DIVISION 23

SECTION 23 09 13

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes requirements for provision of automatic temperature control equipment, devices, components, accessories and associated wiring for HVAC systems and components.

B. Where so specified under Section 23 52 39, “Firetube Boilers”, controls and wiring associated with the Steam Boiler Plant and associated auxiliary equipment, shall be provided as specified under Section 23 52 39.

C. Where so specified under Section 23 09 14, “Natural Gas and CO Gas Leak Detection Equipment”, controls and wiring associated with the natural gas leak detection systems shall be provided as specified under Section 23 09 14.

D. Where so specified under Section 23 09 24, “Steam Flow Meters”, controls and wiring associated with the steam flow meters shall be provided as specified under Section 23 09 24.

E. Where so specified under Section 23 25 19, “Water Treatment for Steam System Feedwater”, controls and wiring associated with the water treatment for steam feedwater systems shall be provided as specified under Section 23 25 19.

F. The Automatic Temperature Control Sequences of Operation for the Building No. 5 Steam Boiler Plant and the boilers Feedwater Pumps and Receiver Set shall be as specified under Sections 23 52 39 and 23 53 13, respectively. The Automatic Temperature Control Sequences of Operation for the ventilation systems of the gas fired Water Heater Rooms of the Buildings (Satellite Buildings) other than that of the central steam boiler plant, shall be as specified under this Section.

G. Future BMS monitoring points for future instrumentation connections and interfaces with the future BMS, to be provided under a separate Contract by Others, in the future, shall be accommodated by means of provision of piping taps, ports and auxiliary contact sets that shall be provided by the Contractor under this Section, in accordance with the Future BMS Points List as specified under this Section.

H. Under a future separate contract scope of work, to be provided by Others, the Building No. 5 central steam boiler plant is to be provided with a BACnet protocol supervisory building controller (Tridium JACE 8000, or equivalent), to collect data from the boiler master controller and other boiler plant equipment and monitoring points. The supervisory building controller will interface with existing Niagara N4 front end software and utilize NYCHA standard graphics templates and naming standards. A BMS Points List for monitoring and control in the Central Steam Boiler Plant, and the gas-fired domestic water heating systems of each of the Buildings, is specified under Sub-

Paragraph 2.11 of this Section. The Instrumentation and Controls Contractor of this Section shall provide the necessary piping pressure, temperature and flow-rate wells, ports, taps, instrumentation, meters, associated control wiring, control transformers and power for control, to facilitate the future connections of the monitoring and controls instrumentation of the new central Steam Boiler Plant, and of each of the new domestic water heating systems, as specified under the BMS Points List of this Section, to the future BMS. The interfaces with the future BMS shall be for provision of "monitoring-only" BMS points, except where otherwise specifically noted for "shut-down override" control points, so that the local central boiler plant control system provided as specified under Section 23 52 39, and the local domestic hot water heating control systems provided as specified under the Plumbing Sections of the Work, retain the highest level of independent authority for command and control of their systems.

1. The new central steam boiler plant controls, as specified to be provided under Section 23 52 39, are to utilize open BACnet and/or Modbus protocols.
2. The new domestic water heaters, as specified under the Plumbing Sections of the Work, are to be provided with an integral BACnet card, and instrumentation ports and taps are to be provided as shown under the Plumbing Contract Drawings, as necessary in each Building's domestic water heaters system, for future connections of future monitoring instrumentation to be provided by others, to the future BMS.
3. Plant steam flow meters, makeup water meters and potable cold water supply meters to new domestic water heaters, as specified under other Sections of Div. 22 and Div. 23, are to be furnished and installed to facilitate future remote monitoring via the future BMS.
4. The natural gas utility meter is to be provided with capability to facilitate real-time digital monitoring via the future BMS.

