Construction Contracts Administration, Procurement Contracts & Materials Management (PCMM)
Oregon State University
644 SW 13th Ave.
Corvallis, Oregon 97333

P 541-737-3401
F 541-737-5546
oregonstate.edu

5/28/2019

Oregon State University
Construction Contract Administration
ITB 199053 – MERRYFIELD HALL RENOVATION RE-BID

ADDENDUM NO. 8

THIS ADDENDUM IS BEING ISSUED for clarification and/or revisions of the Solicitation Documents as noted. This document is hereby made a part of the Solicitation Documents to the extent as though it was originally included therein.

ITEM NO. 1 Included with this addendum are Addendum 8 items as provided by Benchmark Architectural Services (dated 5/28/2019).

END OF ADDENDUM NO. 8

BENCHMARK ARCHITECTURAL SERVICES

2897 FIRWOOD PL. S.E., ALBANY, OREGON 97322 PHONE/FAX (541) 704-0619, benchmark@proaxis.com

May 28, 2019

Mr. Matt Hausman
Mr. Dave Raleigh
Oregon State University
Construction Contracts Administration
130 Oak Creek Building
Corvallis, Oregon 97331

Subject: OSU Merryfield Hall Renovation Project ReBid
Addenum #8

Dear Matt and Raleigh,

In response to the omission of specifications relating to the Alternate bid items from the issued bid documents it has been determined that the following specifications sections shall be incorporated into the bidding documents:

230523	Globe Valves for HVAC piping
230523.13	Butterfly Valves for HVAC Piping
230523.14	Check Valves for HVAC Piping
230523.15	Gate Valves for HVAC Piping
230923.11	Control Valves
230993	Sequence of Operations for HVAC DDC Alternate Bid 1
232213	Steam and Condensate Heating Piping
232216	Steam and Condensate Heating Piping Specialties

Please include this information in the next Addendum released and contact me if you have any questions or if you require any additional assistance at this time.

Sincerely,

Gary Day

Attachments:

1) 230523 SF - Globe Valves for HVAC piping
2) 230523.13 SF - Butterfly Valves for HVAC Piping
3) 230523.14 SF - Check Valves for HVAC Piping
4) 230523.15 SF - Gate Valves for HVAC Piping
5) 230923.11 SF - Control Valves
6) 230993 FL - Sequence of Operations for HVAC DDC Alternate Bid 1
7) 232213 SF - Steam and Condensate Heating Piping
8) 232216 SF - Steam and Condensate Heating Piping Specialties

SECTION 230523.11 - GLOBE VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze globe valves.
2. Iron globe valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.1 for power piping valves.
5. ASME B31.9 for building services piping valves.

C. Refer to HVAC valve schedule articles for applications of valves.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valves in Insulated Piping: With 2-inch stem extensions.

2.2 BRONZE GLOBE VALVES

A. Bronze Globe Valves, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. KITZ Corporation.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Stockham; a Crane brand.
    h. WATTS.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded.
    e. Stem and Disc: Bronze.
    f. Packing: Asbestos free.
    g. Handwheel: Malleable iron.

B. Bronze Globe Valves, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. KITZ Corporation.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. WATTS.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 300 psig.
    c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: Bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron.

2.3 IRON GLOBE VALVES

A. Iron Globe Valves, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. Jenkins Valves; a Crane brand.
    e. KITZ Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Stockham; a Crane brand.
    i. WATTS.

2. Description:

    a. Standard: MSS SP-85, Type I.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    d. Ends: Flanged.
    e. Trim: Bronze.
    f. Packing and Gasket: Asbestos free.
    g. Operator: Handwheel or chainwheel.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
    1. Throttling Service, Steam: Globe valves.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller: Bronze globe valves, Class 150, with bronze disc, and threaded ends.

B. Pipe NPS 2-1/2 and Larger: Iron globe valves, Class 125, with flanged ends.

3.5 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze globe valves, Class 150, with bronze disc, and threaded ends.

B. Pipe NPS 2-1/2 and Larger: Iron globe valves, Class 125.

END OF SECTION 230523.11

SECTION 230523.13 - BUTTERFLY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Iron, single-flange butterfly valves.
2. High-performance butterfly valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B31.1 for power piping valves.
4. ASME B31.9 for building services piping valves.

C. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:

1. Gear Actuator: For valves NPS 8 and larger.
2. Handlever: For valves NPS 6 and smaller.

F. Valves in Insulated Piping: With 2-inch stem extensions with extended necks.

2.2 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Single-Flange, High-Performance Butterfly Valves, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Bray Controls.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Stockham; a Crane brand.

2. Description:

    a. Standard: MSS SP-68.
    b. CWP Rating: 285 psig at 100 deg F.
    c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
    e. Seat: Reinforced PTFE or metal.
    f. Stem: Stainless steel; offset from seat plane.
    g. Disc: Carbon steel.
    h. Service: Bidirectional.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2-1/2 and Larger: High-performance butterfly valves, single flange, Class 150.

3.4 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2-1/2 and Larger: High-performance butterfly valves, single flange, Class 150.

END OF SECTION 230523.13

SECTION 230523.14 - CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.
   2. Iron swing check valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.1 for power piping valves.
   6. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. Jenkins Valves; a Crane brand.
    e. KITZ Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Stockham; a Crane brand.
    i. WATTS.

2. Description:

    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 200 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

2.3 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. Jenkins Valves; a Crane brand.
    e. KITZ Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Stockham; a Crane brand.
    i. WATTS.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
    c. NPS 14 to NPS 24, CWP Rating: 150 psig.
    d. Body Design: Clear or full waterway.
    e. Body Material: ASTM A 126, gray iron with bolted bonnet.
    f. Ends: Flanged.
    g. Trim: Bronze.
    h. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves with bronze disc, Class 125.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. NPS 2-1/2 to NPS 12: Iron swing check valves with lever and spring**-c**losure control, Class 125.
3. Iron swing check valves with metal seats, Class 125.

3.5 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

B. Bronze swing check valves with bronze disc, Class 125.

C. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. NPS 2-1/2 to NPS 12: Iron swing check valves with lever and spring**-c**losure control, Class 125.
3. Iron swing check valves with metal seats, Class 125.

END OF SECTION 230523.14

SECTION 230523.15 - GATE VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze gate valves.
2. Iron gate valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.1 for power piping valves.
5. ASME B31.9 for building services piping valves.

C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. RS Valves in Insulated Piping: With 2-inch stem extensions.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. Jenkins Valves; a Crane brand.
    e. KITZ Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Stockham; a Crane brand.
    i. WATTS.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: Solid wedge; bronze.
    g. Packing: Asbestos free.
    h. Handwheel: Malleable iron.

B. Bronze Gate Valves, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Flow Controls; Conbraco Industries, Inc.
    b. Crane; a Crane brand.
    c. Hammond Valve.
    d. Jenkins Valves; a Crane brand.
    e. KITZ Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Stockham; a Crane brand.
    i. WATTS.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded.
    e. Stem: Bronze.
    f. Disc: Solid wedge; bronze.

g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 IRON GATE VALVES

A. Iron Gate Valves, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Jenkins Valves; a Crane brand.
e. KITZ Corporation.
f. Legend Valve & Fitting, Inc.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Stockham; a Crane brand.
j. WATTS.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

B. Iron Gate Valves, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Jenkins Valves; a Crane brand.
e. KITZ Corporation.
f. Legend Valve & Fitting, Inc.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Stockham; a Crane brand.
j. WATTS.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Gate valves.

B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends, except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

A. Pipe NPS 2 and Smaller: Bronze gate valves, NRS, Class 125.

B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y, Class 125.

3.5 STEAM-CONDENSATE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze gate valves, NRS, Class 125.

B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y, Class 125.

END OF SECTION 230523.15

SECTION 230923.11 - CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.11.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.
2. Include diagrams for pneumatic signal and main air tubing.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control valves and actuators, including the following:

a. Flow at project design and minimum flow conditions.
b. Pressure differential drop across valve at project design flow condition.
c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
d. Design and minimum control valve coefficient with corresponding valve position.
e. Maximum close-off pressure.
f. Leakage flow at maximum system pressure differential.
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Determine control valve sizes and flow coefficients by ISA 75.01.01.

F. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

G. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:
   a. Steam: 15psig @ 250 degrees F.

