



BID ADDENDUM NO. 1

Boiler Upgrades AT MIDWAY ELEMENTARY AND DINWIDDIE ELEMENTARY SCHOOLS DINWIDDIE COUNTY PUBLIC SCHOOLS

**IFB # 25 – 011525
RRMM Project # 21215 - 02**

February 10, 2025

This Addendum forms a part of the Construction Documents and modifies the bid documents dated November 21, 2024 (Project Manual) November 21, 2024 (Construction Drawings).

The information in this Addendum supersedes any contradictory information or omission set forth in the Contract Documents.

Where any component of the Contract Documents is modified or deleted by this Addendum, the unaltered components of that Section, Article, or Drawing shall remain in effect.

Acknowledge receipt of this Addendum by inserting its number and date in the Proposal Form. Failure to do so may subject Bidder to disqualification.

Bid Addendum No. 1 consists of Thirty Two (32) pages comprised of this three (3) page Bid Addendum and Twenty Nine (29) pages of attachments.

CLARIFICATIONS

- 1.1 **Limitation of Bid Scope: Due to the urgent nature of work at the middle school, the scope of the issued construction documents shall be limited to ONLY the work required at the Midway Elementary and Dinwiddie Elementary Schools.**
- 1.2 **Pre-Bid Meeting (Non-Mandatory) Sign-In Sheet.** Attached for reference.
- 1.3 **Pre-Bid (Non-Mandatory) Conference Agenda.** Attached for reference.
- 1.4 Please find an attached revised specification section 230500- this should replace the section found in the project manual in its entirety.

DRAWINGS

- 1.5 No drawing changes are issued at this time

PRE-BID QUESTIONS

- 1.6 **Q: Can Smith Cast Iron be added as an acceptable alternate boiler manufacturer?**
A: Yes, Smith has been added to a revised 230500 specification included in this Addendum.
- 1.7 **Q: Manufacturers; would the owner accept a 3rd brand choice? Please consider Unilux as an equal to those specified.**
A: Unilux has been added to a revised 230500 specification included in this Addendum as an acceptable alternate manufacturer to the BOD boilers.
- 1.8 **Q: Can the CleaverBrooks FLX boiler be added to the list of acceptable alternate manufacturers/models?**
A: Yes, the requirement for a specific CleaverBrooks model has been removed from the revised 230500 specification included in this Addendum.
- 1.9 **Q: Are there liquidated damages associated with these projects?**
A: Liquidated damages are not included in the contract for these projects.
- 1.10 **Q: Will Commercial Building Permits need to be acquired by Mechanical Contractor?**
A: A building permit is not anticipated for the scope of this project, as a mechanical permit should cover all work required. Contractor shall verify permit requirements with Dinwiddie County prior to submitting bid.
- 1.11 **Q: There is no boiler piping detail in the drawings. Are we to use the hot water piping diagrams for reference?**
A: Yes, piping connections to boilers are included on the hot water piping diagrams.
- 1.12 **Q: Is there glycol present in any of these hot water systems?**
A: There is no glycol present in the hot water systems at these 3 schools.
- 1.13 **Q: Scope of Work states TAB contractor cannot be a subcontractor of the Mechanical Contractor. Will the Owner be covering this service? Please advise.**
A: This verbiage is typically intended for larger projects involving a GC. For a project of this size, it is to be assumed that a Mechanical Contractor will be functioning as the GC and that the TAB contractor will be a subcontractor of the Mechanical Contractor.
- 1.14 **Q: Valves shows Nibco, Apollo, or Milwaukee as acceptable above 2-1/2", but Line item #2 states Bray Series 30/31 "NO SUBSTITUTES". Drawing M-301 also shows Bray Series ONLY. Please clarify if there are acceptable alternate valve manufacturers.**
A: Valves by Nibco, Apollo, or Milwaukee are all acceptable. Bray Valves are only specified where butterfly valves are used for isolation purposes in lieu of gate valves. Contractor shall have option to provide gate valves for isolation by the 3 manufacturers listed above, or Bray butterfly valves for isolation purposes.
- 1.15 **Q: Requesting confirmation of materials used for Boiler Combustion Air Intake. Detail shows PVC intake for boilers, but no piping schedule is provided in Project Manual.**

A: Schedule 40 PVC shall be provided for Boiler Combustion Air Intakes based on BOD manufacturer literature, however all vent material shall comply with boiler manufacturer's requirements in the event that an alternate manufacturer is provided.

END OF BID ADDENDUM NO. 1



DINWIDDIE COUNTY
PUBLIC SCHOOLS

Dinwiddie County Public Schools
BOILER UPGRADES –
MIDWAY ES, DINWIDDIE ES & DINWIDDIE MS
 IFB # 25 – 011525

Non-Mandatory Pre-Bid Meeting: 2:30 P.M.
 01/28/2025

ATTENDEES			
Name	Organization	Phone	Email
Matthew Hawkins	DCPS	804.898.9559	mahawkins@dcpsnet.org
Jeff Walters	DCPS		jwalters@dcpsnet.org
Brenda Austin	DCPS		baustin@dcpsnet.org
Roy Stump	RRMM	804.931.4910	rstamp@rrmm.com
John (JD) Wassum	Thompson Consulting Eng	804.912.0082	jwassum@tceva.com
CARTER WALKER	ETEC MECHANICAL	804-762-2000	cwalker@ETECMECHANICAL.COM
DREW STEINER	CWC	804-399-8089	—
Charles Radford	CWC	804-894-2235	Charles.Radford@Colonialwebb.com
RONALD KUNDA	CSE	434-665-8564	RONALD.KUNDA@CSEONLINE.NET
Joe Gallagher	WPMI	804-741-4650	Joe.gallagher@WPMmechanical.com
Scott Houghtaling	HAI Boiler	804-938-3097	SCOTT@HAIBOILER.com
Ed Ponce	UBMI	870 342-3900	solutions@valljboiler.net
Antwone Ross	Retrofit Services	804 921 6090	aross@retrofit-services.com



DINWIDDIE COUNTY
PUBLIC SCHOOLS

Dinwiddie County Public Schools
BOILER UPGRADES –
MIDWAY ES, DINWIDDIE ES & DINWIDDIE MS
 IFB # 25 – 011525

Non-Mandatory Pre-Bid Meeting: 2:30 P.M.
 01/28/2025

ATTENDEES			
Name	Organization	Phone	Email
Brandon Franz	Retrofit Services	804-845-1630	ontastemail@gmail.com
Joseph Powroznik	Capitol Boiler Works LLC	571-482-0361	jpowroznik@capitolboilerworks.com
Brian Connor	Waco Inc	804-512-0407	bconnor@wacoinc.net
Anderson Barrrientes	Capitol Boiler Works Inc	571-285-6770	
Wilson Ramirez	Capitol Boiler Works	571-330-8925	
Matt Price	Cleaver Boilers	704-574-4102	matt.price@cleaver.com
Gary Williams	Power Mechanical	757-247-3000	gwilliams@powermechanical.com
Amanda Boys	JCI	(804) 213-6473	amanda.boys@jci.com



PRE-BID (NON-MANDATORY) CONFERENCE AGENDA

PROJECT NAME

DINWIDDIE COUNTY PUBLIC SCHOOLS

BOILER UPGRADES – MIDWAY ES, DINWIDDIE ES & DINWIDDIE MS

IFB # 25 – 011525

OWNER'S NAME: DINWIDDIE COUNTY SCHOOL BOARD
Dinwiddie County Public Schools
(Architect's Project No. 21215-02)

DATE: January 28, 2025

TIME: 2:30 P.M.