I. The existing steam boiler plant NYCHA Computerized Heating Automation System (CHAS) panels, as identified on the Contract Drawings, (ie., existing Intec21 ZVLC and RE control panels, and existing Dunham Corp. control panels), shall remain in-place, fully intact, operational and functional, and the Contractor shall provide complete temporary protection for the existing control panels, fully protecting them from any potential damages due to impact, dust and/or moisture, throughout the duration of construction. The existing steam boiler plant NYCHA CHAS panels shall remain in-place, fully intact and operational throughout the complete duration of this Contract Scope of Work, and until the future BMS system controls work begins. Any new control wiring interfaces to be provided from new instrumentation or sequencers to the existing CHAS panels that are to remain, shall be provided in such a manner so as to easily allow for later control panel replacement to a nearby location.

J. Related Sections:

1. Section 01 51 23 - Temporary Heating
2. Section 23 05 00 – Common Work Results For HVAC
3. Section 23 05 13 - Common Motor Requirements For HVAC Equipment
4. Section 23 05 23 - General Duty Valves For HVAC Piping
5. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
6. Section 23 05 53 - Identification for HVAC Piping and Equipment
7. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

8. Section 23 07 00 - HVAC Insulation
9. Section 23 09 13 - Instrumentation and Control for HVAC
10. Section 23 09 14 - Natural Gas and CO Gas Leak Detection Equipment
11. Section 23 09 23 - Control Dampers
12. Section 23 09 24 - Steam Flow Meters
13. Section 23 22 13 - Steam and Condensate Heating Piping
14. Section 23 25 19 - Water Treatment for Steam System Feedwater
15. Section 23 31 13 - Metal Ducts
16. Section 23 33 00 - Air Duct Accessories
17. Section 23 34 16 - Boiler Room Combustion Air Makeup And Ventilation System
18. Section 23 51 00 - Chimney Liner
19. Section 23 51 16 - Prefabricated Breechings and Accessories
20. Section 23 51 23 - Gas Vents
21. Section 23 52 39 - Firetube Boilers
22. Section 23 53 12 - Vacuum Condensate Pumps
23. Section 23 53 13 - Boiler Feedwater Pumps

1.02 SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. BMS Points Lists, demonstrating conformance with the BMS Points List requirements as specified herein.
5. Automatic Control Sequences of Operation, demonstrating conformance with the Automatic Control Sequences of Operation as specified herein.

C. Software and firmware operational documentation.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.04 GUARANTEE

A. All heating control panels, outdoor sensors and system sensors installed under this Contract, shall carry a three (3) year labor and material guarantee starting from the date of installation and successful testing and commissioning of the new system. Replacements of any of these components shall be at no cost to NYCHA, during the Guarantee Period. Any component that has a failure rate of twenty-five percent (25%) within the Guarantee Period shall be replaced with one of a superior quality and shall

carry a full three (3) years guarantee from the date of replacement. The Contractor shall furnish instruments separately evidencing the guarantees covered by the Contract.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work shall include, but are not limited to, the manufacturers specified or Approved Equal.

2.02 CONTROL SYSTEM

A. Available Manufacturers:

1. Alerton Inc.
2. Andover Controls Corporation.
3. Automated Logic Corporation
4. Delta Controls Inc.
5. Heat-Timer Corporation.
6. Honeywell International Inc., Building Controls Div.
7. Invensys Building Systems.
8. Johnson Controls, Inc.; Controls Group.
9. Siemens Building Technologies, Inc.
10. Intech21 Corp.
11. Preferred Utilities Corp.
12. Or Approved Equal.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, control panel, other apparatus, wiring and accessories to control mechanical systems.

2.03 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor.
2. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.04 MOTORIZED MODULATING FEEDWATER CONTROL VALVES

A. Automatic modulating feedwater control valves shall be of the electrically operated proportioning design, of size as recommended by the boiler manufacturer. Valve actuator shall return the valve to close position by spring action in case of loss of power. Feedwater valves shall be operated by their associated boiler mounted water level controller. A three valve manual by-pass piping arrangement, with full-sized globe bypass valve and two gate valves, shall be provided for each feedwater valve assembly at each boiler's feedwater valve. Voltage shall be 120V/1-Ph/60Hz. The timing of the proportioning modulating feedwater valve motor shall not exceed 30 seconds. Feedwater valve shall be a servo type as furnished by Preferred Instruments or Autoflame Engineering, or a Belimo B2-Series, or Approved Equal, two-way modulating ball valve, with forged brass nickel plated body, stainless steel ball, stainless steel stem, fiberglass reinforced Teflon PTFE, 2 EPDM O-rings packing, 600 psi pressure rating.

