDED WARRANTY FOR EACH CONTROLLER/ GATEWAY, INCLUDING PROGRAMMING, PARTS, AND LABOR.***

## 2.3 NETWORKING/COMMUNICATIONS

Provide communication port(s) on OEM supplied controllers/gateways for single point connection to the DDC system. OEM supplied controllers/gateways shall utilize BACnet MS/TP; ***no other***

*communications protocol is acceptable.*

For each OEM supplied controller/gateway, provide a Protocol Implementation Conformance Statement (PICS), including a listing of BACnet Interoperability Building Blocks (BIBBs) utilized. The PICS shall be a written document, created by the OEM, that identifies the particular objects and options specified by BACnet that are implemented in the OEM controller/gateway, utilizing the ANSI/ASHRAE Standard 135 format included in Appendix 230924 at the end of this Section. *Minimum required compliance is Level 3, with the ability to support data read and write functionality.*

- A. At a minimum, all OEM controllers/gateways shall support the following:

Segmentation Capability:

Segmentation requests supported

Segmentation responses supported

Standard Object Types Supported, Minimum:

Accumulator  
Analog input  
Analog output  
Analog value  
Binary input  
Binary output  
Binary value  
Calendar  
Command  
Device  
Event enrolment  
Group  
Multistate input  
Multistate output  
Multistate value  
Notification class  
Schedule  
Trend Log

Character Sets supported:

ISO 10646 Universal Character Set-2

- B. Each OEM controller/gateway shall operate as a stand-alone device capable of performing its specified control responsibilities independently of other controllers in the network. Each OEM controller/gateway shall be a microprocessor based, multi-tasking, real-time digital control processor.

- C. Each OEM controller/gateway shall have sufficient memory to support its own operating system and databases including:

Control Processes

Energy Management Applications

Operator I/O (Portable Service Terminal)

- D. Provide the necessary software, loaded onto one or more laptop computers provided by the Owner, along with necessary connection cable(s), to allow direct connection to the OEM supplied controller/gateway. The capabilities of the software shall include, but not be limited to, the following:

Display status

Display setpoints

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- Display control parameters
- Override binary output control
- Override analog output control
- Override and adjust analog setpoints
- Modification of tuning and offset calibration constants

All OEM controller/gateway setpoints, proportional bands, control algorithms, calibration constants, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming.

### PART 3 - EXECUTION

#### 3.1 GENERAL

OEM controllers/gateways shall be installed, wired, configured, tested, etc. in accordance with the requirements of Part 3, Section 230923.

#### 3.2 OWNER INSTRUCTION AND TRAINING

Provide Owner instruction and training.

END OF SECTION 230924

APPENDIX 230924

PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT

Project Name: \_\_\_\_\_

Project Number: \_\_\_\_\_

Vendor/Supplier: \_\_\_\_\_

Equipment Designation and Description:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

BACnet Standardized Device Profile (Annex L):

- BACnet Building Controller (B-BC)
- BACnet Advanced Application Controller (B-AAC)
- BACnet Application Specific Controller (B-ASC)
- BACnet Smart Sensor (B-SS)
- BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Blocks (BIBBs) Supported (Annex K):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Segmentation Capability:

- Able to transmit segmented messages Window Size \_\_\_\_\_
- Able to receive segmented messages Window Size \_\_\_\_\_

Standard Object Types Supported (Point Mapping):

An object type is supported if it may be present in the device. For each standard Object Type supported provide the following data:

Whether objects of this type are dynamically creatable using the CreateObject service

Whether objects of this type are dynamically deletable using the DeleteObject service

List of the optional properties supported

List of all properties that are writable where not otherwise required by this standard

List of all properties that are conditionally writable where not otherwise required by this standard

List of proprietary properties and for each its property identifier, datatype, and meaning

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List of any property range restrictions

Data Link Layer Options:

- BACnet IP, (Annex J)
- BACnet IP, (Annex J), Foreign Device
- ISO 8802-3, Ethernet (Clause 7)
- ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
- ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s) \_\_\_\_\_
- MS/TP master (Clause 9), baud rate(s): \_\_\_\_\_
- MS/TP slave (Clause 9), baud rate(s): \_\_\_\_\_
- Point-To-Point, EIA 232 (Clause 10), baud rate(s): \_\_\_\_\_
- Point-To-Point, modem, (Clause 10), baud rate(s): \_\_\_\_\_
- LonTalk, (Clause 11), medium: \_\_\_\_\_
- BACnet/ZigBee (ANNEX O)
- Other: \_\_\_\_\_

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.)

- Yes     No

Networking Options:

- Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
- Annex H, BACnet Tunneling Router over IP
- BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices?

- Yes     No

Does the BBMD support network address translation?

- Yes     No

Network Security Options:

- Non-secure Device - is capable of operating without BACnet Network security
- Secure Device - is capable of using BACnet Network Security (NS-SD BIBB)
  - Multiple Application-Specific Keys:
  - Supports encryption (NS-ED BIBB)
  - Key Server (NS-KS BIBB)

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

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- |  |   |                                     |
|--|---|-------------------------------------|
| <input type="checkbox"/> ISO 10646 (UTF-8) | <input type="checkbox"/> IBM™/Microsoft™ DBCS | <input type="checkbox"/> ISO 8859-1 |
| <input type="checkbox"/> ISO 10646 (UCS-2) | <input type="checkbox"/> ISO 10646 (UCS-4)    | <input type="checkbox"/> JIS X 0208 |

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

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END OF APPENDIX 230924

# Request for Substitution



133 Southcenter Ct., Suite 1000  
Morrisville, NC 27560  
Tel 919.789.9750



**Substitution Request Date:** May 1, 2019  
**Current Project Bid Date:** May 21, 2019  
**Project Name:** Sweeney Water Treatment Plant Boiler Replacement  
**Mechanical Engineer:** CBHF Engineers, PLLC  
**Specification Section:** Hydronic Pumps  
**Specification Number:** 232123  
**Proposed Substitution:** Add PATTERSON as an approved manufacturer.

Attached data includes product description, specifications, drawings, photographs, performance, and test data adequate for evaluation of request. Applicable data is clearly identified. If applicable, attached data also includes description of changes to Contract Documents the proposed substitution requires for is proper installation.

**Undersigned certifies the following items, unless modified by attachments, are correct:**

1. Proposed substitution does not affect dimensions shown on drawings.
2. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
3. Maintenance and service parts are available locally or are readily obtainable for proposed substitution.