LOCATION: Dinwiddie Middle School, 11608 Boydton Courthouse Road, Dinwiddie, VA

I. INTRODUCTIONS

- A. The Owner: Dinwiddie County Public Schools
 - Matthew Hawkins, Director of School Facility Operations
 - Jeffrey Walters, Chief Operations Officer
 - Brenda Austin, Finance Manager, Purchasing Agent
- B. The Architect: RRMM Architects
 - Roy Stump, Construction Administration
- C. The Consultants:
 - John (JD) Wassum, Thompson Consulting Engineers

II. OVERVIEW OF PROJECT/DOCUMENTS

- A. Overview of Addendum and scope split
- B. Summary of Work

The project scope is generally described as the demolition/removal of old existing boilers and associated equipment and subsequent installation of new boilers and associated equipment as noted within the construction documents at three (3) schools; Midway Elementary School, Dinwiddie Elementary School and Dinwiddie Middle School.

1. Bid Drawings: One Volume, dated November 21, 2024.
2. Project Manual: One Volume, dated November 21, 2024.
 - 1) Invitation For Bid (IFB)
 - 2) Instructions to Bidders (AIA – A701)
 - 3) General Conditions of the Contract for Construction (AIA – A201)
 - 4) Standard Form of Agreement Between Owner and Contractor (AIA-A101)
 - 5) Division 1, Division 23 & Division 26 specifications.

III. BIDDING PROCEDURES:

- A. Invitation for Bids: Includes instructions on how to obtain electronic copies of documents and/or locations to view documents.
 1. Received at Dinwiddie County School Board, Finance Department, 14016 Boydton Plank Road, Dinwiddie, VA 23841, Attn: Ms. Brenda Austin.
 2. Deadline for submitting bids is 2:00 P.M. sharp, as determined by the Bid Officer, on Thursday, February 20, 2025.
 3. The bids will be opened publicly and read aloud beginning at 2:10 P.M., on Thursday, February 20, 2025, at the same location.
- B. Instructions to Bidders: AIA – A701 (included in Project Manual).
 1. Bid Bond (May be Required): Refer to Section 7.34 of the Invitation for Bid portion of the Project Manual.
 2. Withdrawal or Modification of Bids: Refer to Section 7.33 of the Invitation for Bid portion of the Project Manual.
 3. Substitutions: Refer to Section 7.29 of the Invitation for Bid portion of the Project Manual and individual technical specification sections.
- C. Bid Form: Included in Invitation for Bid portion of the Project Manual (Attachment G).
- D. Questions Prior to Receipt of Bids:
 1. Pre-Bid Question Form included in Invitation for Bid portion of the Project Manual (Attachment E).
 2. All questions must be submitted no later than 2:00 P.M. on Friday, February 07, 2025.
 3. All required responses to questions regarding the Bid Documents prior to receipt of bids will be in writing by Addendum and sent to all document holders.

4. Responses not in writing and not included in Addendum shall not be binding.

E. Other Required Bid Documents:

1. State Corporation Commission form (Attachment A)
2. Certification of Contractor (Attachment B)
3. References (Attachment C)

IV. PROJECT CONDITIONS

A. Substantial Completion:

1. Summer 2025
 - a. NTP – March 14, 2025, Work to start at site – May 30, 2025
 - b. Substantial Completion - August 11, 2025

B. Final Completion: 30 consecutive calendar days after the date of Substantial Completion as determined by the A/E.

C. Site Visits: Arrange through Matt Hawkins, Telephone (804) 898-9559.

D. Job Site Safety: Contractor shall meet all local, state, and federal safety regulations. Construction means and methods shall remain the responsibility of the Contractor, as design professionals and Owner's inspectors are neither considered nor licensed as general contractors in the eyes of the law.

E. Work Restrictions: Refer to Section 011000 "Summary."

F. Temporary Facilities and Utilities: Refer to Section 015000 "Temporary Facilities and Controls."

G. Submittals: Refer to Section 013300 "Submittal Procedures."

V. OWNER COMMENTS

VI. QUESTIONS

END OF AGENDA

SECTION 230500 - HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections and Section 230100 "Mechanical General Provisions" apply to this Section.
- B. Refer to Specification Sections 230900 "Automatic Temperature Controls" and the Control Diagrams on drawings for additional requirements and coordination between equipment and controls.

1.2 WARRANTY-GUARANTEE

- A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of material and workmanship for a period of 12 months from date of Substantial Completion of the building. Refer to Section 230100 for additional warranty period responsibilities.

1.3 SUBMITTALS

- A. Submit manufacturer's performance data and unit details on all products specified below or indicated on drawings.

1.4 PROTECTION OF EQUIPMENT AND MATERIAL

- A. All equipment and material not specifically designed for exterior installation shall not be delivered to the job site until an indoor, dry location is available for storage. All equipment and material shall be covered and protected from dirt, debris, moisture, paint, coatings and damage of any kind. Store off the floor, in a location approved by the Owner, to prevent contact with water.

PART 2 - PRODUCTS

2.1 HEAT GENERATION

- A. Oil-Fired Flexible Water-Tube Boiler (Midway ES and Dinwiddie ES)

1. Delivery, Storage, Protection, and Warranty
 - a. Protect boiler package from damage by leaving factory inspection openings and shipping packaging in place until final installation.
 - b. If stored outside prior to final installation, boiler package must be protected from the elements and ground water with tarps and blocking as needed.
 - c. The boiler vessel shall be warranted for 25 years against thermal shock on a non-prorated basis. Refer to Specification Section 230100 for additional warranty requirements.
 - d. Midway ES only: Boiler shall be shipped in full “knock-down” configuration for transport into mechanical room. Boiler shall be completely reassembled per manufacturer’s instructions once all components are inside mechanical room. Doorframe dimensions are approximately 38” wide x 83” tall.

2. Manufacturers
 - a. Manufacturer shall meet all aspects of the specifications. Basis of design is BRYAN “AB”. Alternates include **CLEAVER BROOKS, UNILUX, and SMITH**. NO SUBSTITUTIONS.