2.05 BUILDING HEATING CONTROL PANELS (This Sub-Paragraph Shall Only Apply If And Where The Contract Drawings May Specifically Call For Replacement Of Any Existing Intech Corp. Heating Control Panels.)

A. If the Contract Drawings do not explicitly call for replacement of any existing Intech Corp. heating control panels, and/or building end-of-steam-main heat sensors, this entire Sub-Paragraph shall NOT apply.

B. The new heating control panels shall be of modular construction to facilitate field modification, upgrading or repair. The heating control panel shall incorporate the following four integrated functions:

1. Outdoor temperature cutoff;
2. Day/night heat level programming;
3. Morning preheat (heat up);
4. System reset and steam control valve modulation.

C. The digital control panel shall include the following:

1. The temperature control equipment of each zone shall be electrically connected to its digital control panel which shall be furnished and suitably mounted at the central control operating station, located as per drawings and hereinafter. This control with its panel membrane keypad shall provide the following control and/or display, indicated from a continuous digital display with two (2) lines and sixteen (16) characters.

    a. Automatic control of the steam supply, when normal building temperatures are desired, by balancing the building rate of heat loss, caused by the weather, as measured by a resistance thermometer type outdoor selector, with the amount of heat input of the heating system as measured by an (end of the main sensor), comprised of resistance type thermometer, to maintain desired building temperature.

    b. Manual control for varying the supply of steam to the entire system or zone to a rate above or below the normal requirements of the system.

c. Controls the zone valve with floating point type motor and position feedback potentiometer. Adaptable to valves with 4-20mA, 1– 5V, 2–10V or 135ohm input control types.

d. Automatic positioning of the zone valve in accordance with operation settings and measured temperatures.

e. Manual positioning of the control valve. Displays the valve position and Measures and displays Out Door Temperature.

f. Day and Night modes of operation. Programmable heating season dates. Automatic Daylight Saving Time clock adjustment.

g. Five programmed sequential Events can be set by operator (or remotely). Programmable Heat-Up Scheduling and Morning Boost period up to 120 min. Internal real-time clock/calendar with backup battery.

h. Vacuum Pumps control output. Programmable advance time for Vacuum Pump ON or Shutdown Off signal. Programmable delay time for Vacuum Pump OFF or Shutdown On signal.

i. Condensate Return Temperature measurements. Programmable Condensate Return temperature Cutoff Set-Point.

j. Programmable indoor temperature Cut-Off (if required). Indoor Temperature Cutoff, Day/Night Set-Points.

k. Adjustable no action zone (Dead-Band) for Indoor and or Condensate Return Temperature Cut-Off. Adjustable Cut-Off depth from 0-100%.

l. Detects for open and short of the temperature sensors input and displays on the status screen. Adaptable to different types of standard temperature sensors and valve motors. Provides Compensator control for unusual weather conditions.

m. Programmable maximum valve position limit. Programmable Heat Gain from: .1 to 50. Programmable Compensation Scale from: 1.0 to 20.0.

n. Automatic storage of setup values. No loss of setup values or mode of operation if power is OFF for extended time. Remotely controlled and/or monitored through the RS485 interface.

o. The heating control panel shall be Intech model ZVLC-2104, or Approved Equal.