**Undersigned agrees the terms and conditions for substitutions found in Bidding Documents apply to this proposed substitution.**

**Submitted by:** Crystal Twiss | Project Engineer | [ctwiss@insightusa.com](mailto:ctwiss@insightusa.com) | 919.376.6902

**Pump Data Sheet - Patterson HVAC Pumps**

Company: Sweeney WTP Boiler  
 Name:  
 Date: 04/25/2019

HWP01 & HWP02



**Pump:**

Model: V2C7A-CC Dimensions: Suction: 2 in  
 Type: VIL Discharge: 2 in  
 Synch Speed: 1800 rpm  
 Dia: 6.875 in  
 Size: 2x2x7.5  
 Impeller: D05-89879  
 Specific Speeds: Ns: 1060  
 Nss: 2027

**Fluid:**

Name: Water  
 SG: 1 Vapor Pressure: 0.256 psi a  
 Density: 62.4 lb/ft<sup>3</sup> Atm Pressure: 14.7 psi a  
 Viscosity: 1.1 cP  
 Temperature: 60 °F

**Search Criteria:**

Flow: 120 US gpm Near Miss: ---  
 Head: 41 ft Static Head: 0 ft

**Pump Limits:**

Temperature: --- Sphere Size: ---  
 Wkg Pressure: ---

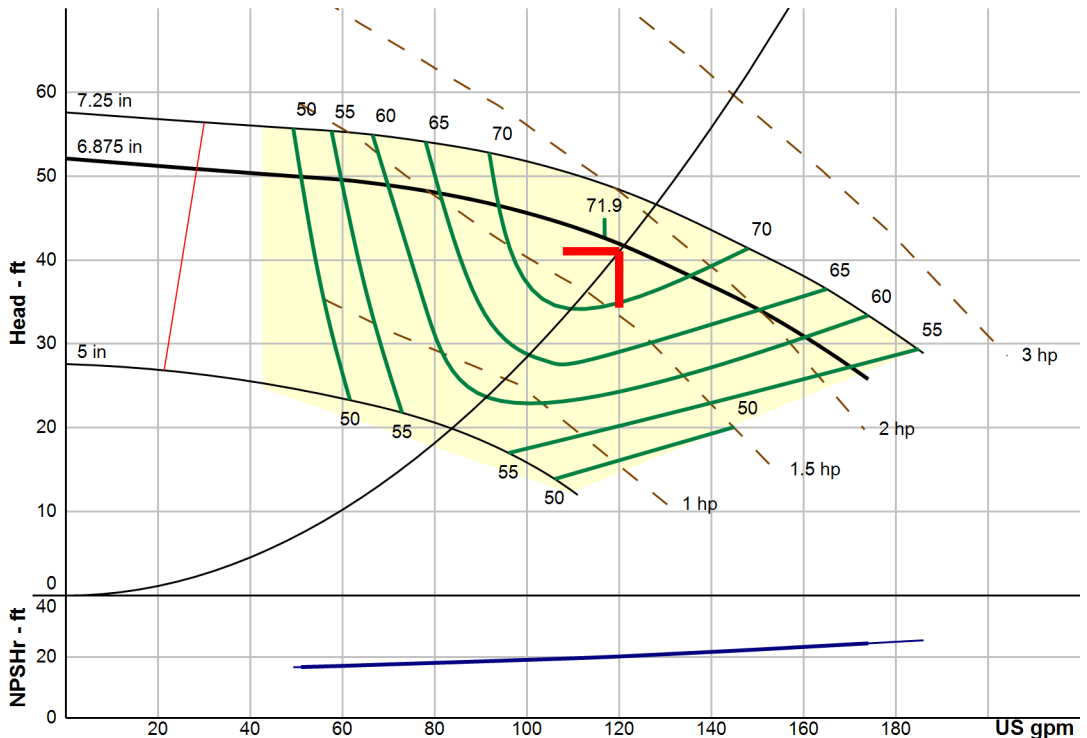
**Motor:**

Standard: NEMA Size: 3 hp  
 Enclosure: ODP Speed: 1800 rpm  
 Frame: See Chart  
 Sizing Criteria: Max Power on Design Curve

**Pump Selection Warnings:**

None

--- Duty Point ---	
Flow:	121 US gpm
Head:	41.6 ft
Eff:	71.5%
Power:	1.77 hp
NPSHr:	20.2 ft
Speed:	1750 rpm
--- Design Curve ---	
Shutoff Head:	52.1 ft
Shutoff dP:	22.6 psi
Min Flow:	29.2 US gpm
BEP:	71.9% @ 117 US gpm
NOL Power:	
	2.19 hp @ 174 US gpm
--- Max Curve ---	
Max Power:	
	2.51 hp @ 186 US gpm



Refer to Working Pressure vs. Temperature chart for maximum rated working pressure. All data are subject to change. Consult factory for certified data.

**Performance Evaluation:**

Flow	Speed	Head	Efficiency	Power	NPSHr
US gpm	rpm	ft	%	hp	ft
144	1750	35.8	67.1	1.94	21.9
120	1750	41.9	71.6	1.77	20.1
96	1750	46.1	70.2	1.59	18.8
72	1750	48.7	61	1.45	17.6
48	1750	50.1	48.3	1.26	16.7

# Vertical In-line HVAC Pumps



## Close-Coupled Configuration

Patterson EnviroFlo™ vertical in-line HVAC pumps, with a legacy of quality and durability, offer reliability and full flexibility to serve all applications and overcome constraints.

### BENEFITS

- High-efficiency design minimizes energy consumption
- Back pullout configuration for easy access and maintenance
- Gauge taps at the suction and discharge connections for complete monitoring flexibility
- Annular pressure reducing clearance with impeller balance holes to reduce axial thrust
- Precision-cast, dynamically balanced impeller minimizes vibration and maximizes bearing life
- Precision bearings and machining limit shaft deflection to only 0.002" at the seal face

### FEATURES

- Flows to 2,500 GPM, heads to 400' TDH
- Split coupling design above 5 HP optional
- Double suction impeller on largest sizes (12" and 14")
- Machined mounting support surface
- Standard case wear ring
- Grease-lubricated motor bearing
- Mechanical seal is standard in carbon vs. silicon carbide (optional: tungsten carbide) with seal flush lines
- Every pump hydrostatically pressure-tested
- Optional 250-lb discharge flanges and external seal flush lines available on many models
- Bronze fitted construction with bronze shaft sleeves standard; optional stainless steel shaft and stainless steel sleeve available



**ENVIROFLO**  
HYDRONIC PUMPING SOLUTIONS

Pumping Technology for Tomorrow's World  
**Patterson**

## SPECIFICATIONS: CLOSE-COUPLED

Pumps shall be high efficiency vertical in-line close-coupled design. The pumps shall be of the pullout design, single stage, and capable of being serviced without disturbing piping connections.

The pump volute case shall be class 30 cast iron. The pumps shall have case wear rings. The pumps shall be rated for a minimum of 175 psi working pressure (optional: 250 psi, many models). Casing shall have tapped holes on the suction and discharge to accommodate gauges, fittings, and drain ports.