3. Packaged Boiler
 - a. Description: The boiler shall be constructed and assembled as a completely packaged unit ready for field connections to the water supply, return connection, electrical power supply, fuel supply(s), relief valve discharge, building management controls and flue-gas vent.
 - 1) The water boiler shall be manufactured in strict accordance with ASME Heating Boiler Code, Section IV, and shall bear the ASME “H” stamp for maximum working pressure of 160 PSIG and 250° F temperature.
 - 2) The boiler shall be built to withstand 150 degree delta “T”
 - 3) The boiler shall have no less than 5 sq. feet of heating surface per boiler horsepower, verified by documentation with 80% combustion efficiency standard.
 - 4) A tube removal and replacement shall be demonstrated at time of start-up. Demonstration time not to exceed 40 minutes.

4. Vessel and Tube Construction
 - a. The boiler shall be constructed on a heavy steel frame.
 - b. The boiler pressure vessel shall be provided with adequately sized upper and lower drums.
 - c. A minimum of two downcomers shall be provided and shall be located inside furnace chamber to maximize proper thermal internal water circulation.
 - d. No external water circulation source shall be required.
 - e. Steel water tubes are to be 1" O.D., .095 wall thickness, six-pass, flexible serpentine bend design, not subject to thermal shock damage.

- f. Individual water tubes shall be easily removable and replaceable without either welding or rolling.
 - g. The boiler shall have no more than two tube configurations.
 - h. The boiler shall be furnished with an adequate number of tappings and inspection openings to facilitate internal boiler inspection and cleaning.
5. Furnace/Combustion Chamber Construction
- a. Access to the furnace/combustion chamber is gained by an access door(s) with an opening of no less than 28" wide x 50" high maximum to allow for inspection of the interior chamber and the burner head. All panels shall be individually removable.
 - b. All access panels shall be affixed to the pressure vessel frame and insulated with 2" mineral fiber mono block and 2" high temperature ceramic blanket insulation and be fully gasketed for pressurized firing.
 - c. The furnace/combustion chamber shall be primarily of water-wall design with one side of removable panels.
 - d. The stationary interior wall shall be lined with 2" ceramic blanket insulation.
 - e. The front and rear walls are insulated with 4" mineral fiber mono block and 2" ceramic blanket insulation.
 - f. The floor beneath the tubes shall be lined with 2" mineral fiber mono block insulation and 2" ceramic blanket insulation.
 - g. The boiler furnace/combustion chamber and flue ways shall be designed to operate at a positive 0.25" w.c. at the boiler flue outlet.
 - h. The boiler will require a "positive pressure" type metal flue.
 - i. Burner assembly shall be provided with fresh air intake assembly for direct ducting of combustion air from outdoors.
6. Jacket Construction
- a. The boiler shall be complete with a metal jacket, 16 gauge, zinc-coated rust resistant steel casing, finished with a suitable heat resisting paint and shall be constructed on a structural steel frame and properly insulated with no less than 1½" fiberglass insulation.
 - b. Complete jacket and insulation shall be easily removable and reinstalled.
 - c. The boiler shall incorporate individually removable jacket doors, with handles providing easy access to combustion chamber and access panels.
 - d. The entire tube area shall be easily accessible for fireside cleaning.
 - e. All appropriate controls where possible, shall be mounted on boiler front.
 - f. Any external downcomers shall be provided with factory supplied insulation, jacketing and guards to prevent human contact to high temperature surfaces while boiler is operating.
7. Hot Water Boiler Trim
- a. The boiler shall be provided with the following trim and controls:
 - 1) Safety relief valves
 - 2) Combination temperature and pressure gauge

- 3) Water temperature control operator
 - 4) High limit safety control
 - 5) Low water cutoff.
- b. The following optional boiler trim shall be provided:
- 1) Barometric damper.
8. Combination Gas/Oil Burner and Control Equipment
- a. Boiler shall be furnished with a UL listed force draft, pressure atomizing, dual fuel burner, suitable for operation with No. 2 fuel oil and natural gas (or other gas). Burner shall be complete with integral motor and blower for supplying sufficient combustion air with normal vent conditions.
- b. Fuel:
- 1) Liquid propane gas
 - 2) No. 2 heating fuel oil
- c. The following controls shall be furnished:
- 1) Main manual gas shutoff valves
 - 2) Motorized gas valve operator and auxiliary safety shutoff gas valve
 - 3) High and low gas pressure switches (Dinwiddie ES only)
 - 4) Gas pilot shutoff and solenoid valves
 - 5) Gas pilot ignition assembly with ignition transformer for both fuels
 - 6) Pilot and main gas pressure regulators
 - 7) Oil valves – primary and auxiliary
 - 8) Two stage fuel oil unit burner mounted
 - 9) Burner mounted control panel containing:
 - a) Four indicator lights – call for heat, ignition, fuel and flame safeguard alarm
 - b) Air safety switch
 - c) Fused on/off switch
 - d) Honeywell electronic combustion safety control
 - e) Manuel fuel selection switch
 - f) Modulating burner
 - g) Fireye combustion safety control
9. Boiler Interface to Building Automation System
- a. The following points must be available to the building automation system for status or adjustment
- 1) Boiler Enable/Disable
 - 2) Hot Water Supply Temperature Setpoint
 - 3) Summary Alarm

- b. Specified points shall be available via dry contacts.
- c. Boiler supplier shall provide lead/lag control panel to sequence and control boilers.

10. Spare Parts

- a. Boiler manufacturer shall provide two spare boiler tubes for each tube configuration used in each boiler. Boiler tubes shall be supplied to the owner at time of tube removal and replacement demonstration.

B. Oil-Fired Flexible Water-Tube Boiler (Dinwiddie MS)

1. Delivery, Storage, Protection, and Warranty

- a. Protect boiler package from damage by leaving factory inspection openings and shipping packaging in place until final installation.
- b. If stored outside prior to final installation, boiler package must be protected from the elements and ground water with tarps and blocking as needed.
- c. The boiler vessel shall be warranted for 25 years against thermal shock on a non-prorated basis. Refer to Specification Section 230100 for additional warranty requirements.

2. Manufacturers

- a. Manufacturer shall meet all aspects of the specifications. Basis of design is BRYAN "RV". Alternates include WEIL-MCLAIN, MESTEK, PRECISION, **CLEAVER BROOKS, UNILUX, and SMITH.**

3. Packaged Boiler

- a. Description: The boiler shall be constructed and assembled as a completely packaged unit ready for field connections to the water supply, return connection, electrical power supply, fuel supply(s), relief valve discharge, building management controls and flue-gas vent.
 - 1) The water boiler shall be manufactured in strict accordance with ASME Heating Boiler Code, Section IV, and shall bear the ASME "H" stamp for maximum working pressure of 160 PSIG and 250° F temperature.
 - 2) The boiler shall be built to withstand 150 degree delta "T"
 - 3) The boiler shall have no less than 5 sq. feet of heating surface per boiler horsepower, verified by documentation with 80% combustion efficiency standard.
 - 4) A tube removal and replacement shall be demonstrated at time of start-up. Demonstration time not to exceed 40 minutes.