2. Fail positions unless otherwise indicated:
   a. Steam: Last position.

3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
4. Modulating valve sizes for steam service shall provide a pressure drop at design flow equal to lesser of the following:
   a. 50 percent of the absolute steam pressure at the valve inlet.

2.2 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:

1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
2. Construct the valves to be serviceable from the top.
3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.
4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.
5. Replaceable seats and plugs.
6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:

   a. Manufacturer's name, model number, and serial number.

b. Body and trim size.
c. Arrow indicating direction of flow.

B. Two-Way Globe Valves NPS 2 and Smaller:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johnson Controls, Inc.
b. Siemens Industry, Inc., Building Technologies Division.
2. Globe Style: Single port.
3. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
4. End Connections: Threaded.
5. Bonnet: Screwed.
6. Packing: PTFE V-ring.
7. Plug: Top guided.
8. Plug, Seat, and Stem: Brass or stainless steel.
9. Process Temperature Range: 35 to 248 deg F.
10. Ambient Operating Temperature: 35 to 150 deg F.
11. Leakage: FCI 70-2, Class IV.
12. Rangeability: 25 to 1.
13. Equal percentage flow characteristic.

C. Two-Way Globe Valves NPS 2-1/2 to NPS 6:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johnson Controls, Inc.
b. Siemens Industry, Inc., Building Technologies Division.
2. Globe Style: Single port.
3. Body: Cast iron complying with ASME B61.1, Class 125.
4. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
5. Bonnet: Bolted.
6. Packing: PTFE cone-ring.
7. Plug: Top or bottom guided.
8. Plug, Seat, and Stem: Brass or stainless steel.
9. Process Temperature Rating: 35 to 281 deg F.
10. Leakage: 0.1 percent of maximum flow.
11. Rangeability: Varies with valve size between 6 and 10 to 1.
12. Modified linear flow characteristic.

2.3 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belimo Aircontrols (USA), Inc.
2. Johnson Controls, Inc.

3. Siemens Industry, Inc., Building Technologies Division.

B. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: Voltage selection delegated to professional designing control system.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

    a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
    b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10- or 2- to 10-V dc and 4- to 20-mA signals.
    c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
    d. Programmable Multi-Function:

1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

K. Position Feedback:
1. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

L. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.

M. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

N. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

O. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

P. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

Q. Stroke Time:

1. Operate valve from fully closed to fully open within 60 seconds.
2. Operate valve from fully open to fully closed within 60 seconds.
3. Move valve to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.

R. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
2. Steam System,, Two-Way Applications Controlled by Flow: Globe-style, two-way valves.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.

3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

D. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

E. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

F. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

G. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

H. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

I. Install engraved phenolic nameplate with valve identification on valve.

3.5 CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
6. Verify that control valves are installed correctly for flow direction.

7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.11

SECTION 230993.11 - SEQUENCE OF OPERATIONS FOR HVAC DDC – Alternate Bid #1

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control sequences for DDC for HVAC systems, subsystems, and equipment.

B. Related Requirements:

1. Section 230923 "DDC Systems for HVAC" for control equipment.

1.3 DEFINITIONS

A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).

B. Binary Output: On/off output signal or contact closure.

C. DDC: Direct digital control.

D. Digital Output: Data output that must be interpreted digitally.

1.4 ACTION SUBMITTALS

A. Product Data:

1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

B. Shop Drawings:

1. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.
3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

1.5 AIR HANDLING UNIT (AHU-1) CONTROL SEQUENCES

A. AHU System Enable: Enable the associated air handling unit system subject to Hand/Off/Auto selector switch BAS selector switch.

1. Hand Position: System shall run continuously
2. Off Position: System is disabled continuously.
3. Auto Position: System shall run continuously, 24 hours per day, 365 days per year.

B. Start and Stop Supply Fan:

1. Enable: Freeze Protection:

   a. Input Device: Duct-mounted averaging element thermostat, located before supply fan.
   b. Output Device: Hard wired through VFD; DDC system alarm.
   c. Action: Allow start if duct temperature is above 37 deg F; signal alarm if fans fails to start as commanded.

2. Enable: Smoke Control:

   a. Input Device: Duct-mounted smoke detector, located in exhaust and supply air.
   b. Output Device: Hard wired through VFD; DDC system alarm.
   c. Action: Allow start if duct is free of products of combustion.

