AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF PAGES
	1	3

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0002	5 FEB 99		

6. ISSUED BY CODE

Department of the Army
Corps of Engineers
Fort Worth District

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE FACILITY CODE

(√) X

9A. AMENDMENT OF SOLICITATION NO.
DACA63-99-R-0003

9B. DATED *(SEE ITEM 11)*
18 DECEMBER 1998

10A. MODIFICATION OF CONTRACTS/ORDER NO.

10B. DATED *(SEE ITEM 13)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(√) A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).

C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for BASE OPERATIONS FACILITY, RANDOLPH AIR FORCE BASE, SAN ANTONIO, TEXAS, is amended as follows:

See Continuation Sheet.

NOTE: The Bid Opening date remains "17 February 1999 at 4 pm, local time", as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

A. DRAWINGS:

(1) Sequence 36, Sheet A4-1, 1st Floor Reflected Ceiling Plan: Room 128; change Notes by Symbol to 8, instead of 7.

(2) Sequence 112, Sheet TE-01, Temporary Facility Electrical Site Plan: Change graphic scale to 1:200 instead of 1:10.

(3) Sequence 17, Sheet A2-1, Architectural First Floor Plan: Add the following:

a. Room 103: add 1 marker board to north wall.
b. Room 104: add 1 marker board to south wall.
c. Room 105: add 1 marker board to north wall.
d. Room 113: add 1 marker board to west wall.

(4) Sequence 18, Sheet A2-2, Architectural Second Floor Plan: Add the following:

a. Room 202: add 1 marker board to west wall.
b. Room 204: add 1 marker board to west wall, north of door.
c. Room 204: add 1 tack board to west wall, south of door.
d. Room 213: add 1 marker board to south wall.
e. Room 213: add 1 tack board to east wall.

(5) Sequence 94, Sheet E2-2. Keynote 1. The actual monorail hoist not in contract. See Structural for monorail rail to be provided in contract.

(6) Sequence 92 and Sequence 112, Sheets E1-1 and TE-01, modify Note 1 to read "… four 25mm innerducts…".

(7) Sequence 92, Sheet E1-1, Append the following to Note 17; "Concrete encase primary ducts as shown on Detail 2, Sheet E6-2."

(8) Sequence 105, Sheet E7-2, Detail 2 - COMMUNICATIONS RISER DIAGRAM, modify the note callout on the Panduit panel to refer to Category V cable, rather than Category VII cable.

(9) Sequence 105, Sheet E7-2, Detail 1 – FIRE ALARM RISER DIAGRAM, add a manual pull station on the initiating circuit and label RM 106.

(10) Sequence 105, Sheet E7-2, Detail 2 – COMMUNICATIONS RISER DIAGRAM, modify the note callout on the communications entry conduit to read "… four 25mm innerducts…".

(11) Sequence 97, Sheet E4-1, add a manual pull station in Room 106 on the east wall adjacent to the north exit doors.

(12) Sequence 42, Sheet A8-1, Room Finish Table, Flooring, C2 (border) shall be 300 mm wide for all floors labeled for F2 flooring.

(13) The drawings listed below shall be voided and the attached new drawings of the same number, each bearing the notation "AM #0002", shall be substituted therefor:

Seq 3 G0-3 LOCATION/AREA MAPS
Seq 6 C0-1 LEGENDS, GENERAL NOTES, SYMBOLS
Seq 7 C3-1 SITE DEMOLITION PLAN
Seq 8 C4-1 SITE PLAN
Seq 9 C7-1 UTILITY PLAN
Seq 65 M1-1 MECHANICAL LEGEND AND SCHEDULES
Seq 77 P2-1 FIRST FLOOR PLUMBING PLAN

B. SPECIFICATIONS:

(1) Section 02551 Bituminous Paving for Roads, Streets and Open Storage Areas, change the following:

Paragraph 2.1.3 a: Revise to read; 'Material retained on the 2 mm size sieve shall not exceed 65 percent.'