4. Vessel and Tube Construction

- a. The boiler shall be constructed on a heavy steel frame.
 - b. The boiler pressure vessel shall be provided with adequately sized upper and lower drums.
 - c. A minimum of two downcomers shall be provided and shall be located inside furnace chamber to maximize proper thermal internal water circulation.
 - d. No external water circulation source shall be required.
 - e. Steel water tubes are to be 1½" O.D., .095 wall thickness, six-pass, flexible serpentine bend design, not subject to thermal shock damage.
 - f. Individual water tubes shall be easily removable and replaceable without either welding or rolling.
 - g. The boiler shall have no more than two tube configurations.
 - h. The boiler shall be furnished with an adequate number of tappings and inspection openings to facilitate internal boiler inspection and cleaning.
5. Furnace/Combustion Chamber Construction
- a. Access to the furnace/combustion chamber is gained by an access door(s) with an opening of no less than 26" wide x 62" high maximum to allow for inspection of the interior chamber and the burner head. All remaining panels shall be individually removable.
 - b. All access panels shall be affixed to the pressure vessel frame and insulated with 2" mineral fiber mono block and 2" high temperature ceramic blanket insulation and be fully gasketed for pressurized firing.
 - c. The furnace/combustion chamber shall be primarily of water-wall design with one side of removable panels.
 - d. The stationary interior wall shall be lined with 2" ceramic blanket insulation.
 - e. The front and rear walls are insulated with 5" mineral fiber mono block and 2" ceramic blanket insulation.
 - f. The floor beneath the tubes shall be lined with 2" mineral wool insulation, 1" mineral fiber mono block insulation and 2" ceramic blanket insulation.
 - g. The boiler furnace/combustion chamber and flueways shall be designed to operate at a positive 0.50" w.c. at the boiler flue outlet.
 - h. The boiler will require a "positive pressure" type metal flue.
6. Jacket Construction
- a. The boiler shall be complete with a metal jacket, 16 gauge, zinc-coated rust resistant steel casing, finished with a suitable heat resisting paint and shall be constructed on a structural steel frame and properly insulated with no less than 1½" fiberglass insulation.
 - b. Complete jacket and insulation shall be easily removable and reinstalled.
 - c. The boiler shall incorporate individually removable jacket doors, with handles providing easy access to combustion chamber and access panels.
 - d. The entire tube area shall be easily accessible for fireside cleaning.
 - e. All appropriate controls where possible, shall be mounted on boiler front.
 - f. Any external downcomers shall be provided with factory supplied insulation, jacketing and guards to prevent human contact to high temperature surfaces while boiler is operating.

7. Hot Water Boiler Trim
 - a. The boiler shall be provided with the following trim and controls:
 - 1) Safety relief valves
 - 2) Combination temperature and pressure gauge
 - 3) Water temperature control operator
 - 4) High limit safety control
 - 5) Low water cutoff.
 - b. The following optional boiler trim shall be provided:
 - 1) Barometric damper.
8. Combination Gas/Oil Burner and Control Equipment
 - a. Boiler shall be furnished with a UL listed force draft, pressure atomizing, dual fuel burner, suitable for operation with No. 2 fuel oil and natural gas (or other gas). Burner shall be complete with integral motor and blower for supplying sufficient combustion air with normal vent conditions.
 - b. Fuel:
 - 1) Liquid propane gas
 - 2) No. 2 heating fuel oil
 - c. The following controls shall be furnished:
 - 1) Main manual gas shutoff valves
 - 2) Motorized gas valve operator and auxiliary safety shutoff gas valve
 - 3) High and low gas pressure switches
 - 4) Gas pilot shutoff and solenoid valves
 - 5) Gas pilot ignition assembly with ignition transformer
 - 6) Pilot and main gas pressure regulators
 - 7) Oil valves – primary and auxiliary
 - 8) Two stage fuel oil unit burner mounted
 - 9) Direct spark oil igniter assembly with ignition transformer and oil ignition and nozzle assembly
 - 10) Burner mounted control panel containing:
 - a) Four indicator lights – call for heat, ignition, fuel and flame safeguard alarm
 - b) Air safety switch
 - c) Fused on/off switch
 - d) Honeywell electronic combustion safety control
 - e) Manuel fuel selection switch
 - f) Modulating burner
 - g) Fireye combustion safety control

9. Boiler Interface to Building Automation System
 - a. The following points must be available to the building automation system for status or adjustment
 - 1) Boiler Enable/Disable
 - 2) Hot Water Supply Temperature Setpoint
 - 3) Summary Alarm
 - b. Specified points shall be available via dry contacts.
 - c. Boiler supplier shall provide lead/lag control panel to sequence and control boilers.
10. Spare Parts
 - a. Boiler manufacturer shall provide two spare boiler tubes for each tube configuration used in each boiler. Boiler tubes shall be supplied to the owner at time of tube removal and replacement demonstration.

C. Boiler Vent System

1. Vents shall be Saf-T Vent CI Plus as manufactured by HEATFAB, INC., SCHEBLER, JEREMIAS EXHAUST SYSTEM, Z-FLEX, SECURITY CHIMNEY, or approved equal. A complete manufacturer-approved drawing of the entire venting system shall be provided with the boiler vent submittal.
2. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, NFPA-54, where applicable and shall comply with and be listed to UL1738, Standard for Venting Systems for Gas-Burning Appliances, Category II, III and IV. Components coming in direct contact with products of combustion shall carry the appropriate UL listing mark or label.
3. The vent shall be of the double-wall, factory-built type for use on condensing appliances or pressurized venting systems serving Category II, III, or IV appliances or as specified by the equipment manufacturer. Maximum temperature shall not exceed 550°F (288°C).
4. Vent shall be listed for an internal static pressure of 6" w.g. and tested to 15" w.g.
5. Vent shall be constructed with an inner and outer wall, with a 1" annular insulating air space.
6. The inner wall (vent) shall be constructed of AL29-4C, superferritic stainless steel, .015" thickness for 6"-12" diameters and .024" thickness for 14"-24" diameters.
7. The outer wall (casing) shall be constructed of aluminized steel or 430 stainless steel, .018" thickness for 6"-12" diameters and .024" thickness for 14"-24" diameters.
8. Inner and outer walls shall be connected by means of spacer clips that maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.
9. All vent parts exposed to the weather shall be stainless steel.
10. All supports, wall penetrations, terminations, appliance connectors and drain fittings, required to install the vent system shall be included.
11. Wall penetration pieces shall be UL listed and provided by the vent manufacturer.