3. Initiate: Occupied Time Schedule:

   a. Input Device: DDC system time schedule.
   b. Output Device: Binary output to VFD.
   c. Action: Energize fan(s).

4. Initiate: Unoccupied Time Schedule:
   a. Fan is always in occupied mode unless overridden from the BAS workstation.

5. Display: Supply-fan on-off indication.

C. Supply Fan(s) Variable-Volume Control:

1. Occupied Time Schedule:

   a. Input Device: DDC system time schedule.
   b. Output Device: Binary output.
   c. Action: Enable control.

2. Volume Control:.

   a. Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to conditioned-space static pressure.
   b. Output Device: DDC system analog output to VFD speed controller. Action: Maintain supply-duct static pressure setpoint. Reset shall not be used on this supply fan since the DDC system is not directly controlling individual air valves.

3. High Pressure:

a. Input Device: Differential pressure switch sensing supply-duct static pressure referenced to static pressure outside the duct.
b. Output Device: Hardwire to VFD.
c. Action: Stop fan and signal alarm when static pressure rises above excessive-static-pressure set point.

4. Display:

a. Supply-fan-discharge static-pressure indication.
b. Supply-fan-discharge static-pressure set point.
c. Supply-fan speed.

D. Direct Expansion Heating/Cooling Coil:

1. Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output.
c. Action: Enable control.

2. Discharge-Air Temperature:

a. Input Device: Electronic temperature sensor.
b. Output Device: Exterior VRF condensing unit. Modulate VRF system supply air temperature setpoint.
c. Action: Maintain supply-air temperature set point of 55 deg F.

3. Unoccupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output.
c. Action: Disable control.

4. Display:

a. Fan-discharge air-temperature indication.
b. Fan-discharge air-temperature set point.
c. Cooling/heating-coil air-temperature indication.
d. Cooling/heating-coil air-temperature set point.

E. Mixed-Air Control:

1. Modulate bypass damper around heat pipe when the outside air temperature is capable of providing heating or cooling as required to maintain the AHU supply air temperature setpoint.

F. Heat Pipe: During occupied periods (always), when supply fan is running, enable the unit return fan to draw outside air through the heat pipe. See return air sequence above for start/stop and variable air volume requirements.

G. Filters: During occupied periods, when fan is running, monitor differential air-pressure transmitters for pre/final filter and the heat pipe filters.

1. Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: DDC system output.
c. Action: Enable control.

2. Differential Pressure:

a. Input Device: Differential-pressure sensor/transmitter.
b. Output Device: DDC system alarm.
c. Action: Signal alarm on low- and high-pressure conditions.

3. Display:

a. Filter air-pressure-drop indication.
b. Filter low-air-pressure set point.
c. Filter high-air-pressure set point.

H. Coordination of Air-Handling Unit Sequences: Ensure that preheat, mixed-air, heating-coil, and cooling-coil controls have common inputs and do not overlap in function.

I. Operator Station Display: Indicate the following on operator workstation display terminal:

1. DDC system graphic.
2. DDC system on-off indication.
3. DDC system occupied/unoccupied mode.
4. Outdoor-air-temperature indication.
5. Supply-fan on-off indication.
6. Supply-fan-discharge static-pressure indication.
7. Supply-fan-discharge static-pressure set point.
8. Supply-fan airflow rate.
9. Supply-fan speed.
10. Return-fan on-off indication.
11. Return-fan speed.
12. Heating-coil air-temperature set point.
13. Heating-coil control-valve position.
14. Mixed-air-temperature indication.
15. Mixed-air-temperature set point.
16. Mixed-air damper position.
17. Filter air-pressure-drop indication.
18. Filter low-air-pressure set point.
19. Filter high-air-pressure set point.
20. Cooling-coil air-temperature indication.
21. Cooling-coil air-temperature set point.
22. Cooling-coil control-valve position.
23. All other points listed on drawing DDC points schedule.

J. Air Handling Unit System Safety Control

1. Supply Fan Failure: Activate BAS workstation alarm if the supply fan is commanded “ON” and the fan status is “OFF” after a 30 second delay period. Stop the fan.
2. Return Fan Failure: Activate BAS workstation alarm if the return fan is commanded “ON” and the fan status is “OFF” after a 30 second delay period. Stop the fan.
3. Smoke Detector Alarm: Activate BAS workstation alarm if the return air or supply air duct detector is in alarm. Stop supply and return fan. Modulate mixed air dampers so that outside air dampers are closed.