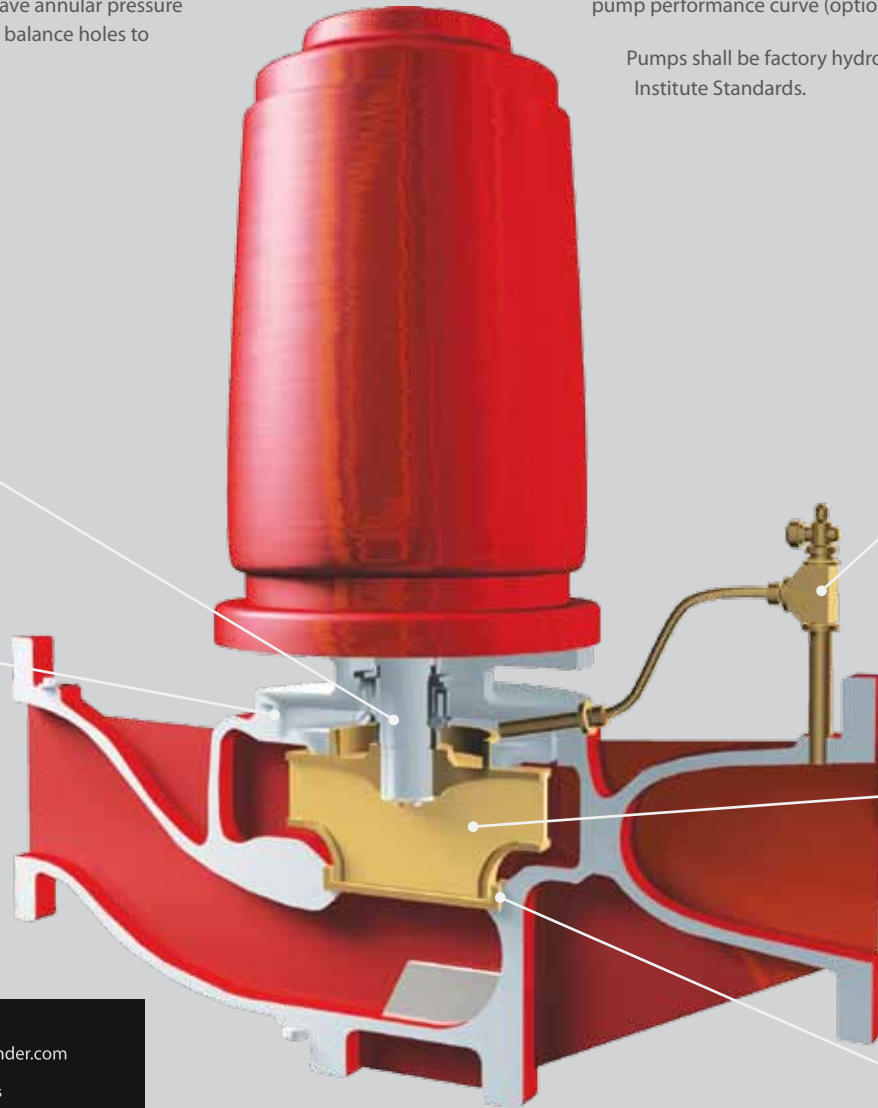
Impellers shall be precision-cast and dynamically balanced and shall be of the enclosed type, non-leaking brass and keyed to the shaft. The impellers shall have annular pressure reducing clearance with impeller balance holes to reduce axial thrust.

Pumps shall be designed for a maximum shaft deflection of 0.002" at the seal face.

The pumps shall have a replaceable bronze or stainless steel shaft sleeve and shall cover the liquid area under the seal. The pump shall have a mechanical seal type carbon vs. silicon carbide with seal water flush line (optional: tungsten carbide).

Motors shall be EPAC/Nema rated and shall be of the size, voltage, and enclosure (ODP/TEFC) as outlined in the plans and specifications. The motor shall be non-overloading throughout the entirety of the pump performance curve (optional: premium efficiency).

Pumps shall be factory hydrostatically tested per Hydraulic Institute Standards.



Designed for maximum shaft deflection of 0.002" at the seal face

External seal flush line

Registered fits at the volute cover maintain pump alignment

Precision-cast, dynamically balanced impeller

Casing rings provided to protect casing from wear

### Size One!

Log on to [www.pattersonpumpfinder.com](http://www.pattersonpumpfinder.com)

- View dynamic curves
- Generate system resistance curves
- Download data sheets
- Submit RFQs

*Registration required; free 21-day trial.*

**PATTERSON PUMP COMPANY**  
 A Gorman-Rupp Company  
 Post Office Box 790 • Toccoa, Georgia 30577  
 (706) 886-2101  
 E-mail: [marketing@pattersonpumps.com](mailto:marketing@pattersonpumps.com)  
[www.envirofloppumps.com](http://www.envirofloppumps.com)

Pumping Technology for Tomorrow's World  
**Patterson**<sup>®</sup>

# PATTERSON PUMP COMPANY

## SECTION 23\_\_\_\_\_ - HYDRONIC PUMPS- Vertical In Line Pump

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division \_\_\_ Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Rigidly coupled, vertical in-line centrifugal pumps.
  - 2. Closed coupled, vertical in line centrifugal pumps.

#### 1.3 DEFINITIONS

- A. CSC: Carbon vs. Silicon Carbide
- B. STC: Solid Tungsten Carbide

#### 1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves. Pump shall be non-overloading thru out the operating curve.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated Refer to Division \_\_\_ Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D- Pump Manufacture shall be ISO certified and Six Sigma rated .

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion solution after assembly and testing. Protect flanges, pipe openings, and nozzles with plastic cover over entire pump.
- B. Store pumps in dry location. Rotate Motor & Impeller routinely for long storage periods.
- C. Retain protective covers for flanges and protective wood crate and plastic wrap during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

#### 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division \_\_\_.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Mechanical Seals: One mechanical seal and volute gasket for each pump.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

# PATTERSON PUMP COMPANY

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
- 2, Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 CLOSED COUPLED, Vertical, IN-LINE CENTRIFUGAL PUMPS

### A. Manufacturers:

1. Patterson Pump Company
2. Bell & Gossett; Div. of ITT Industries.
3. Armstrong Pumps Inc.
4. Aurora Pumps.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close coupled, in-line pump as defined in Hi 1.1-1.2 and Hi 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 170-psig maximum working pressure and a continuous water temperature of 225 deg F.

### C. Pump Construction:

1. Casing: Back Pull-Out design, cast iron, with threaded gage tappings at inlet and outlet, and flange connections. ASTM A48-CL30. Provide case wear rings per ASTM B505-932. Bottom of casing to be drilled and tapped to accommodate a pipe flange for floor supports. Provide stamped pump serial number in casing, so as to identify pump if tag is removed.
2. Impeller: ASTM B584-875, precision cast bronze; statically and dynamically balanced, and keyed to shaft with Stainless Steel Key.. Trim impeller to match specified performance. Impeller to be balanced and trimmed by the Pump Manufacture. Impeller attached to Pump motor shaft with a Stainless Steel bolt and washer.
3. Mechanical Seal: Carbon rotating ring against a Silicon Carbide seat held by a 416 stainless-steel spring, and Buna-N bellows and gasket. Copper flush seal line shall be installed from discharge of pump to seal gland.
4. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: JM Frame, Single speed, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division \_\_\_ Section "Common Motor Requirements for HVAC Equipment." Motor shall be a JM Frame Motor.

### E. Capacities and Characteristics;

1. Refer to schedule on drawings.

## 2.3 RIGIDLY COUPLED, VERTICAL IN-LINE CENTRIFUGAL PUMPS

### A. Manufacturers:

1. Patterson Pump Company
2. Bell & Gossett; Div. of ITT Industries.
3. Armstrong Pumps Inc.
4. Aurora Pumps.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in Hi 1.1-1.2 and Hi 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 170-psig maximum working pressure and a continuous water temperature of 225 deg F.

### C. Pump Construction:

1. Casing: Back Pull-out design, cast iron, with threaded gage tapings at inlet and outlet, drain plug at bottom, flanged connections. ASTM A48-CL30. Bottom of casing to be drilled and tapped to accommodate a pipe flange for floor supports. Provide stamped pump serial number in casing, so as to identify pump if tag is removed.
2. Impeller: ASTM B584-875, precision cast bronze; statically and dynamically balanced, keyed to shaft, secured with a locking stainless steel cap screw. Trim impeller to match specified performance. Impeller to be balanced and trimmed by the Pump Manufacture.
3. Pump Shaft: 416 Stainless Steel, with Graph alloy GM 205.3 throttle bushing.
4. Mechanical Seal: Carbon rotating ring against a Silicon Carbide seat held by a 416 stainless-steel spring, and Buna-N bellows and gasket. Copper flush seal line shall be installed from discharge of pump to seal gland.