12. All inner vent connections shall be secured by means of profiled connector bands with gear clamp tighteners. Joints shall be sealed with P077 Sealant.
13. Where exposed to weather, the outer closure band shall be sealed to prevent rainwater from entering the space between inner and outer walls.
14. Vent shall terminate in accordance with installation instructions and local codes.
15. Clean all breechings of dust and debris prior to final connection to appliances.
16. Contractor shall pressure test the Breeching Systems as recommended by the manufacturer to demonstrate System integrity. Make necessary adjustments as required to meet the manufacturer's recommendations for System airtightness.

2.2 REFRIGERATION (NOT USED)

2.3 AIR HANDLING EQUIPMENT

A. Supply/Exhaust Fans

1. Fans shall be size, type, and have capacity as indicated on drawings. GREENHECK, LOREN COOK, PENN BARRY or approved equal.
2. Fans shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. Fan air performance ratings shall be based on tests conducted in an AMCA registered laboratory for AMCA 210 air performance testing. The Test Standard used shall be ANSI/AMCA Standard 210-85, ANSI/ASHRAE Standard 51-1985, "Laboratory Methods of Testing Fans for Rating." All sizes must be tested, calculations to other sizes not acceptable. Fan sound performance shall be based on tests conducted in an AMCA registered laboratory for AMCA 300 Sound Performance Testing. The Test Standard used shall be AMCA 300 "Reverberant Room Method for Sound Testing of Fans." All sizes must be tested, calculations to other sizes are not acceptable. Air or Sound Test results are to be included in submittal.
3. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
4. Provide solid-state speed controls for all direct drive fans unless otherwise noted.
5. All fans shall be statically and dynamically balanced.
6. Install as required for quiet operation.
7. Motor shall be a DC electronic commutation type motor (ECM) specifically designed for fan applications unless otherwise noted.
8. Downblast power roof ventilators
 - a. Downblast power roof ventilators shall have aluminum housing, backward-inclined aluminum fan wheel, gravity-type back-draft dampers, bird screen, aluminum curb cap with pre-punched mounting holes, aluminum rub ring, motor isolated shock mounts, corrosion-resistant fasteners, lifting lugs and factory-wired NEMA 1 toggle disconnect switch. Provide direct or belt drive as indicated. Shaft shall be mounted in ball bearing pillow blocks. Bearings shall have grease fittings. Provide adjustable pulley and motor plate on belt drive units
9. Inline Supply Fans

- a. Cabinet in-line type shall have forward curved centrifugal fan wheel, and galvanized fan housing and factory-wired disconnect switch. Provide vibration isolators as specified in Section 2.8.
- b. The fan housing shall be of the square design, constructed of heavy gauge galvanized steel and shall include duct mounting collars.
- c. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be sufficient size to permit easy access to all interior components.

2.4 UNITARY EQUIPMENT (NOT USED)

2.5 TERMINAL EQUIPMENT

A. Hot Water Unit Heater

1. Units shall be size, type, and have capacity as indicated. TRANE, DAIKIN, or approved equal.
2. Units shall be complete, including casing, hot water coil, fan, fan guard, and motor. Units shall be horizontal discharge type with adjustable air deflectors. Provide with integral factory wired disconnect switch.

2.6 HVAC PIPING AND SPECIALTIES

A. Piping

1. Water piping shall be provided as specified below. Where options of different materials are given for the same service, contractor shall select materials and use them uniformly throughout the system. Contractor shall submit experience with all of the materials and joining methods specified.
2. Hot water piping
 - a. Above ground
 - 1) Type L copper (2 inch and under)
 - 2) Schedule 40 black steel (2-1/2 inch and over)
3. Fuel Oil Piping
 - a. Within building
 - 1) Type K copper tubing tested in accordance with ASTM B-75
4. Drain piping in mechanical equipment rooms:

- a. Type L copper, except for boiler drains, which shall be galvanized or stainless steel.
5. Domestic cold water make-up piping
 - a. Type L copper
6. Chemical Feed piping
 - a. Type L copper
7. Type L copper pipe shall conform to ASTM B42, and be assembled with wrought-copper soldering fittings using 95-5 solder or with press on fittings as specified herein.
8. Schedule 40 PVC pipe shall be assembled in strict accordance with manufacturer's instructions. Solvent cement shall conform to ASTM D2564.
9. Schedule 40 black steel pipe shall be fabricated by welding using Schedule 40 steel welding fittings conforming to ASTM A53.
10. Press on Connector Fittings
 - a. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and NSF/ANSI Standard (NSF 61). Sealing elements for press fittings shall be factory installed EPDM.
 - b. Press-connected fittings 1/2" – 2" press end shall have a leak-before-press feature, which assures leakage from inside the system past the sealing element of an unpressed connection.
 - c. Copper press fitting joints shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tuning marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark in the tubing to ensure the tubing is fully inserted in the fitting. The joints shall be pressed using the pressing tool and jaws or jaw set, approved by the fitting manufacturer.
 - d. Fitting installer shall be trained by the fitting manufacturer's factory representative.
 - e. Press connected fittings shall be by ELKHART PRODUCTS CORP., NIBCO, VIEGA or approved equal.
11. Coordinate installation of piping with other disciplines. Locate all piping tight against structure where possible. No piping shall be installed below mechanical equipment, or within mechanical or electrical equipment clearance requirements.
12. Pitch hydronic piping to vent at high points and provide accessible drains at low points.

B. Valves

1. Valves 2" size and under shall be bronze with soldered ends, rough bodies, and finish trim. Valves 2-1/2" size and over shall be iron-body, bronze-mounted with flanged ends, except where specifically indicated. Valves on cold or chilled piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. Gate valves for water shall be solid-wedge type. Catalog numbers indicated below are

NIBCO. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.

Size	Pipe Material	Globe	Check	Ball/Butterfly	Gate
2" and under	Copper	S-235	S-413-Y	S-585-70-66NS	——
2-1/2" and over	Steel	F718-B	F918-B	LC-2000	F-619

2. In lieu of gate valves, the contractor may provide “Bray Series 30/31” butterfly valves, NO SUBSTITUTIONS, where shown for isolation of mechanical systems and equipment. The valves shall be provided with double u-cup stem seal, molded seat flat primary and secondary seals and flanged connections.
3. Check valves in pump discharge lines shall be NIBCO F-910 “silent check valve,”. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.
4. Balancing valves 2" and smaller shall be NIBCO S-585-70-66NS. Balancing valves 2-1/2" and larger shall be butterfly valves as specified below. Valves shall be complete with memory stops. Valves on cold or chilled piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.
5. Butterfly valves used for balancing purposes shall be cast iron, lug type and suitable for dead-end service, 200 psig, bubble-tight shutoff, and 250°F service. Disc shall be aluminum bronze with 416 stainless-steel extended shaft and copper or brass bushings. Seat shall be EPDM. Provide lever actuators with ten positions with memory stops. Valves on cold or chilled piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. NIBCO LC-2000, or approved equal. Valves 6" and above shall be provided with gear operators. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.
6. Pressure Relief Valves
 - a. Provide ASME-rated bronze body, direct spring-loaded, diaphragm-type, lever-operated relief valve with factory-set discharge pressure. Valve body shall have threaded connections and be designed for a working pressure of 150 psi. Fluid shall not discharge into spring chamber.
 - b. Provide relief valves on low pressure side of pressure reducing valves where indicated.
 - c. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity.