4. Freeze Stat Alarm: Activate BAS workstation alarm in freeze stat alarm is activated. Stop supply and return fans. Open chilled water and pre-heat valves to full open.
5. High Discharge Temperature Alarm: Activate BAS workstation alarm if supply air temperature exceeds 70°F (adjustable) for more than 5 minutes.
6. Low Discharge Temperature Alarm: Activate BAS workstation alarm is the supply air falls below 45°F for more than 5 minutes (adjustable).
7. High Duct Static Pressure (Supply and Return): Activate BAS workstation alarm is the upon high supply or return air duct static pressure.

1.6 COMPUTER ROOM AIR CONDITIONING UNIT CONTROL SEQUENCES (MDF)

A. Computer Room Unit System Enable: Enable the associated unit system subject to Hand/Off/Auto selector switch BAS selector switch.

1. Hand Position: System shall run continuously
2. Off Position: System is disabled continuously.
3. Auto Position: System shall run continuously, 24 hours per day, 365 days per year.

B. Start and Stop System:

1. Initiate: Occupied Time Schedule:

   a. Input Device: DDC system time schedule.
   b. Output Device: Binary output to VFD.
   c. Action: Energize fan(s).

2. Initiate: Unoccupied Time Schedule:
   a. System is always in occupied mode unless overridden from the BAS workstation.

3. Display: Supply-fan on-off indication.

C. Filters: During occupied (always) periods, when fan is running, monitor differential air-pressure transmitters for filters.

1. Occupied Time Schedule:

   a. Input Device: DDC system time schedule.
   b. Output Device: DDC system output.
   c. Action: Enable control.

2. Differential Pressure:

   a. Input Device: Differential-pressure sensor/transmitter.
   b. Output Device: DDC system alarm.
   c. Action: Signal alarm on low- and high-pressure conditions.

3. Display:

   a. Filter air-pressure-drop indication.
   b. Filter low-air-pressure set point.
   c. Filter high-air-pressure set point.

D. Room Temperature Control: The DDC system shall start and stop the computer room units, but temperature control shall be accomplished by internal unit controls. DDC system shall monitor temperature only.

E. Display:
1. Room temperature.
2. AC unit ON or OFF.
3. Indoor and Outdoor unit kilowatt-hour power usage.

F. Computer Unit System Safety Control

1. Supply Fan Failure: Activate BAS workstation alarm if the supply fan is commanded "ON" and the fan status is "OFF" after a 30 second delay period. Stop the fan.
2. High Room Temperature Alarm: Activate BAS workstation alarm if room air temperature exceeds 80°F (adjustable) for more than 2 minutes.

1.7 ELEVATOR EQUIPMENT AIR CONDITIONING UNIT CONTROL SEQUENCES

A. Room Temperature Monitoring: Monitor room temperature in elevator equipment room.

B. Display:
1. Room temperature.

C. System Safety Control
1. High Room Temperature Alarm: Activate BAS workstation alarm if room air temperature exceeds 80°F (adjustable) for more than 2 minutes.

1.8 EXHAUST FAN (LEF-1) CONTROL SEQUENCES

A. Exhaust Fan 1 System Enable: Enable the associated exhaust fan system subject to Hand/Off/Auto selector switch BAS selector switch.

1. Hand Position: System shall run continuously
2. Off Position: System is disabled continuously.
3. Auto Position: System shall run continuously, 24 hours per day, 365 days per year.

B. Start and Stop Exhaust Fan:

1. Enable: Smoke Control:

a. Input Device: Duct-mounted smoke detector, located in outside and supply air of AHU-1.
b. Output Device: Output to variable frequency drive and isolation damper.
c. Action: Open isolation damper and allow start via VFC if duct is free of products of combustion.

2. Initiate: Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output to motor starter.
c. Action: Energize fan(s).

3. Initiate: Unoccupied Time Schedule:

a. Fan is always in occupied mode unless overridden from the BAS workstation.