D. Rigid Shaft Coupling: High Tensile Aluminum, two piece design. Coupling key to be Steel-ASTM A 108-1018.

# PATTERSON PUMP COMPANY

- F. (OPTIONAL) Mounting Frame: Factory fabricated C-Channel Steel to mount pump casing to floor.
- G. Motor: VP Frame Single speed, with permanently lubricated ball bearings, unless otherwise indicated; secured to motor mounting frame, with adjustable alignment : Cast Iron ASTM A48-CL30, allowing the removal of Motor without disturbing wet end of pump. Comply with requirements in Division \_\_\_ Section "Common Motor Requirements for HVAC Equipment."
- H. Capacities and Characteristics:
  - 1. Refer to schedule on drawings.

## 2.4 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; straightening vanes; drain plug; and factory-fabricated support boss. Diffuser shall accommodate a fully opened Butterfly Valve on the vertical inlet side. Manufactured by Pump Manufacture.
- B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, Pump discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement. Manufactured by Pump Manufacture.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 (optional) SUPPORT BASES

- A. Vertical In-Line pump shall be supplied from factory with optional C-Channel Steel one piece base. Pump shall come attached to base from Pump Manufacture.
- B. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division \_\_\_ Section "Common Work Results for HVAC."
  - 1. Install anchor rods to connect concrete base to concrete floor. Unless otherwise indicated, install anchor rods on i-1inch centers around full perimeter of base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Cast-in-place concrete materials and placement requirements are specified in Division \_\_\_

### 3.3 PUMP INSTALLATION

- A. Comply with HI 14.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division \_\_\_ Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division \_\_\_ Section "Hangers and Supports for HVAC Piping and Equipment."
- E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
  - 1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting
  - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

# PATTERSON PUMP COMPANY

## 3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C- Adjust pump and motor shafts for angular and offset alignment by methods specified in Hi 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill Base plate with non shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

## 3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division \_\_\_ Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install triple-duty valve on discharge side of pumps.
- F. Install Y-Strainer or Suction Diffuser and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves with control rods.
- H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- I. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Install electrical connections for power, controls, and devices.
- K. Ground equipment according to Division \_\_\_ Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division \_\_\_ Section "Low-Voltage Electrical Power Conductors and Cables."

## 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 6. Start motor.
  - 7. Open discharge valve slowly.

## 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division \_\_\_ Section "Demonstration and Training."

END OF SECTION 23 \_\_\_\_\_

# The VFD Way To Efficient Pumping In ANY SIZE Hydronic System...

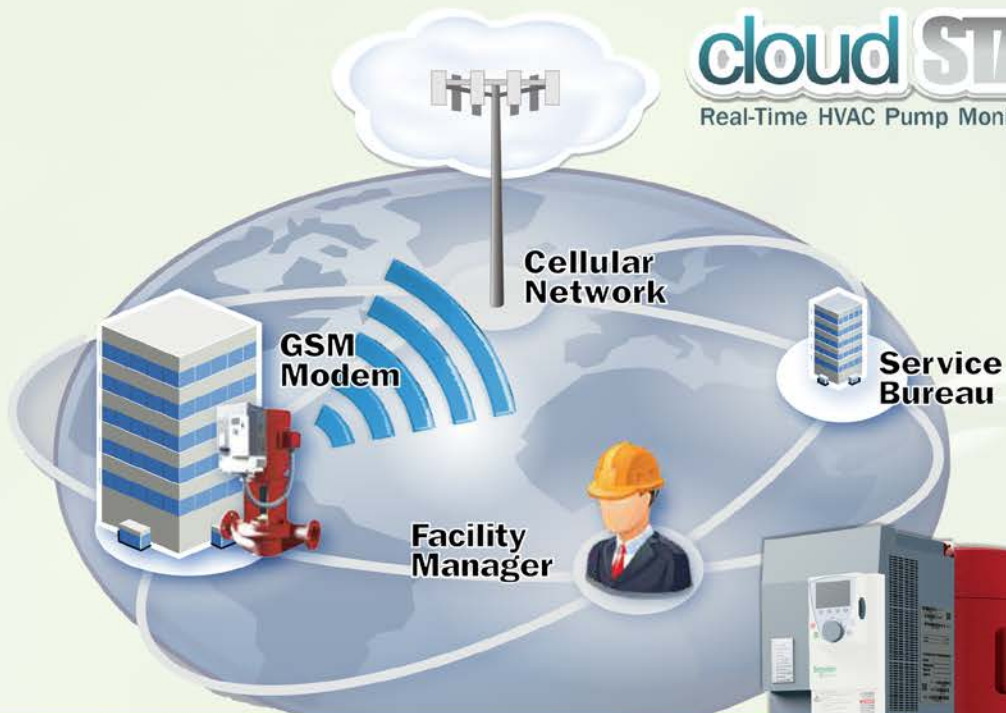
...With A Cloud's Eye View Of Status. Enjoy the advantages of Variable Frequency Drive power in sensor or sensorless Vertical In-Line (VIL) series pump configurations. Slash pumping costs by 50% with these **ASHRAE 90.1-compliant** systems.

**For larger systems with sensors.** Schneider Electric™ Altivar ATV212 and ATV61 Variable Frequency Drives (VFDs), regulating power to Patterson's VIL series HVAC pumps, eliminate the need for pressure reducing or throttling valves or inlet guide vanes. These compact drives reduce installation costs and maximize building occupant comfort with accurate flow control.

The drives offer the latest in VFD technology to help keep total harmonic distortion (THD) levels within the limits of the IEEE 519-1992. These drives are specifically designed to comply with IEC/EN 61000-3-12, which limits THDI of system components to 35%. Additionally, these drives feature resonant frequency skipping, soft starting and stopping, under-load and over-load detection and time limits for operating at minimum speed.

**For smaller systems—the sensorless option.** With no differential pressure transducers necessary, Schneider-Electric Altivar Process VFDs provide easy and space efficient installation in simple systems. In addition, they offer the highest possible performance with Patterson VIL pumps through changing load conditions:

- Operation closest to the pumps' best efficiency point (BEP)
  - New insights into pumping performance through remote communications
  - Energy drift detection in real time preventing abnormal conditions and premature equipment wear
  - Low harmonic distortion—48% THDi
  - Troubleshooting and maintenance reduced by 20%— dynamic QR code generation
- Beyond peak performance, the drive communicates all the information you need:
- Embedded Ethernet with web server and customizable dashboards protected by Achilles Level 2 cyber security
  - Embedded monitoring of pump efficiency load curves
  - Embedded power measurement at accuracy rate below 5%
  - Energy dashboards with meaningful information on consumed energy
  - Customizable alarm management system
  - Logging of all events to assist in managing predictive maintenance



With CloudStat<sup>®</sup> monitoring, supervisors can remotely monitor the outstanding efficiency and status of VIL series pumps powered by new Variable Frequency Drives.