C. Base Mounted End Suction Circulating Pumps

1. Pumps shall be size, type, have capacity and arrangement as indicated, designed for service encountered. BELL & GOSSETT, or equal by ARMSTRONG or TACO.
2. End suction pumps shall be bronze fitted, cast-iron case. Pumps shall be base-mounted, single stage, end suction design.
 - a. Pump volute shall be made of cast iron with integrally cast pedestal support. The impeller shall be cast bronze, enclosed type, statically and hydraulically balanced. Impeller shall be keyed to the shaft and secured by a hex head impeller nut and washer.

- b. Pumps shall be provided with a single inside unbalanced mechanical shaft seal for leakless operation. A suitable arrangement shall be provided to furnish a portion of the pumped liquid to lubricate and cool the seal faces.
 - c. Pump shall be rated for a minimum of 175 psi working pressure. Casings shall be provided with tapped and plugged holes for priming, vent, and drain.
 - d. Pump bearing housing shall have heavy duty re-greaseable ball bearings.
 - e. Baseplate shall be channel steel, sufficiently rigid to support the pump and driving motor.
 - f. A flexible-type coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required. Contractor to level and grout each unit according to manufacturer's instructions.
 - g. The motor shall be NEMA specifications and shall be the size, voltage and enclosure called for on the plans. Pump and motor shall be factory aligned, and shall be realigned by contractor after installation.
 - h. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.
 - i. Each pump shall be checked by the contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to the pump for owner's reference.
3. Pumps shall be non-overloading over entire impeller curve within service factor of motor. Pumps shall be sized for a maximum discharge velocity of 16 FPS and a maximum suction velocity of 12 FPS.
 4. Provide suction diffusers matched to pump and system piping for end suction pumps.
 5. Provide Aegis Shaft Grounding Rings on all pump shafts to extend the life of the bearings.
 6. Provide with full-size impeller.

D. Suction Diffusers

1. Contractor shall furnish and install a suction diffuser on the suction side of pumps as indicated on the drawings. Suction diffuser shall be as manufactured by Bell & Gossett or approved equal. Suction diffusers shall meet sizes and characteristics as specified in the following and as scheduled.
2. Units shall consist of an angle type body with internal straightening vanes that run the full length of the diffuser and a combination diffuser/strainer/orifice cylinder with 3/16" diameter openings for pump protection. The orifice cylinder shall be equipped with a disposable bronze fine 16-mesh strainer, which shall be removed after system start-up. Orifice cylinder shall be designed to withstand pressure differential equal to pump shutoff head and shall have a free area equal to five times cross section area of pump suction opening. Vane length shall be no less than 2 1/2 times the pump connection diameter. Unit shall be provided with a connection point where a field fabricated support foot can be attached to carry weight of suction piping
3. Diffuser manufacturer shall be responsible for any reduction in pump performance or damage due to high pressure drops, internal failures of components or harmonic oscillations caused by the diffuser.

E. Y-Strainers

1. Strainers:

- a. "Y" Pattern pipeline strainers shall be installed where shown on plans or required by equipment manufacturers.
- b. Y Strainer shall be of the low pressure drop design with the following C_v values:
 - 1) 6" pipe – 976
- c. Y Strainer shall be model "LPD" as manufactured by The Metraflex Company, or equal.
- d. Strainer body shall be ASTM A126-B Cast Iron.
- e. Screens shall be Type 304 Stainless steel.
- f. Screen perforations shall be 0.125".
- g. Strainer shall have a screen pitch of 22.5°.
- h. Screens shall be removable via an access cover sealed with O-ring.
- i. Strainer shall be manufactured with .25" pressure differential ports, with one placed on each side of the screen.
- j. Strainer shall be equipped with a dry well port. Port shall be 1" for sizes 4" – 12".
- k. Strainer connection shall be 125 lb. class flange.
- l. Y Strainer shall be installed in accordance with manufacturer's recommendations and contact requirements.
- m. Provide valved blow-off outlet with hose connection and cap on each strainer. Blow-off connections shall be at bottom of strainer and shall be of size equal to 1/2 the pipe up to a maximum of 2".

F. Flexible Pipe Connectors

1. Provide spool-type expansion joint, standard single-arch type, on suction and discharge piping of base-mounted pumps, and where indicated. KEFLEX, or approved equal.
2. Joints shall be constructed of abrasion-resistant rubber compounds, reinforced with steel rings and high-tensile strength fabrics. Flanges shall be steel.
3. Joints shall be installed so that they carry no piping load. Misalignment of piping shall not exceed 1/8".
4. Control rods shall be installed at each joint. Rods shall be attached with neoprene bushings to prevent transmission of noise and vibration.

G. Pressurized Expansion Tanks

1. Tanks shall be ASME Code construction for 125 psi service, of sizes indicated. Tanks shall be pre-charged bladder type. BELL & GOSSETT Series "B" or equal by TACO.
2. Expansion tanks are ASME rated pre-charged bladder-type pressure vessels designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions.
3. Tank shall have a heavy-duty bladder to contain system water to prevent tank corrosion and water logging problems.

4. Maximum working pressure shall be 125 PSI and maximum operating temperature shall be 240°F.
5. System connections shall be forged steel. Tank shell shall be carbon steel.
6. Bladder shall be heavy duty butyl rubber.
7. Tank shall be designed and constructed per ASME Section VIII, Division.
8. Tanks shall be complete with system and drain connections, air charging valve connection, and lifting ring.
9. Volume of tank indicated is acceptance volume.

H. Air Eliminator and Dirt Separator

1. Furnish and install a coalescing type air eliminator and dirt separator on the chilled water and hot water systems, SPIROVENT Model VDN or equal. All combination units shall be fabricated steel, rated for 150 psig working pressure with entering velocities not to exceed 4 feet per second at specified GPM.
2. Units shall include an internal bundle filling the entire vessel to suppress turbulence and provide high efficiency. The bundle must consist of a copper core tube with continuous wound copper medium permanently affixed to the core.
3. A separate copper medium is to be wound completely around and permanently affixed to the internal element. Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.
4. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
5. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
6. Separator shall have the vessel extended below the pipe connections an equal distance for dirt separation.
7. Air Eliminators shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid. Dirt separation shall be at least 80% of all particles 30 micron and larger within 100 passes.
8. Separator shall include a removable flanged lower head to facilitate removal of assembly for inspection or cleaning.