Paragraph 2.2.1: Revise next to last sentence to read; 'Bituminous mix that deviates more than 4 degrees C. from the JMF shall be rejected.'

Paragraph 2.2.2.1: Revise TABLE II, first line to read:

Wearing Course Intermediate Course.

Stability minimum, newtons 2200 2200

(2) SECTION 16528 EXTERIOR LIGHTING

Paragraph 16528-2.9 revised to read as follows:

Metal and concrete poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of 31.3 meters per second at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-2. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

(3) The following listed section shall be voided and the accompanying new section of the same title and number, bearing the notation "ACCOMPANYING AMENDMENT NO. 0002 TO SOLICITATION NO. DACA63-99-R-0003" shall be substituted therefor:

SECTION 15569 WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH

SECTION 15569

WATER AND STEAM HEATING; OIL, GAS OR BOTH; UP TO 20 MBTUH

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

\-ANSI Z21.13-\	(1991; Z21.13a; Z21.13b) Gas-Fired Low-Pressure Steam and Hot Water Boilers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

\-ASTM A 53-\	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
\-ASTM A 105-\	(1996) Forgings, Carbon Steel, for Piping Components
\-ASTM A 167-\	(1993) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
\-ASTM A 193-\	(1996) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
\-ASTM A 234-\	(1996) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
\-ASTM A 366-\	(1991; R 1993) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
\-ASTM A 515-\	(1992) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
\-ASTM A 516-\	(1990) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
\-ASTM A 526-\	(1990) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
\-ASTM B 32-\	(1995) Solder Metal
\-ASTM B 75-\	(1993) Seamless Copper Tube
\-ASTM B 88-\	(1993a) Seamless Copper Water Tube
\-ASTM B 813-\	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

\-ASTM B 828-\	(1992) Making Capillary Joints by Soldering of Copper and Copper-Alloy Tube and Fittings
\-ASTM D 596-\	(1991) Reporting Results of Analysis of Water

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

\-ASME B1.20.1-\	(1983; R 1992) Pipe Threads, General Purpose (Inch)
\-ASME B16.3-\	(1992) Malleable Iron Threaded Fittings
\-ASME B16.4-\	(1992) Cast Iron Threaded Fittings
\-ASME B16.5-\	(1988; Errata Oct 88; B16.5a) Pipe Flanges and Flanged Fittings
\-ASME B16.9-\	(1993) Factory-Made Wrought Steel Buttwelding Fittings
\-ASME B16.11-\	(1991) Forged Fittings, Socket-Welding and Threaded
\-ASME B16.15-\	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
\-ASME B16.18-\	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
\-ASME B16.21-\	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
\-ASME B16.22-\	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
\-ASME B16.26-\	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
\-ASME B16.34-\	(1988) Valves - Flanged, Threaded and Welding End
\-ASME B16.39-\	(1986; R 1994) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
\-ASME B31.1-\	(1995) Power Piping
\-ASME B31.5-\	(1992; B31.5a) Refrigeration Piping
\-ASME B40.1-\	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
\-ASME BPV IV-\	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section IV, Heating Boilers
\-ASME BPV VIII Div 1-\	(1995; Addenda Dec 1995) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

AMERICAN WATER WORKS ASSOCIATION (AWWA)

\-AWWA C606-\	(1987) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

\-AWS A5.8-\	(1992) Filler Metals for Brazing and Braze Welding
\-AWS B2.2-\	(1991) Brazing Procedure and Performance Qualification

COPPER DEVELOPMENT ASSOCIATION (CDA)

\-CDA 404/0-RR-\	(1993) Copper Tube for Plumbing, Heating, Air Conditioning and Refrigeration

HYDRONICS INSTITUTE (HYI)