Patterson VFD VIL HVAC Pumps are available in sensorless (left) and sensor models to accommodate the needs of any size hydronic system



**All the information for efficient pumping management.** And on the management front, Patterson CloudStat<sup>®</sup>-enabled HVAC pumps mark a true step forward. CloudStat Real-Time, Web-Based HVAC Pump Monitoring provides a browser-based, real-time view of pump status and efficiency from 500 ft or 50,000 miles. CloudStat is based on one-way cellular technology, installable without IT involvement, and there are no security risks. The system consists of a GSM modem installed in the control panel and an external antenna.

Cloud-hosted information includes:

- Cost in kW/gal of water pumped
- User-specified high and low alarm conditions: suction and discharge pressures, water volume pumped (with availability of volumetric rate signals)
- Trend lines: power cost for each pump, water consumption (with availability of flowmeter volumetric rate signals), operating pressures and total cost of operation

CloudStat allows compiling of important data for up to three years, aiding preventative maintenance. Alarms are communicated instantly by email or SMS text.



## Operational Intelligence

Applications need to run at optimum efficiency for your success. Making informed decisions, easily, at a moment's notice is foundational to this. Embedded process knowledge provided by Patterson Intuition gives you the information you need.

## Embedded Guidance

Avoid getting lost with start-up, integration of your drives and maintenance needs. New and intuitive built-in functions simplify support and diagnostics, allowing issues to be solved quickly and comprehensively.

## Reliable and Sustainable

Long operating life and reliability have been the hallmarks of Patterson Pump Company and Schneider Electric for over 30 years. The tradition continues. We are ready to help you solve your challenges.



## Operational Intelligence

### > Custom Information

- Configurable Dashboard
- Graphical Keypad
- Pump Language

### > Energy Management

- Motor Power Measurement
- Energy Dashboards
- Export Energy Data

### > Embedded Ethernet and Web Server

- Local or Remote Access
- Achilles Level 2 Security
- Web server on any device using HTML5

### > Process Monitoring & Control

- Operating Data Feedback
- Compare to Expected Values
- Predictive Maintenance
- Stop & Go
- Real time clock
- Sensor-less control (including multi-pump)
- Multi-Pump control (up to 6 pumps)

## Reliable and Sustainable

- Digital Inputs
- Analog Inputs
- Relays
- Analog Outputs
- Conformal coating
- 50 degree C rating

## Embedded Guidance

### > Startup

- Pump specific functions
- Simply Start
- QR Code access to product information and technical support

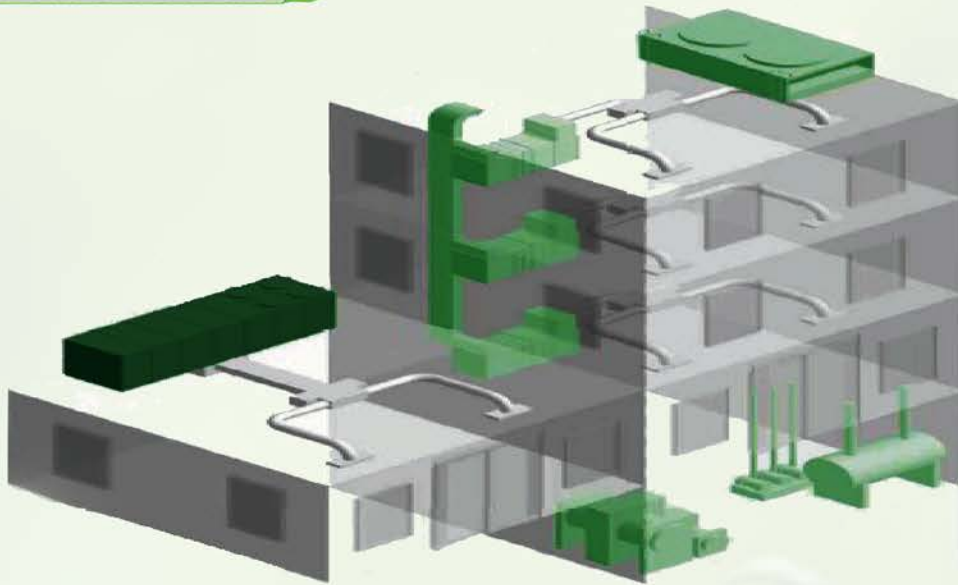
### > Integration

- PlantStruxure Optimized
- FDT / DTM Ready
- Industry Standard Communications

### > Maintenance Excellence

- Dynamic QR code assistance
- Troubleshooting Messages
- Fast Device Replacement





## Applications

- Booster Pumps
- Hot Water Pumps
- Chilled Water Pumps
- Condenser Water Pumps

*Patterson intuition variable speed drives have over 30 functions dedicated for pumping applications.*

## Pump Functions

- Anti-Jam
- Flow Limitation
- Friction Loss Compensation (ASRAE 90.1-2010)
- Input Pump Curve Values
- Multi-Pump Control (Up to 6 Pumps)
- PID Monitoring Feedback
- PID Regulator
- Pipe Fill
- Pump Monitoring
- Pump Priming Control
- Sensorless Flow Estimation & Control
- Sleep / Wake Up

Voltage	Power Range	Standard Enclosure Offer
200 – 240 VAC	1 – 100 HP	Type 1: 1 – 100 HP Type 12: 1 – 60 HP Type 3R: 1 – 60 HP
400 – 480 VAC	1 – 900 HP	Type 1: 1 – 900 HP Type 12: 1 – 900 HP Type 3R: 1 – 125 HP

## Pump Protection

- Dry Run
- High Flow
- Inlet/ Outlet Pressure
- Low Pressure
- No or Low Flow
- Process Overload Detection
- Process Under-load Detection
- Pump Cavitation
- Pump Cyclic Start



## Options to Create the Right Solution

- Remote keypad mounting
- I/O extension cards
- Heatsink mounting kits
- Communication options: Ethernet IP/ Modbus TCP dual port, Profibus, ProfiNet, DeviceNet, CanOpen, Bacnet
- Incoming and outgoing power options

## VFD Specifications

Drive Model:	Sensor Systems	Sensorless Systems
	ATV212	ATV Process
Voltage Ratings	3-Ø, 200–240 V 3-Ø, 380–480 V	1-Ø, (future) 3-Ø, 200–240 V 3-Ø, 380–480 V 3-Ø, 500–690 V
Horsepower Range	1–40 HP, 200 V/240 V 1–100 HP, 380 V/480 V	1–60 HP, 200 V/240 V 1–1000 HP, 380 V/480 V 2–1500 HP, 500 V/690 V
Enclosure Ratings	NEMA 1 (Std.) NEMA 12 (Opt. @ 480 V)	NEMA 1 (Std.) NEMA 12 (Opt.) NEMA 3R (Opt. <150hp)
Ambient Temperature Ratings, °C	40 (No Derate) Up to 60 (With Derate)	40 (No Derate) Up to 60 (With Derate)
Elevation Rating, Ft Above Sea Level	Up to 3300 (No Derate) 1% Derate For Each Additional 330 Ft Up To 6600 Ft	Up to 3300 (No Derate) 1% Derate For Each Additional 330 Ft Up To 15,800 Ft
Available Built In Disconnect	No	Yes
Communication (Integrated)	Modbus, Apogee P1, BACnet, Metasys® N2	Modbus Serial, Modbus TPC
Communication (Opt.)	LonWorks	Modbus TPC & Ethernet I/P dual port, CANopen, ProfiNet, Profibus DP V1, DeviceNet
Multi-Pump Control	No	Yes
Sensorless Control	No	Yes
Number of Functions	50	> 150
<b>Number of I/Os</b>		
Analog Inputs	2	3–5
Analog Outputs	1	2
Logic Inputs	3	6–12
Logic/Relay Outputs	2 — 1 N.O./N.C. & 1 N.O. Relay	2 DO, 2 STO, 3 — 6 N.O./N.C. Relay



*ATV Process display with embedded dynamic QR codes for contextual, instantaneous access to online help using a smartphone or tablet.*

*ATV Process terminal showing dynamic pump operation in relation to its optimum operation.*





## Warranty

Patterson Pump Company and Divisions of Patterson Pump Company ("Patterson") warrants, to the extent hereinafter set forth, each new piece of Patterson equipment to be free from defects in material and workmanship under the normal use and service for which it was intended if, and only if, it has been properly installed and operated.