I. Air Vents

1. Provide automatic air vents where indicated (in Mechanical Room only.) BELL & GOSSETT Model 107, or approved equal.
2. Provide manual air vents where indicated, and where required to properly and adequately vent heating system of air. Vent shall utilize a ball valve with handle in lieu of key operated.

J. Thermometers

1. Thermometers shall be provided as indicated. WEKSLER INSTRUMENT, Type "AF."
2. Thermometers in pipelines shall be separable socket 5" dial bi-metal insertion type, with scale suitable for temperature range of medium being measured. Thermometers shall be located to facilitate reading from floor. Angle-type shall be used where necessary to facilitate reading. Install in thermal well in flow of fluid.

3. Thermometer range shall be 20-240°F for hot water.

K. Pressure Gauges

1. Pressure gages shall be provided on suction and discharge line of each pump and where indicated. WEKSLER INSTRUMENT, model AA-14-2.
2. Gages shall be bourdon spring type with 4-1/2" dial set in polypropylene case. Gauges shall be equipped with brass tee-handle shut-off cocks. Gauges shall have required range of 0-100 psig and not in more than 2 psi graduations.

L. Venturi Flow Measuring and Balancing Valves

1. Provide venturi flow measuring and balancing valves where indicated, NuTech Model MB for pipe size 1/2" to 2" and Model MF for sizes 2-1/2" and larger, or approved equal.
2. Balancing valves 1/2" thru 2" shall be constructed of bronze or brass. Valves shall be rated for 600 psi at 250°F. The valve ball ID shall be minimum standard port (one size smaller than valve connection size) Reduced port valves are not acceptable.
 - a. Sizes 2-1/2" and larger venturi flow meter and butterfly balancing valve shall be constructed of cast carbon-steel ASTM A120 with accurately machined throat. Sizes 8" and larger shall be fabricated carbon-steel with carbon steel insert. Provide 150-pound ANSI B16.5 flanged connections. Valves shall be rated at 200 psig at 250°F. Butterfly valve shall be constructed of ductile-iron, lug-type body, ANSI Class 125/150, with EPDM seat and gasket, 416 stainless-steel stem, bronze sleeve bearing and aluminum/ bronze disk. The butterfly valve shall have a 2" extended neck above the flange to accommodate insulation thickness. The valve handle shall have infinite flow positioning plate which allows the valve to be closed without the need of unlocking the valve or losing the balancing position valve sizes 2" thru 6". Gear operator shall be supplied on valve sizes 8" and larger.
3. Venturi section shall be low loss with a minimum accuracy of 3% of rate.
4. Valves shall be provided with pressure/temperature ports and memory stop. Valves shall be equipped with metal tag and chain. Valves shall be supplied with extended handles and PT ports to clear insulation on chilled water service.
5. Valves shall be sized as indicated or as recommended by valve manufacturer for intended flow capacity.

M. Flow Stations

1. Provide venturi flow meter and butterfly balancing valve as indicated. NUTECH Model MF, or approved equal.
2. Flow meter sizes 2-1/2" thru 6" shall be constructed of cast carbon-steel ASTM A120 with accurately machined throat. Sizes 8" and larger shall be fabricated carbon-steel with carbon steel insert. Provide 150-pound ANSI B16.5 flanged connections. Meter shall be rated at 200 psig at 250°F. Provide brass needle valves 1/4" SAE M with 2.5" brass extension. Low loss venturi shall have a measurement accuracy of 3%.

3. Butterfly valve shall be constructed of ductile-iron, lug-type body, ANSI Class 125/150, with EPDM seat and gasket, 416 stainless-steel stem, Teflon bushing and aluminum/bronze disk. The butterfly valve shall have a 2" extended neck above the flange to accommodate insulation thickness. The valve handle shall have infinite flow positioning plate which allows the valve to be closed without the need of unlocking the valve handle or losing the balancing position on valve sizes 2-1/2" thru 6". Gear operator shall be supplied on valves sizes 8" and larger.
4. The entire assembly shall have been matched and laboratory tested for accuracy and shall have a 5-year warranty.
5. Total pressure drop shall not exceed one foot.
6. Flow rate increments shall be suitable for the indicated flow rate.

N. Test Stations – Pressure/Temperature (PT)

1. Install a 1/4" NPT fitting (Test Plug) of solid brass with brass chain at indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1,000 psig. PETERSON EQUIPMENT COMPANY, SISCO, or approved equal.

2.7 AIR DISTRIBUTION

A. Ductwork

1. Provide all ducts, plenums, connections, dampers, and related items required to form a complete system as indicated on drawings and specified herein.
2. All ductwork shall be sheet metal.
3. Sheet-metal ducts shall be fabricated from G60 galvanized-steel sheets, and shall be of gauges called for and as detailed in 2005 SMACNA Manual, HVAC Duct
4. Duct sealing requirements shall be Class B for all ductwork.
5. All companies being considered as potential suppliers of duct and fitting components shall submit drawings and dimension data for approval. These submittals will serve as a basis for acceptance or rejection of product.
 - a. All fittings furnished for use on a project must be identical to the approved submittal data.
 - b. Any fittings rejected by the project engineer shall be replaced with fittings equal to the original approved submittals. All expenses incurred in the replacement of fittings that do not conform to these requirements shall be the responsibility of the installing contractor.
6. Duct shall be provided in continuous, un-joined lengths wherever possible. Except when interrupted by fittings, round spiral duct sections shall not be less than 12 feet long.
7. Insulation shall have the following UL rating:

Flame Spread	10-20
Fuel Contributed	10-15
Smoke Developed	0-20

8. Rectangular low velocity ductwork shall be constructed from galvanized steel sheets of lock form quality per ASTM A653 with a G60 zinc coating (0.60 oz/ft²), unless otherwise shown on the contract documents. Sheets shall be free of pits, blisters, slivers, and un-galvanized spots.
9. Construct, brace, and support ducts and air chambers in a manner that they will neither sag nor vibrate to any perceptible extent when fans are operating at maximum speed or capacity.
10. Connect ductwork to intake and discharge louvers, dampers, and other work installed in various trades requiring sheet-metal connections.
11. Provide opposed-blade dampers for control of air volume and for balancing system, where indicated or required. Dampers shall be of sheet metal at least one gauge heavier than duct and reinforced; shall be installed in an accessible location. Provide indicating quadrant and locking device for adjusting and locking dampers in position. Provide extended shafts on all volume dampers greater than the thickness of the insulation to provide free movement of damper positioner. Stiffen duct at damper location, install damper in manner to prevent rattling.
12. Duct sizes are inside free area. Increase duct sizes as required.
13. Ductwork and accessories shall not be delivered to the job site until just prior to erection and must be stored in an approved manner.
14. All ductwork shall be internally cleaned by vacuuming prior to installation.
15. All ductwork open ends shall be sealed with polyethylene and duct tape during construction after hanging.