\-HYI-IBR Ratings-\	(1994) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

\-MSS SP-25-\	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
\-MSS SP-58-\	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
\-MSS SP-69-\	(1991) Pipe Hangers and Supports - Selection and Application
\-MSS SP-70-\	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
\-MSS SP-71-\	(1990) Cast Iron Swing Check Valves, Flanges and Threaded Ends
\-MSS SP-72-\	(1992) Ball Valves with Flanged or Buttwelding Ends for General Service
\-MSS SP-73-\	(1991) Brazing Joints for Copper and Copper Alloy Pressure Fittings
\-MSS SP-78-\	(1987; R 1992) Cast Iron Plug Valves, Flanged and Threaded Ends
\-MSS SP-80-\	(1987) Bronze Gate, Globe, Angle and Check Valves
\-MSS SP-85-\	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
\-MSS SP-110-\	(1992) Ball Valves Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

\-NFPA 54-\	(1992) National Fuel Gas Code

\-NFPA 85C-\	(1991) Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-Furnaces
\-NFPA 8501-\	(1992) Single Burner Boiler Operations

UNDERWRITERS LABORATORIES (UL)

\-UL-06-\	(1994; Supple) Gas and Oil Equipment Directory
\-UL 795-\	(1994) Commercial-Industrial Gas Heating Equipment

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.2 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

1.2.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each pressure vessel shall have an approved ASME stamp.

1.2.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown

1.2.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section \=01300=\ SUBMITTAL PROCEDURES:

SD-01 Data\

Manufacturer's Catalog Data\; *GA*\.

Manufacturer's catalog data shall be included with the detail drawings for the following items:

Boilers
Fuel Burning Equipment
Pumps
Fittings and Accessories

The data shall show model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements.

Spare Parts Data\; *FIO*\.

Spare parts data for each different item of material and equipment, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

Water Treatment Plan\; *FIO*\.

Six complete copies of the proposed water treatment plan. The plan shall include a layout, control scheme, a list of the existing water conditions including the items listed in paragraph BOILER WATER TREATMENT, a list of all chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Heating and Fuel Systems Test Procedures\; *GA*\.

Proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

Qualification\; *FIO*\.

A statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section.

SD-04 Drawings\

Heating System\; *GA*\.

Detail drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-06 Instructions\

Posted Instructions\; *GA*\.

System layout diagrams that show the layout of equipment, piping, and ductwork and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

SD-07 Schedules\

Tests\; *FIO*\.

Proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing.

SD-09 Reports\

Heating System and Fuel System Tests\; *FIO*\.

Test reports for the heating system tests and the fuel system test, upon completion of testing complete with results.

Water Treatment Tests\; *FIO*\.

(1) The water quality test report shall identify the chemical composition of the boiler water. The report shall include a comparison of the condition of the boiler water with the manufacturer's recommended conditions. Any required corrective action shall be documented within the report.

(2) A test report shall identify the condition of the boiler at the completion of 1 year of service. The report shall include a comparison of the condition of the boiler with the manufacturer's recommended operating conditions.

SD-13 Certificates\

Bolts\; *FIO*\.

Written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

Boiler Emissions\; *FIO*\.

Written certification by the boiler manufacturer that each boiler furnished complies with Federal, state, and local regulations for emissions. The certification shall also include a description of applicable emission regulations. If any boiler is exempt from the emission regulations, the certification shall indicate the reason for the exemption.

SD-19 Operation and Maintenance Manuals\

Heating System\; *GA*\.

Six complete manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 8 hour onsite response to a service call on an emergency basis.

Water Treatment System\; *GA*\.

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures, including procedures for testing the water quality.

1.4 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

PART 2 PRODUCTS

2.1 BOILERS

Each boiler shall have the output capacity in kilowatts (kW) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, natural draft/atmospheric burner, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with \-ASME BPV IV-\. Each boiler shall be of the watertube type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in \-HYI-IBR Ratings-\ or as certified by the American Boiler Manufacturers Association, or American Gas Association. Each boiler shall be designed for exterior installation and service.