Patterson's obligation under the warranty is limited to replacing or repairing, free of charge, F.O.B. point of manufacture, any defective part or parts of the equipment that were manufactured by Patterson and which are returned to Patterson at Toccoa, Georgia, provided that such part or parts are received at the Patterson factory not later than twelve (12) months after installation or eighteen (18) months after shipment whichever occurs first.

As to a part or parts such as engines, motors and accessories which are furnished by Patterson, but not manufactured by it, same will carry only the warranty of the manufacturer of such part or parts, and this shall be the limit of Patterson's liability with respect to such part or parts. Mechanical seals provided on commercial products (HVAC & Plumbing) are not covered by this warranty.

Purchaser must notify Patterson by registered or certified mail, return receipt requested, of a claimed breach of warranty within thirty (30) days after discovery thereof, but not later than the termination of the guarantee period hereinabove provided; otherwise, such claim shall be deemed waived.

Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other equipment or machinery.

This warranty shall not apply to any Patterson Equipment, or parts thereof, which have been repaired or altered without Patterson's written consent, outside Patterson's factory, or which have been altered in any way so as in the judgement of Patterson, to affect adversely the performance or reliability of the Patterson equipment, or which have been subject to misuse, negligence or accident, or which have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications for such equipment.

THIS WARRANTY IS FURNISHED EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT OTHERWISE SET FORTH IN A WRITING SIGNED BY AN AUTHORIZED REPRESENTATIVE OF PATTERSON.

Patterson shall not be liable for any loss or damage resulting, directly or indirectly, from the use or loss of use of the equipment. Without limiting the generality of the foregoing, this exclusion from liability embraces the Purchaser's expenses for downtime or for making up downtime, and/or damage for which the purchaser may be liable to other persons, and/or damages to property, and/or injury to or death of any persons. Patterson neither assumes nor authorizes any person to assume for it any other liability in connection with the sale or use of the Patterson Equipment.

PATTERSON PUMP COMPANY / A Subsidiary of Gorman-Rupp  
2129 Ayersville Road  
Box 790 / Toccoa, Georgia 30577 (706) 886-2101 / FAX (706) 886-0023  
[www.pattersonpumps.com](http://www.pattersonpumps.com)

# Request for Substitution



133 Southcenter Ct., Suite 1000  
Morrisville, NC 27560  
Tel 919.789.9750

**Substitution Request Date:** May 1, 2019

**Current Project Bid Date:** May 21, 2019

**Project Name:** Sweeney Water Treatment Plant Boiler Replacement

**Mechanical Engineer:** CBHF Engineers, PLLC

**Specification Section:** Hydronic Piping Specialties

**Specification Number:** 232116

**Proposed Substitution:** Add Spirotherm as an approved manufacturer.

**APPROVED**

Attached data includes product description, specifications, drawings, photographs, performance, and test data adequate for evaluation of request. Applicable data is clearly identified. If applicable, attached data also includes description of changes to Contract Documents the proposed substitution requires for is proper installation.

**Undersigned certifies the following items, unless modified by attachments, are correct:**

1. Proposed substitution does not affect dimensions shown on drawings.
2. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
3. Maintenance and service parts are available locally or are readily obtainable for proposed substitution.

**Undersigned agrees the terms and conditions for substitutions found in Bidding Documents apply to this proposed substitution.**

**Submitted by:** Crystal Twiss | Project Engineer | [ctwiss@insightusa.com](mailto:ctwiss@insightusa.com) | 919.376.6902

### Spirovent® Dirt Air Eliminator and Dirt Separator

Job Name:
Engineer:
Contractor:
Representative:

Tag	Model	Flow	Size	Location

**Specifications:**

Shell	Steel
Vent Head	Brass
Float	Non-Ferrous
Seal	Viton
O Ring	Viton
Skim Valve	Brass
Coalescing Medium	Copper
Ball Valve	Brass
Max. Working Pressure	150 psig
Max. Operating Temperature	270°F

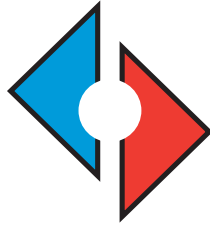
**Notes:**

PS – Pipe Size	2"	2 ½"	3"	4"	5"	6"	8"	10"	12"
D (inches)	6.3	6.3	8.6	8.6	12.8	12.8	16.0	20.0	24.0
H2 (inches)	25.3	25.3	31.4	31.4	41.7	41.7	51.8	67.5	79.7
h2 (inches)	10.4	10.4	13.6	13.6	18.9	18.9	24.2	32.1	38.2
L (inches)	10.2	10.2	14.6	14.6	---	---	---	---	---
LF (inches)	15.2	15.7	20.2	20.6	27.7	27.7	33.6	37.5	42.5
e (inches)	1	1	1	1	1	1	1	1	1
Weight NPT (lbs)	55	56	105	120	---	---	---	---	---
Weight Flg (lbs)	66	75	139	149	238	260	436	718	1250
Rec. Flow (gpm)	60	90	140	240	370	540	940	1470	2090
Model*	VDT-200	VDT-250	VDT-300	VDT-400	VDT-500	VDT-600	VDT-800	VDT-1000	VDT-1200

(Dimensions for reference only)

\*VDT xxx MT. Threaded NPT

\*VDT xxx FA: Flanged ASME Section VIII, Division 1 Stamped and Registered



**SPIROVENT® DIRT**



**AIR ELIMINATORS  
DIRT SEPARATORS  
STANDARD VELOCITY**

**SPIROTHERM**

THE ULTIMATE IN DISTRIBUTION EFFICIENCY

# AIR- AND DIRT-FREE SYSTEM WATER THROUGH A SINGLE UNIT

The life and efficiency of a heating or cooling system are greatly dependent on the quality of the system water. Air and dirt problems cause frequent breakdowns and increased customer complaints. Corrosion, cavitation, and component wear are consequences of air-saturated, dirty water.

Recurring problems and increased maintenance results in unnecessary costs and dissatisfied owners.

**There is a solution!**

A system without air and dirt is possible! There is a unique dual-purpose device that will remove air and dirt down to the smallest particle, keeping the system free from air and dirt, permanently. It requires little maintenance, and works without strainers or filters. Less maintenance, fewer costs, satisfied owners!