4. Display: Supply-fan on-off indication.

C. Exhaust Fan Variable-Volume Control:

1. Occupied Time Schedule:

a. Input Device: DDC system time schedule.
b. Output Device: Binary output.
c. Action: Enable control.

2. Volume Control: LEF-1 shall utilize a variable frequency drive, but shall operate at 60Hz during normal operation for maximum exhaust air discharge velocity.

a. Input Device: Static-pressure transmitter sensing supply-duct static pressure referenced to conditioned-space static pressure.
b. Action: Maintain exhaust-duct static pressure setpoint. Coordinate with balancing contractor for setpoints.

3. Display:

a. Exhaust-fan static-pressure indication.
b. Exhaust-fan-discharge static-pressure set point.
c. Exhaust air temperature upstream of heat pipe.
d. Exhaust air temperature downstream of heat pipe.

D. Exhaust Fan Safety Control

1. Fan Failure: Activate BAS workstation alarm if the supply fan is commanded “ON” and the fan status is “OFF” after a 30 second delay period. Stop the fan.

E. Exhaust Fan (LEF-1) Fire/Smoke Alarm Operation.

1. In the event of a shutdown of AHU-1 during a smoke alarm, LEF-1 should reduce speed via variable frequency drive to a minimum setting to provide a minimum level of ventilation for the laboratories and chemical storage room. This shall be done to keep minimum ventilation and also allow door operation in the labs per code. Minimum speed setting should be set by the balancing contractor.

1.9 LABORATORY AIR OPERATING SEQUENCE

A. The DDC system shall interface with the laboratory airflow control system to provide the following sequences. The laboratory airflow control system shall control airflows to maintain room negative static pressure.

B. Supply Air Valves:

1. Occupancy:

a. Input Device: Time schedule.

b. Output Device: DDC system binary output.
c. Action: Report occupancy and enable occupied temperature and flow set points.

1) Heating Occupied Temperature: 68 deg F.
2) Heating Unoccupied (room unoccupied but building in occupied mode) Temperature: 65 deg F
3) Heating Night Setback: 55 deg F.
4) Cooling Occupied Temperature: 75 deg F.
5) Cooling Unoccupied (room unoccupied but building in occupied mode) Temperature: 80 deg F
6) Cooling Night Setback: 85 deg F.
7) Occupied Airflow: Constant air flow per plans.
8) Unoccupied Airflow: 4 ACH.

2. Room Temperature:

a. Input Device: Electronic temperature sensor.
b. Output Device: Air valve actuators and control-valve operators.
c. Action: Modulate air valve and steam valve to maintain temperature.

1) Sequence air valve from full open to minimum position, then heating valve from closed to fully open.

3. Laboratory Pressure Control:
a. Control shall be determined by laboratory controls to maintain lab negative pressure.

4. Laboratory Exhaust Fan Shutdown:
a. Provide interface with laboratory and science prep fume hoods so that in the event that LEF-1 is OFF that fume hood monitors will not enable the audible alarm. The fume hoods specified and the existing relocated hoods have this option as part of the fume hood monitor. If LEF-1 is ON audible alarm shall be able to operate.

5. Display:

a. Room/area served.
b. Room occupied/unoccupied.
c. Room temperature indication.
d. Room temperature set point.
e. Room temperature set point, occupied.
f. Room temperature set point, unoccupied.
g. Supply air valve discharge temperature (downstream of heating coil).
h. Control-valve position as percent open.
i. System in purge sequence.

1.10 VENTILATION SEQUENCES

A. Exhaust Fans (all exhaust fans except for LEF-1): DDC system cycles fan based on occupied/unoccupied schedule.

B. Motorized damper shall open when fan is on and close when fan is off.

1.11 VARIABLE REFRIGERANT FLOW HEAT PUMP / FAN COILS

A. Variable refrigerant flow fan coil unit and heat pump shall operate via integrated controls to maintain the occupied setpoint temperature. The fan coil units shall monitor room air temperature to maintain the setpoint. The occupant shall be able to adjust the room temperature between 68 degrees F and 74 degrees F (adjustable from the DDC system).

B. FC-5-OSA. Provide controls to enable unit of the occupied schedule. Unit shall operate to maintain the supply air temperature of 68 degrees to 72 degrees F. Provide supply air temperature reset based on building loads.