2.1.1 Watertube Boiler

Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. The heat input rate for finned tube designs shall not be greater than 38 Kw per square meter based on internal heater area. The heat input rate for other boilers shall not be greater than 12 Kw per square meter of fireside heating surface.

2.2 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn gas. Boiler shall comply with Federal, state, and local emission regulations. As a minimum, the following emission requirements shall be met:

2.2.1 Burners

2.2.1.1 Gas Fired Burners and Controls

Burners shall be UL approved natural draft/atmospheric burners. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

a. Gas-fired units shall conform to \-UL 795-\. Gas fired units less than 3.66 MW input shall conform to \-ANSI Z21.13-\. Single burner gas-fired units greater than or equal to 3.66 MW input shall conform to \-NFPA 8501-\. Multiple burner gas-fired units greater than or equal to 3.66 MW input shall conform to \-NFPA 85C-\.

2.3 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water temperature shall be controlled by a water temperature controller. The equipment shall operate either electrically. On multiple boiler installations, each boiler unit shall have a completely independent system of controls responding to the load and to a plant master controller. If recording instruments are provided, a 1 year supply of ink and 400 blank charts for each recorder shall be furnished.

2.3.1 Electrical controls

Electrical control devices shall be rated at 120 volts and shall be connected as specified in Section \=16415=\ ELECTRICAL WORK, INTERIOR.

2.3.2 Water Temperature Controller

See Temperature Control Sequence

2.3.2.1 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall be interlocked with the combustion control system to effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

[AM#2] 2.3.3 Combustion Safety Controls and Equipment

Combustion safety controls and equipment shall be UL listed, microprocessor-based distributed process controller. The controller shall be composed of an EPROM type chip. The system shall include mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions,

sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. Controllers shall be mounted in weather resistant enclosures designed to protect the controllers. Indicator lamps, and signaling devices shall be visible without opening the enclosure. Controllers shall function properly when mounted in an exterior environment adjacent to the associated boiler. The enclosure shall protect the controller from failure due to temperature, humidity, dust, wind, rain, sleet, hail, or snow. Control systems and safety devices for automatically fired boilers shall conform to \-ASME CSD-1-\. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section \=16415=\ ELECTRICAL WORK, INTERIOR. A 100 mm diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

a. Flame failure.

b. Failure to establish pilot flame.

c. Failure to establish main flame.

d. Low-water.

e. High temperature cutoff.

[AM#2] 2.3.3.1 Low-water Cutoff

Low-water cutoff shall be provided to stop the burner when the water level drops below a predetermined point. The cutoff shall consist of a float chamber with float, float switch, and drain valve. The float switch shall be mounted on the float chamber with a packless-type leakproof connection. The float mechanism and drain valve shall be constructed of a corrosion-resistant material. The low-water cutoff shall be \-UL-06-\ listed and shall be furnished with approved fittings and installed according to ASME boiler code requirements.

2.4 PUMPS

2.4.1 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. and shall be closed-coupled shaftHot water circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base and shall have a closed-coupled shaft . The hot water circulating pumps shall be horizontal split case. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 115 degrees C temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the

manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The hot water circulating pump discharge heater shall be provided with a flow switch . Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow. Switch shall be a SPDT with 120-volt, 15-ampere rating.

2.4.1.1 Rating and Testing

The pump manufacturer shall submit a certified test report covering the actual test of the unit and certifying that the equipment complies with the indicated requirements.

2.5 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section \=15895=\ AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.6 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with \-ASME BPV IV-\, unless otherwise specified.

2.6.1 Expansion Tank

The hot water pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with \-ASME BPV VIII Div 1-\ for a working pressure of 850 kPa and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 120 degrees C .

2.6.2 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with \-ASME BPV VIII Div 1-\ for a working pressure of 850 kPa.

2.6.3 Steel Sheets

2.6.3.1 Galvanized Steel

Galvanized steel shall be \-ASTM A 526-\.