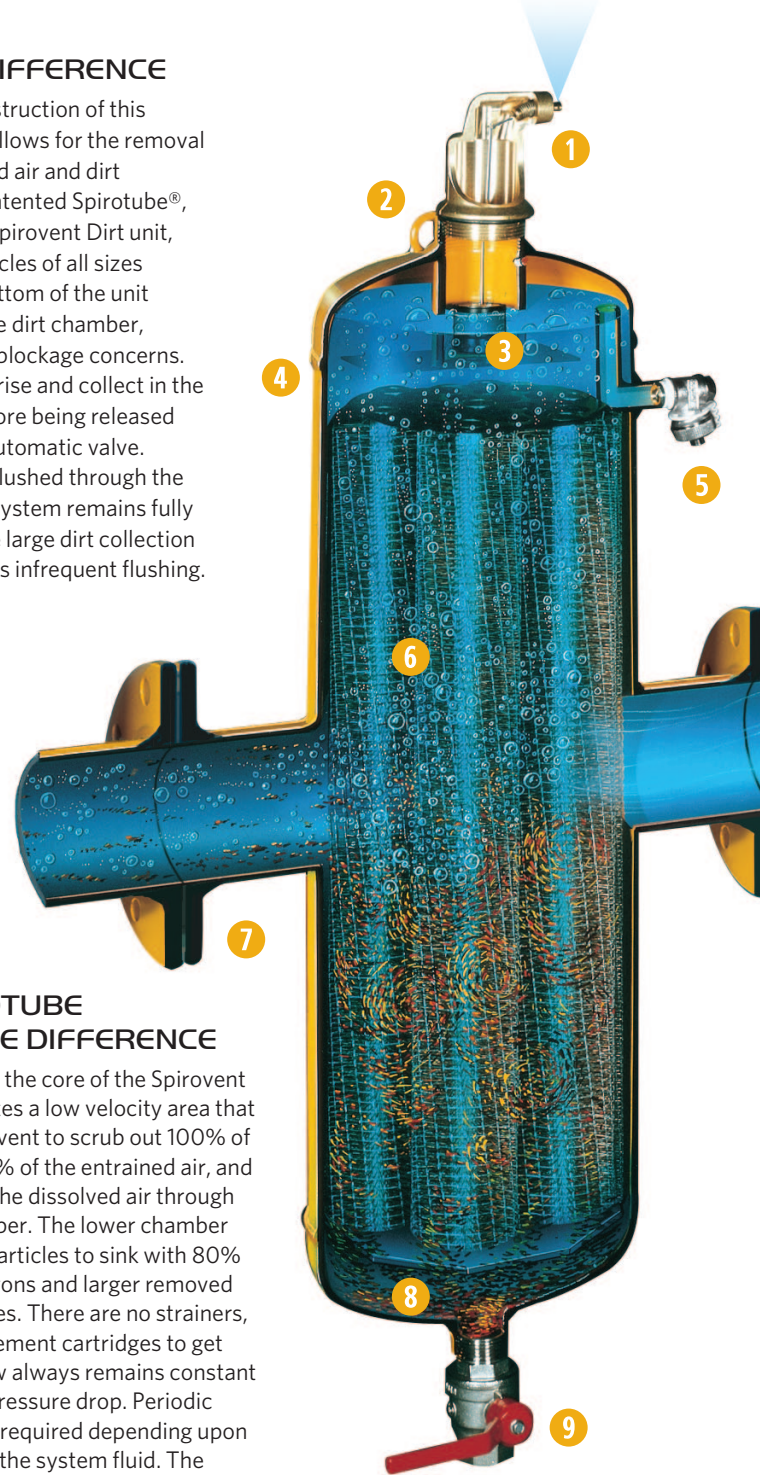
The name:

## SPIROVENT DIRT



## THE KEY DIFFERENCE

The unique construction of this combined unit allows for the removal of both entrained air and dirt particles. The patented Spirotube®, the core of the Spirovent Dirt unit, causes dirt particles of all sizes to sink to the bottom of the unit and collect in the dirt chamber, eliminating any blockage concerns. The air bubbles rise and collect in the air chamber before being released via an integral automatic valve. The dirt can be flushed through the drain while the system remains fully operational. The large dirt collection chamber ensures infrequent flushing.



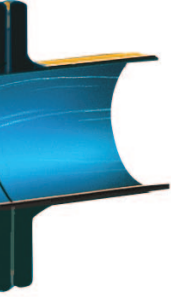
## THE SPIROTUBE MAKES THE DIFFERENCE

The Spirotube is the core of the Spirovent Dirt unit. It creates a low velocity area that allows the Spirovent to scrub out 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air through the upper chamber. The lower chamber allows the dirt particles to sink with 80% of those 30 microns and larger removed within 100 passes. There are no strainers, filters, or replacement cartridges to get clogged and flow always remains constant without a high pressure drop. Periodic blow downs are required depending upon the condition of the system fluid. The result: increased component life and heat transfer efficiency; decreased oxygen-based corrosion and pump cavitation; the elimination of air related noises such as gurgling and cascading; and the need for continual "routine" maintenance to vent, bleed, and purge.

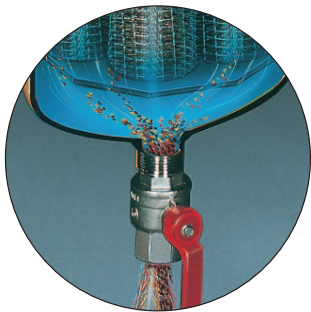


## ADVANTAGES TO THE SPECIFIER, INSTALLER AND OWNER

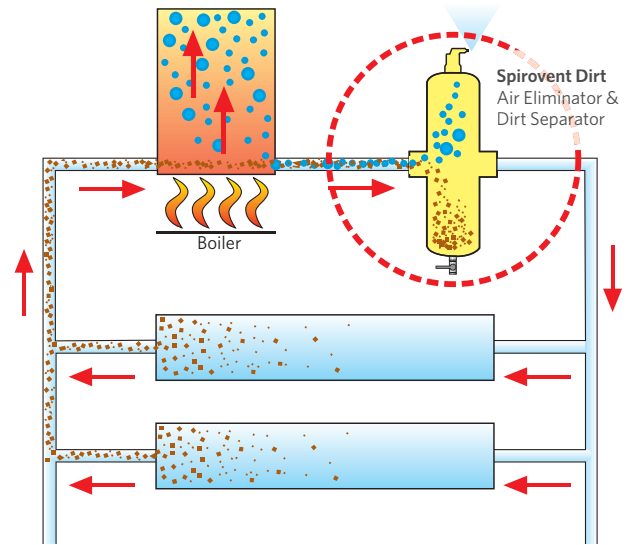
- No bypass, isolating valves or replacement filters to clog and reduce flow
- Dirt can be flushed while the system is in full operation.
- Quiet operation
- Minimum pressure drop; always constant
- Increased component life
- Reduced oxygen-based corrosion and pump cavitation
- Provides optimum heat transfer
- Optional removable head for bundle inspection



- 1 The automatic air vent is guaranteed not to leak and can only be closed by the installer for a pressure test.
- 2 Lifting eyes make installation easy.
- 3 The air chamber has been designed so that dirt cannot reach the valve.
- 4 Welded steel construction guarantees long life.
- 5 Valve for releasing large amounts of air during filling and for skimming off floating dirt.
- 6 The unique Spirotube is the core of the Spirovent. Designed to trap the smallest microbubble and microscopic dirt particle, yet it offers little resistance to flow.
- 7 Threaded or flanged connections available. Threaded 2"- 4" (not available on units with removable head) ; Flanged 2" and up.
- 8 Large capacity collection chamber reduces the need for frequent draining.
- 9 Drain valve for flushing out the dirt.