C. Fan Coils

1. Occupancy:

a. Input Device: Time schedule.
b. Output Device: DDC system binary output.
c. Action: Report occupancy and enable occupied temperature and flow set points.

1) Heating Occupied Temperature: 68 deg F.
2) Heating Unoccupied (room unoccupied but building in occupied mode) Temperature: 65 deg F
3) Heating Night Setback: 55 deg F.
4) Cooling Occupied Temperature: 75 deg F.
5) Cooling Unoccupied (room unoccupied but building in occupied mode) Temperature: 80 deg F
6) Cooling Night Setback: 85 deg F.
7) Occupied Airflow: Constant air flow per plans.
8) Unoccupied Airflow: 0.

D. Heating/Cooling Switchover

1. Determined by VRF manufacturer.

E. The DDC system shall be able to monitor and or control the following fan coil/heat pump points via BACnet through the VRF system controls. These points shall be graphically displayed and the workstation.

1. Fan coil status.
2. Room temperature.
3. Room temperature setpoint.
4. Fan coil enable/disable.
5. Associated heat pump status.
6. Associated heat pump enable/disable.
7. Carbon dioxide (where applicable see plans).

1.12 OPTIMUM START CONTROLS

A. Provide optimum start controls for fan coils and air handling unit systems so that building temperatures are just met at the time of building occupancy.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993.11

SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fittings for LP steam less than 15 psig and condensate piping.

1. Steel pipe and fittings.
2. Joining materials.

B. Related Requirements:

1. Section 232216 "Steam and Condensate Heating Piping Specialties" for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

1.2 ACTION SUBMITTALS

A. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:

1. LP Steam Piping: 15 psig.
2. Condensate Piping: 1 psig at 250 deg F.
3. Makeup-Water Piping: NA
4. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
5. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.

C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. Condensate Piping above Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

C. Condensate Piping below Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

3.2 ANCILLARY PIPING APPLICATIONS

A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

B. Vacuum-Breaker Piping: Outlet, same as service where installed.

C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to top of main pipe.

P. Install valves according to the following Sections or other Sections as needed:

1. Section 230523.11 "Globe Valves for HVAC Piping."
2. Section 230523.12 "Ball Valves for HVAC Piping."
3. Section 230523.13 "Butterfly Valves for HVAC Piping."
4. Section 230523.14 "Check Valves for HVAC Piping."
5. Section 230523.15 "Gate Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

U. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

V. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

W. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.

2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 STEAM AND CONDENSATE PIPING SPECIALTIES INSTALLATION

A. Comply with requirements in Section 232216 "Steam and Condensate Heating Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers and supports. Comply with requirements below for maximum spacing.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

D. Install hangers for steel steam supply piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 9 feet.
2. NPS 1: Maximum span, 9 feet.
3. NPS 1-1/2: Maximum span, 12 feet.
4. NPS 2: Maximum span, 13 feet.
5. NPS 2-1/2: Maximum span, 14 feet.
6. NPS 3 and Larger: Maximum span, 15 feet.

E. Install hangers for steel steam condensate piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps and control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install vacuum breakers downstream from control valve, close to coil inlet connection.

E. Install a drip leg at coil outlet.

3.8 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

E. Prepare test and inspection reports.

END OF SECTION 232213

SECTION 232216 - STEAM AND CONDENSATE HEATING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following piping specialties for steam and condensate piping:

1. Strainers.
2. Stop-check valves.
3. Safety valves.
4. Steam traps.
5. Thermostatic air vents and vacuum breakers.
6. Flexible connectors.

B. Related Requirements:
1. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
2. Section 230523.13 "Butterfly Valves for HVAC Piping" for specification and installation requirements for butterfly valves common to most piping systems.
3. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
4. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.
5. Section 230923.11. "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Strainer.
2. Valve.
3. Steam trap.
4. Air vent and vacuum breaker.
5. Connector.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
   1. LP Steam Piping: 15 psig.
   2. Condensate Piping: 1 psig at 250 deg F.
   3. Makeup-Water Piping: NA
   4. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
   5. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
   6. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STRAINERS

A. Y-Pattern Strainers:

   1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
   3. Strainer Screen: Stainless-steel, 20-mesh strainer or perforated stainless-steel basket.
   4. Tapped blowoff plug.
   5. CWP Rating: 250-psig working steam pressure.