2.6.3.2 Uncoated Steel

Uncoated steel shall be \-ASTM A 366-\, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to manufacturer's standard gauge.

2.6.4 Gaskets

Gaskets shall be nonasbestos material in accordance with \-ASME B16.21-\, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.6.5 Steel Pipe and Fittings

2.6.5.1 Steel Pipe

Steel pipe shall be \-ASTM A 53-\, Type E or S, Grade A or B, black steel, standard weight.

2.6.5.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with \-MSS SP-25-\ so as to permanently identify the manufacturer.

2.6.5.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with \-ASME B16.5-\ class 150 and shall have the manufacturers trademark affixed in accordance with \-MSS SP-25-\. Flange material shall conform to \-ASTM A 105-\. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to \-ASTM A 516-\ cold service and \-ASTM A 515-\ for hot service. Bolts shall be high strength or intermediate strength with material conforming to \-ASTM A 193-\.

2.6.5.4 Welded Fittings

Welded fittings shall conform to \-ASTM A 234-\ with WPA marking. Buttwelded fittings shall conform to \-ASME B16.9-\, and socket-welded fittings shall conform to \-ASME B16.11-\.

2.6.5.5 Cast-Iron Fittings

Fittings shall be \-ASME B16.4-\, Class 125, type required to match connecting piping.

2.6.5.6 Malleable-Iron Fittings

Fittings shall be \-ASME B16.3-\, type as required to match connecting piping.

2.6.5.7 Unions

Unions shall be \-ASME B16.39-\, Class 150.

2.6.5.8 Threads

Pipe threads shall conform to \-ASME B1.20.1-\.

2.6.6 Copper Tubing and Fittings

2.6.6.1 Copper Tubing

Tubing shall be \-ASTM B 88-\, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

2.6.6.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to \-ASME B16.22-\ and \-ASTM B 75-\. Cast copper alloy solder-joint pressure fittings shall conform to \-ASME B16.18-\ and \-ASTM B 828-\.

2.6.6.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to \-ASME B16.26-\.

2.6.6.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.6.6.5 Threaded Fittings

Cast bronze threaded fittings shall conform to \-ASME B16.15-\.

2.6.6.6 Brazing Material

Brazing material shall conform to \-AWS A5.8-\.

2.6.6.7 Brazing Flux

Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides, and contain fluorides. Silver brazing materials shall be in accordance with \-AWS A5.8-\.

2.6.6.8 Solder Material

Solder metal shall conform to \-ASTM B 32-\ 95-5 tin-antimony.

2.6.6.9 Solder Flux

Flux shall be liquid form, non-corrosive, and conform to \-ASTM B 813-\, Standard Test 1.

2.6.7 Dielectric Unions

Dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. Metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact.

2.6.8 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 861.8 kPa or 1034.2 kPa service. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends.

Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.6.9 Pipe Supports

Pipe supports shall conform to \-MSS SP-58-\ and \-MSS SP-69-\.

2.6.10 Pipe Expansion

2.6.10.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in \-ASME B31.1-\. The loops and offsets shall be cold-sprung and installed where indicated. Pipe guides and anchors shall be provided as indicated.

2.6.11 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends per \-AWWA C606-\ may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of \-ASME B31.1-\. The connection type of all valves shall match the same type of connection required for the piping on which installed.

2.6.11.1 Gate Valves

Gate valves 65 mm and smaller shall conform to \-MSS SP-80-\ bronze rising stem, threaded, solder, or flanged ends. Gate valves 80 mm and larger shall conform to \-MSS SP-70-\ cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

2.6.11.2 Globe Valves

Globe valves 65 mm and smaller shall conform to \-MSS SP-80-\, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm and larger shall conform to \-MSS SP-85-\, cast iron, bronze trim, flanged, or threaded ends.

2.6.11.3 Check Valves

Check valves 65 mm and smaller shall conform to \-MSS SP-80-\, bronze, threaded, soldered, or flanged ends. Check valves 80 mm and larger shall conform to \-MSS SP-71-\, cast iron, bronze trim, flanged, or threaded ends.