2.8 VIBRATION ISOLATION

A. Vibration Isolators

1. Mechanical equipment indicated below shall be isolated from the structure by resilient vibration and noise isolators. Equipment to be isolated includes inline supply fan (Midway ES). Minimum deflection shall be 1".
 - a. Hangers shall be pre-compressed and locked at the rated deflection by means of a resilient upstop to keep the equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc. or equal.
 - b. Springs shall be seated in a steel washer reinforced neoprene cup that has a neoprene bushing projecting through the bottom hole to prevent rod to hanger contact. Spring diameters and the lower hole sizes, shall be large enough to allow the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing.

2.9 MEASUREMENT AND CONTROL

A. Variable Frequency Drives

1. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.
2. Provide variable speed frequency drive (VFD) units for the following equipment:
 - a. Pumps P-1 and P-2 (all schools)
3. Acceptable Manufacturers:
 - a. ASEA BROWN BOVERI
 - b. DANFOSS GRAHAM
 - c. TOSHIBA
 - d. MITSUBISHI
4. The VFD package as specified herein shall be enclosed in a UL Listed Type 1 enclosure for indoor applications, completely assembled and tested by the manufacturer in an ISO9001 facility.
 - a. Environmental operating conditions: VFDs shall be capable of continuous operation at 32 to 120 F ambient temperature or VFD must be oversized to meet these temperature requirements.
 - b. Enclosure for indoor applications shall be rated UL Type 1, Enclosures for outdoor applications shall be UL Type 4X-SS for VBCPS. All enclosures shall be UL listed as a plenum rated VFD.
5. All VFDs shall have a Short Circuit Withstand Rating of not less than the rating of the connected equipment in accordance with UL508.
6. All VFDs shall have the following standard features:
 - a. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference.
 - b. There shall be a built-in time clock in the VFD keypad.
 - c. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up.
 - d. The VFD shall have cooling fans that are designed for easy replacement.
 - e. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip.
 - f. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

- g. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients.
 - h. The input current rating of the VFD shall be no more than 3% greater than the output current rating.
 - i. The VFD shall include a coordinated AC transient surge protection system.
 - j. The VFD shall provide a programmable loss-of-load Form-C relay output.
 - k. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of mechanical failure / jam condition causing motor overload.
 - l. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two-zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.
 - m. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user.
 - n. Door interlocked, pad lockable molded case switch that will disconnect all input power from the drive and all internally mounted options.
7. All VFDs to have the following adjustments:
- a. Three (3) programmable critical frequency lockout ranges.
 - b. Two (2) PID Set point controllers allowing pressure or flow signals to be connected to the VFD.
 - c. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e., valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
 - d. Two (2) programmable analog inputs shall accept current or voltage signals.
 - e. Two (2) programmable analog outputs (0-20ma or 4-20 ma).
 - f. Six (6) programmable digital inputs for flexibility in interfacing with external devices.
 - g. Three (3) programmable, digital Form-C relay outputs.
 - h. Run permissive circuit - There shall be a run permissive circuit for damper or valve control.
 - i. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active.
 - j. Seven (7) programmable preset speeds.
 - k. Two independently adjustable accel and decel ramps with 1 - 1800 seconds adjustable time ramps.
 - l. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.
 - m. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

- n. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD.
 - o. The VFD shall include password protection against parameter changes.
8. The Keypad shall include a backlit LCD display. All VFD faults shall be displayed in English words. The keypad shall include the following assistants:
- a. Start-up assistant
 - b. Parameter assistants
 - c. Maintenance assistant
 - d. Troubleshooting assistant
 - e. Drive optimizer assistants
9. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times:
- a. Output Frequency
 - b. Motor Speed (RPM, %, or Engineering units)
 - c. Motor Current
 - d. Motor Torque
 - e. Motor Power (kW)
 - f. DC Bus Voltage
 - g. Output Voltage
10. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed. 2) Operate in a specific fireman's override PID algorithm. The mode shall override all other inputs except customer defined safety run interlocks, and force the motor to run in one of the two modes above.
11. Serial Communications
- a. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available.
 - b. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - 1) Data Sharing - Read Property – B.
 - 2) Data Sharing - Write Property – B.
 - 3) Device Management - Dynamic Device Binding (Who-Is; I-Am).
 - 4) Device Management - Dynamic Object Binding (Who-Has; I-Have).

- 5) Device Management - Communication Control – B.
 - c. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
 - d. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
 - e. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function.
 - f. The VFD shall include an independent PID loop for customer use.
12. EMI / RFI filters. All VFD's shall include EMI/RFI filters.
13. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring.
14. Bypass Controller
 - a. A complete factory wired and tested bypass system shall be provided with the following operators:
 - 1) Bypass Hand-Off-Auto
 - 2) Drive mode selector
 - 3) Bypass mode selector
 - 4) Bypass fault reset
 - b. The bypass shall include an LCD display that allows the user to access owner requested data including but not limited to fails, bypass power (KW), and energy savings.
 - c. The following indicating lights (LED type) or keypad display indications shall be provided.
15. Emergency Stop Function

- a. An emergency stop function shall meet all of the following requirements:
 - 1) The function shall override all other functions and operations under all conditions.
 - 2) Reset must not initiate a restart.
 - 3) An emergency stop shall operate in such a way that, when it is activated, the hazardous movement of the machinery is stopped and the machine is unable to start under any circumstances, even after the emergency stop is released. Releasing the emergency stop only allows the machine to be restarted.
 - 4) The emergency stop shall stop hazardous movement by applying a stop category 0.
 - a) Emergency stop category 0 (according to EN 60204-1) means that the power to the motor shall cut off immediately. Stop category 0 is equivalent to the safe torque off (STO) function, as defined by standard EN/IEC 61800-5-2.

- 16. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.
- 17. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current.
- 18. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.
- 19. The VFD Product Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll-free phone number.

PART 3 - EXECUTION

3.1 TESTS

- A. Refer to Section 230593 “Testing, Adjusting and Balancing” for related requirements.
- B. At his discretion the Owner shall be represented at all tests. Contractor shall provide 48 hours’ notice to the Owner prior to the tests unless otherwise specified.
- C. Before insulation is installed and before piping is concealed, test water piping hydrostatically and prove tight under 100 psig pressure. Test pressure shall be held for minimum of 8 hours. An air test in lieu of water may be used when danger of freezing is possible and when approved.
- D. Coupled pumps shall be field aligned in accordance with the manufacturer’s recommended procedures, alignment completed prior to shipment is not acceptable. After the equipment has been aligned, the contractor shall provide a written report verifying that the pumps vertical and horizontal angularity and parallel offset gap are within one of the following tolerances:

1. Pump parallel offset gap shall be within 1/64" at operating speed and pump angularity shall be within 1/64" per inch of coupler radius.
2. The manufacturer's recommended tolerance for the application and with the Engineer's approval.

3.2 WATER TREATMENT

- A. Refer to Specification Section 232533 for all water treatment procedures and requirements.

END OF SECTION 230500