When the drain valve is opened the system pressure flushes out the collected dirt. This only takes a few seconds.

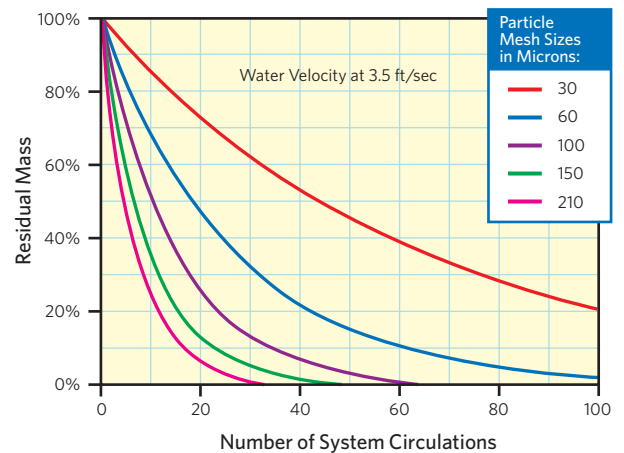


## INSTALL THE SPIROVENT DIRT FOR OPTIMUM PERFORMANCE

Ideal placement of a Spirovent unit is based on microbubble separation and Henry's Law. Simply put, Henry's Law states that air is released from water as the temperature increases or the pressure decreases\*. For this reason, the Spirovent is typically installed in the hottest point in the system. For a heating installation, this is in the supply from the boiler. In a chilled water circuit, the warmest point is in the return to the chiller.

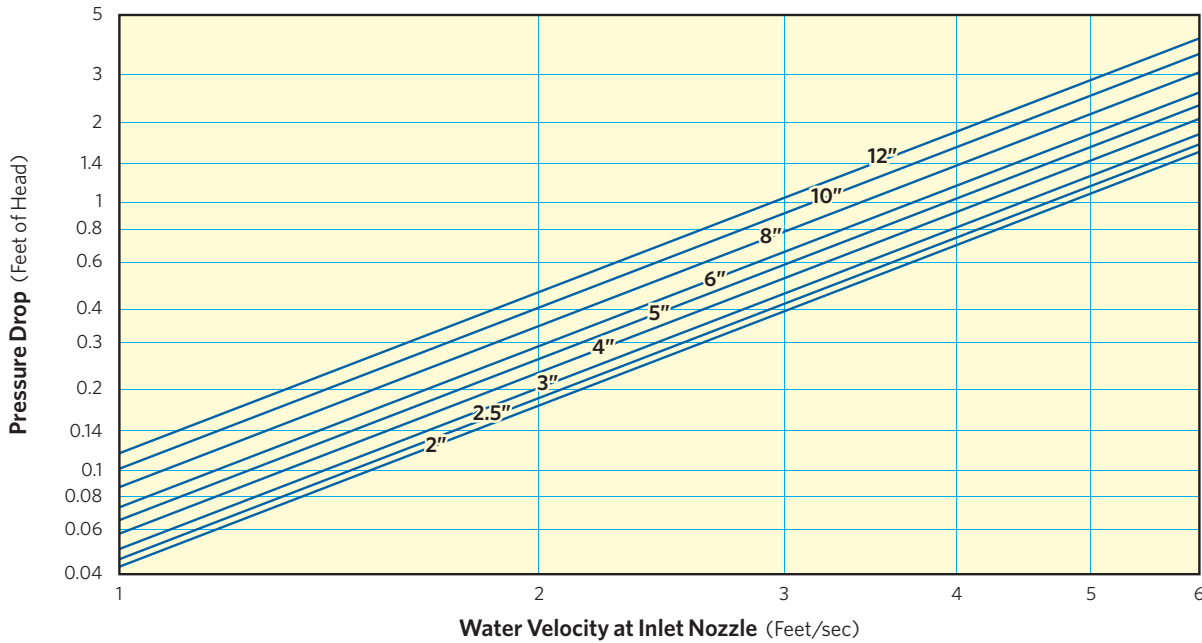
\*For more detailed technical information, ask about our Spirotism booklet.

## DIRT SEPARATION EFFICIENCY



# SPIROVENT® DIRT

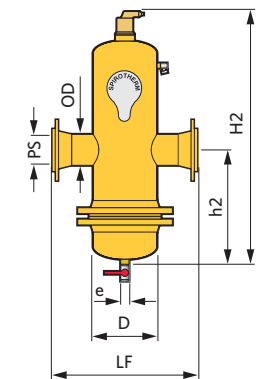
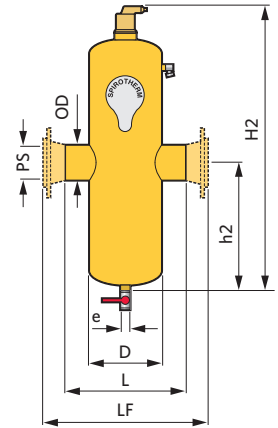
## PRESSURE DROP



## TECHNICAL SPECIFICATIONS

### SPIROVENT SENIOR

DIRT Part Number	VDT200	VDT250	VDT300	VDT400	VDT500	VDT600	VDT800	VDT1000	VDT1200	
DRAIN Part Number	VDN200	VDN250	VDN300	VDN400	VDN500	VDN600	VDN800	VDN1000	VDN1200	
Pipe Size	Inch	2	2.5	3	4	5	6	8	10	12
O.D.	Inch	2.375	3	3.5	4.5	5.5	6.625	8.625	10.75	12.75
Thread	NPT	2	2.5	3	4	—	—	—	—	—
D	Inch	6.3	6.3	8.6	8.6	12.8	12.8	16.0	20.0	24.0
H2	Inch	25.3	25.3	31.4	31.4	41.7	41.7	51.8	67.5	79.7
h2	Inch	10.4	10.4	13.6	13.6	18.9	18.9	24.2	32.1	38.2
L (Threaded)	Inch	10.2	10.2	14.6	14.6	—	—	—	—	—
LF (Flanged)	Inch	15.2	15.7	20.2	20.6	27.7	27.7	33.6	37.5	42.5
e	Inch	1	1	1	1	1	1	1	1	1
Volume	Gal.	1.8	1.8	6.6	6.6	19.8	19.8	39.6	79.3	132.1
Weight: Dirt										
Threaded	Lbs.	55	56	105	120	—	—	—	—	—
Flanged	Lbs.	66	75	139	149	238	260	436	718	1250
Weight: Drain**										
Flanged	Lbs.	107	150	202	233	325	355	686	990	1483
Recom. Flow*	GPM	60	90	140	240	370	540	940	1470	2090



\*Approximately 6 ft. per second inlet velocity.

\*\*Spirovent Drain models are available with flanged connections only and feature a removable lower head to facilitate cleaning.

All Spirovents fabricated and stamped in accordance with ASME Section VIII, Division 1 for unfired pressure vessels.

Standard rating is 150 psi at 270°F. Consult local sales office for special requirements.

Custom dimensions available for space limitations.

Refer to High Velocity models for higher flows and web site Submittal Data for models up to 36".