2.6.11.4 Angle Valves

Angle valves 65 mm and smaller shall conform to \-MSS SP-80-\ bronze, threaded, soldered, or flanged ends. Angle valves 80 mm and larger shall conform to \-MSS SP-85-\, cast iron, bronze trim, flanged, or threaded ends.

2.6.11.5 Ball Valves

Ball valves 15 mm and larger shall conform to \-MSS SP-72-\ or \-MSS SP-110-\, ductile iron or bronze, threaded, soldered, or flanged ends.

2.6.11.6 Plug Valves

Plug valves 51 mm and larger shall conform to \-MSS SP-78-\. Plug valves smaller than 51 mm shall conform to \-ASME B16.34-\.

2.6.11.7 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 120 degrees C temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.6.11.8 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 1135 kPa . Valve bodies shall be cast iron, malleable iron, or steel. \-ASTM A 167-\, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm (8 inches) shall have throttling handles with a minimum of seven locking positions. Valves 200 mm and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.6.11.9 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to \-ASME BPV IV-\ and \-ASTM A 53-\.

2.6.11.10 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 15 and 70 kPa . The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with \-ASME BPV IV-\, shall be installed so that the discharge will be through piping extended to a location as indicated. Each discharge pipe for hot water service shall be pitched away from the valve seat.

2.6.12 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. Strainers shall be designed for 856 kPa service and 120 degrees C . The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 0.795 mm thick brass sheet with small perforations numbering not less than 620,000 per square m to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.6.13 Pressure Gauges

Gauges shall conform to \-ASME B40.1-\ and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall be 90 mm . A pressure gauge shall be provided for each boiler in a visible location on the boiler.

2.6.14 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Thermometers for inlet water and outlet water for each hot water boiler the feedwater for each steam boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 225 mm scale.

2.6.15 Air Vents

2.6.15.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

2.6.15.2 Automatic Air Vents

Automatic air vents shall be 20 mm (3/4 inch) quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein, and a thermostatic member that will close the port against the passage of steam from the system. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

2.7 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section \=16415=\ ELECTRICAL WORK, INTERIOR. Motors which are not an integral part of a packaged boiler shall be rated for standard efficiency service. Motors which are an integral part of the packaged boiler shall be

the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose, Class I, division I enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

2.7.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 375 W and larger shall be three-phase, unless otherwise indicated. Motors shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

2.7.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 7.46 kW ratings. Adjustable frequency drives shall be used for larger motors.

2.8 INSULATION

Shop and field-applied insulation shall be as specified in Section \=15250=\ THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.9 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet, mounted where directed.

2.9.1 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

2.10 BOILER WATER TREATMENT

The water treatment system shall be capable of feeding chemicals and bleeding the system to prevent corrosion and scale within the boiler and piping distribution system. The water shall be treated to maintain the conditions recommended by the boiler manufacturer. Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct chemicals and concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines and proprietary chemicals shall not be used. The water

treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

2.10.1 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.10.2 Chemical Piping

The piping and fittings shall be constructed of steel .

2.10.3 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

PART 3 EXECUTION

3.1 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 40 degrees C. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.2 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of \-ASME B31.1-\. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 100 mm and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 0.2 percent. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 65 mm or less in diameter and with flanges for pipe 80 mm or more in diameter.

Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.

3.2.1 Cold Water Connections

Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately 35 kPa in excess of the static head on the system and shall operate within a 15 kPa tolerance regardless of cold water supply piping pressure and without objectionable noise under any condition of operation.

3.2.2 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 110 degrees C.

3.2.3 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.2.4 Gauge Piping

Piping shall be copper tubing.