2.3 STOP-CHECK VALVES

A. Stop-Check Valves:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. A.Y. McDonald Mfg. Co.
      b. Cincinnati Valve Company.
      c. Crane; a Crane brand.
      d. Jenkins Valves.
      e. Lunkenheimer Valves.

   2. Body and Bonnet: Malleable iron.
   3. End Connections: Flanged.
   4. Disc: Cylindrical with removable liner and machined seat.
   5. Stem: Brass alloy.
   6. Operator: Outside screw and yoke with cast-iron handwheel.
   7. Packing: PTFE-impregnated packing with two-piece packing gland assembly.

8. Pressure Class: 250.

2.4 STEAM SAFETY VALVES

A. Bronze or Brass Steam Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Flow Controls; Conbraco Industries, Inc.
   b. Armstrong International, Inc.
   c. Kunkle Valve.
   d. Spirax Sarco, Inc.
   e. WATTS.

2. Disc Material: Forged copper alloy.
3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet, with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.5 STEAM TRAPS

A. Thermostatic Steam Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
   d. Hoffman Specialty.
   e. Spirax Sarco, Inc.
   f. Sterling.
   g. Tunstall Corporation.

2. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
3. Trap Type: Balanced pressure.
4. Bellows: Stainless steel or monel.
5. Head and Seat: Replaceable, hardened stainless steel.
6. Pressure Class: 125.

B. Float and Thermostatic Steam Traps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Barnes & Jones, Inc.
    c. Dunham-Bush, Inc.
    d. Hoffman Specialty.
    e. Spirax Sarco, Inc.
    f. Sterling.
    g. Tunstall Corporation.

2. Body and Bolted Cap: ASTM A 126 cast iron.
3. End Connections: Threaded.
4. Float Mechanism: Replaceable, stainless steel.
5. Head and Seat: Hardened stainless steel.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
9. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless-steel cage, valve, and seat.
10. Maximum Operating Pressure: 125 psig.

2.6 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong International, Inc.
    b. Barnes & Jones, Inc.
    c. Dunham-Bush, Inc.
    d. Hoffman Specialty.
    e. Spirax Sarco, Inc.
    f. Sterling.
    g. Tunstall Corporation.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Float, Valve, and Seat: Stainless steel.
5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

B. Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Dunham-Bush, Inc.
c. Hoffman Specialty.
d. Johnson Corporation (The).
e. Spirax Sarco, Inc.
f. Tunstall Corporation.

2. Body: Cast iron, bronze, or stainless steel.
3. End Connections: Threaded.
4. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
5. O-Ring Seal: Ethylene propylene rubber.
6. Pressure Rating: 125 psig.
7. Maximum Temperature Rating: 350 deg F.

2.7 FLEXIBLE CONNECTORS

A. Stainless-Steel Bellows, Flexible Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Duraflex, Inc.
b. Flexicraft Industries.
c. Hyspan Precision Products, Inc.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. Twin City Hose, Inc.

2. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
3. End Connections: Threaded or flanged to match equipment connected.
4. Performance: Capable of 3/4-inch misalignment.
5. CWP Rating: 150 psig.
6. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 PIPING INSTALLATION

A. Install piping to permit valve servicing.

B. Install drains, consisting of a tee fitting, NPS 3/4 full-port ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

C. Install valves according to:

1. Section 230523.11 "Globe Valves for HVAC Piping."
2. Section 230523.12 "Ball Valves for HVAC Piping."
3. Section 230523.13 "Butterfly Valves for HVAC Piping."
4. Section 230523.14 "Check Valves for HVAC Piping."
5. Section 230523.15 "Gate Valves for HVAC Piping."

D. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment and elsewhere as indicated.

E. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full-port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

3.3 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.

B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.4 SAFETY VALVE INSTALLATION

A. Install safety valves according to ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping."

B. Pipe safety-valve discharge without valves to atmosphere outside the building.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.5 TERMINAL EQUIPMENT CONNECTIONS

A. Install traps and control valves in accessible locations close to connected equipment.

B. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

C. Install vacuum breakers downstream from control valve, close to coil inlet connection.

END OF SECTION 232216