3.2.5 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, flanged or welded as indicated or specified. Except as otherwise specified, fittings 25 mm and smaller shall be threaded; fittings 32 mm and up to but not including 80 mm shall be either threaded, or welded; and fittings 80 mm and larger shall be either flanged, or welded. Pipe and fittings 32 mm and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 65 mm or smaller in diameter and with flanges for pipe 80 mm or larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

3.2.5.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

3.2.5.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch

connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1.5 mm and no more than 3 mm.

3.2.5.3 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Brazed joints shall be made in conformance with \-AWS B2.2-\, \-MSS SP-73-\, and \-CDA 404/0-RR-\ with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

3.2.5.4 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 50 mm and smaller. Soldered joints shall conform to \-ASME B31.5-\ and \-CDA 404/0-RR-\.

3.2.5.5 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.6 Flanges and Unions

Flanges shall be faced true, provided with 1.6 mm (1/16 inch) thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal

parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

3.2.7 Branch Connections

3.2.7.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 8 mm in 1 m. When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

3.2.8 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with \-MSS SP-73-\, and \-CDA 404/0-RR-\. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 50 mm (2 inches) or smaller. Soldered joints shall conform to \-ASME B31.5-\ and shall be in accordance with \-CDA 404/0-RR-\.

3.2.9 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.10 Supports

3.2.10.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep

pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

3.2.10.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to \-MSS SP-58-\ and \-MSS SP-69-\, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per \-MSS SP-69-\ and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Horizontal pipe supports shall be spaced as specified in \-MSS SP-69-\ and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1500 mm apart at valves.

h. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 4500 mm, not more than 2400 mm from end of risers, and at vent terminations.

i. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

(1) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 100 mm , a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

(2) Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm or by an amount adequate for the insulation, whichever is greater.

j. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

k. Piping in trenches shall be supported as indicated.

l. Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section \=05120=\ STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not exceed 22 kg. Loads exceeding 22 kg shall be suspended from panel points.

3.2.10.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 3 mm shall be provided between the pipe insulation and the clip or clamp for piping which may be subjected to thermal expansion.

3.2.11 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.2.12 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

3.2.13 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. A waterproofing clamping flange shall be installed as indicated where membranes are involved. Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall extend above top surface of floor a sufficient distance to allow proper flashing or finishing. Sleeves through roofs shall extend above the top surface of roof at least 150 mm for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 6 mm between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be

galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section \=07920=\ JOINT SEALING. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

Metal jackets shall not be thinner than 0.1524 mm thick aluminum, if corrugated, and 0.4 mm thick aluminum, if smooth.

Metal jackets shall be secured with aluminum or stainless steel bands not less than 9 mm wide and not more than 200 mm apart. When penetrating roofs and before fitting the metal jacket into place, a 15 mm wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 1000 mm above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a point just beyond the first elbow. When penetrating waterproofing membrane for floors, the metal jacket shall extend from a point below the back-up material to a minimum distance of 50 mm above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm above material to a minimum distance of 50 mm above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm above the floor; when passing through walls above grade, the jacket shall extend at least 100 mm beyond each side of the wall.

3.2.13.1 Pipes Passing Through Waterproofing Membranes

In addition to the pipe sleeves referred to above, pipes passing through waterproofing membranes shall be provided with a 1.6 mm lead flashing or a 0.55 mm copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall set over the membrane in a troweled coating of bituminous cement. The flashing shall extend above the roof or floor a minimum of 250 mm. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 250 mm in diameter which pass through waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.2.13.2 Optional Modular Mechanical Sealing Assembly

At the option of the Contractor, a modular mechanical type sealing assembly may be installed in the annular space between the sleeve and conduit or pipe in lieu of a waterproofing clamping flange and caulking and sealing specified above. The seals shall include interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.2.13.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 150 mm 6 inches in diameter, lead flashing sleeve for dry vents with the sleeve turned down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

3.2.13.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section \=07270=\ FIRESTOPPING.

3.2.14 Balancing Valves

Balancing valves shall be installed as indicated and/or specified.

3.2.15 Thermometer Wells

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.2.16 Air Vents

Air vents shall be installed where shown or directed. Air vents shall be installed in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.2.17 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.2.18 Drains

A drain connection with a 25 mm gate valve or 20 mm hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.2.19 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

3.3 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section \=15488=\ GAS PIPING SYSTEMS.

\-NFPA 54-\ shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in \-UL-06-\. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other components required for safe, efficient, and reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

3.4 FIELD PAINTING

Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section \=09900=\ PAINTING, GENERAL. Exposed pipe covering shall be painted as specified in Section \=09900=\ PAINTING, GENERAL. Aluminum sheath over insulation shall not be painted.

3.5 \+HEATING SYSTEM TESTS+

Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1-1/2 times the design working pressure. Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested. Caulking of joints shall not be permitted. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested. Upon completion of hydrostatic tests and before acceptance of the installation, the Contractor shall balance the heating system in accordance with Section \=15990=\ TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS; and operating tests required to demonstrate satisfactory functional and operational efficiency shall be performed. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

a. Certification of balancing.

b. Time, date, and duration of test.

c. Outside and inside dry bulb temperatures.

d. Temperature of hot water supply leaving boiler.

e. Temperature of heating return water from system at boiler inlet.

g. Boiler make, type, serial number, design pressure, and rated capacity.

h. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for burner motor.

i. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.

j. Flue-gas temperature at boiler outlet.

k. Percent carbon dioxide in flue-gas.

l. Grade or type and calorific value of fuel.

m. Draft at boiler flue-gas exit.

n. Draft or pressure in furnace.

o. Quantity of water circulated.

p. Quantity of fuel consumed.

q. Stack emission pollutants concentration.

Indicating instruments shall be read at half-hour intervals unless otherwise directed. The Contractor shall furnish all instruments, equipment, and personnel required for the tests and balancing. Fuels, water, and electricity shall be obtained as specified in the SPECIAL CLAUSES.

3.5.1 Water Treatment Testing

3.5.1.1 Water Quality Test

The boiler water shall be analyzed prior to the acceptance of the facility by the water treatment company. The analysis shall include the following information recorded in accordance with \-ASTM D 596-\.

Date of Sample	(_____)	
Temperature	(_____)	degrees C
Silica (SiO2)	(_____)	ppm (mg/1)
Insoluble	(_____)	ppm (mg/1)
Iron and Aluminum Oxides	(_____)	ppm (mg/1)
Calcium (Ca)	(_____)	ppm (mg/1)
Magnesium (Mg)	(_____)	ppm (mg/1)
Sodium and Potassium (Na and K)	(_____)	ppm (mg/1)
Carbonate (HCO3)	(_____)	ppm (mg/1)
Sulfate (SO4)	(_____)	ppm (mg/1)
Chloride (C1)	(_____)	ppm (mg/1)
Nitrate (NO3)	(_____)	ppm (mg/1)
Turbidity	(_____)	unit
pH	(_____)	
Residual Chlorine	(_____)	ppm (mg/1)
Total Alkalinity	(_____)	epm (meq/1)
Noncarbonate Hardness	(_____)	epm (meq/1)
Total Hardness	(_____)	epm (meq/1)
Dissolved Solids	(_____)	ppm (mg/1)
Fluorine	(_____)	ppm (mg/1)
Conductivity	(_____)	microhm/cm

If the boiler water is not in conformance with the boiler manufacturer's recommendations, the water treatment company shall take corrective action.

3.5.1.2 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler and condensate piping shall be inspected for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs shall be made by the water treatment company.

3.6 CLEANING

3.6.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and feed water piping shall be thoroughly cleaned by filling the system with a solution consisting of either 0.5 kg of caustic soda or 0.5 kg of trisodium phosphate per 100 L of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 65 degrees C and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

3.6.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new filters shall be installed after construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.7 FIELD TRAINING

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations and boiler safety devices. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

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