2. Sensors:

a. Heat Sensor (Heat Amount Thermostat): The end of the main steam sensor shall consist of a shielded resistance thermometer arranged for mounting directly to the outside wall of the supply main, located at the end of the supply. The temperature sensitive winding shall be encased in protective

metal housing with an electrical junction box for connection of control wiring. This proportional steam sensor is equipped with sensitive resistance temperature measuring coil. This control steam sensor is designed to determine changes in resistance temperature at the end of the supply main and to furnish this information to control center. This heat amount thermostat shall have no moving internal parts.

b. Outdoor Selector (Heat Loss Thermostat): The outdoor selector shall consist of a shielded resistance thermometer arranged for mounting outdoors. The temperature sensitive winding shall be encased in a watertight enclosure with louvers in a frame permitting access of outdoor air to the temperature sensitive element and with a weatherproof junction box for connection of electrical conductors. The units frame will be of aluminum with screened louvers and thermal insulation pad. The sensor shall respond to outdoor temperature and wind chill conditions enabling the digital temperature control panel to govern the supply of heat based on these conditions.

3. Additional Requirements:

a. Wiring: The contractor shall supply the complete temperature control system, including electric wiring, as well as all fuses and switches and electrical connections to power sources as required, all in accordance with manufacturer's instructions, these specifications and local regulations. The power supply shall be as per drawings.

b. Regulatory Approvals: The control shall be UL Listed; Tested per standard 873, Temperature Indicating and Regulating Equipment. It shall be CSA listed; Tested per Standard C22.2 number 24-1987 Temperature Indicating and Regulating Equipment. It shall also be approved for use in NYC by the City of New York, Department of General Services. (Electrical Division).

c. Enclosure: A surface mounted, locking steel enclosure NEMA 1 type, minimum 18 gauge shall be provided.

d. Service, Repair and Parts: The manufacturer shall maintain a service facility in the metro New York area. The manufacturer must have authorized distributors, within this area, which sell replacement parts for this control.

e. Remote Accessible Communication: The control shall be provided with remote communication. Communication shall be via standard telephone lines, RS232 or RS485 as shown on the drawings. No external components shall be required for remote communication. Access to the control shall be via a dumb terminal or Personal Computer. No proprietary software shall be provided. The new heating control system must have network communication ability. The heating control system shall be installed in accordance with manufacturer instructions and all applicable codes and regulations. The manufacturer shall provide full training program for NYCHA's Personnel.

f. The heating control panel shall be Intech ZVLC-2104 or equal.

2.06 NYCHA COMPUTERIZED HEATING AUTOMATION SYSTEM (CHAS) COMPATIBILITY SPECIFICATIONS FOR NEW EQUIPMENT AND DEVICES:

A. All equipment and devices shall have standard RS485 interface.

B. RS485 communication shall be provided directly from users computers to vender devices without intermediate gates, except for gates or transceivers designed for electrical matching, and shall be completely transparent from the point of view of data exchange.

C. Protocols and data exchange for each piece of equipment or device type shall be provided to system integrator and shall be supported by the vendor for a period of not less than ten (10) years. Any and all changes or updates to devices or equipment must be provided to NYCHA and the CHAS system integrator.

D. Baud rate supported by protocols shall be adjustable and set to a value not less than 9600 baud.

E. Implementation of Modbus-like protocols is required.

F. Vendor shall bear responsibility for the provided protocol information and shall replace or update each device not meeting the protocol specifications.

G. Vendor shall be available upon request and shall work with NYCHA's system integrator during equipment installation and software development to make equipment and devices CHAS compatible.

2.07 REMOTE COMMUNICATION PROCESSOR

A. The device shall be capable of standalone local sever RS485 to Ethernet communication converter, communication buffer, pulse counter for energy, gas and water metering, digital I/O interface. The device shall provide interface from alarm sensors, boilers and heating distribution controllers to the local server. Its features shall include:

1. Non-preemptive multithreading.
2. Events.
3. Periodic and one-shot timers.
4. Dynamic heap memory allocation.
5. Interrupt driven streaming I/O.
6. Device shall be able to retain current settings during power outage in the EEPROM, FRAM.
7. Device shall be capable for indoor use, wall or panel mounted, temperature range: 0 to 60 degrees C, Maximum relative humidity 80% for temperatures up to 31 degree C decreasing linearly to 95% relative humidity at 40 degree C. Pollution degree 2 in accordance with IEC664.

B. The remote communication processor shall be Intech model RE2104, or approved equal.

2.08 CONTROL CIRCUITS, CONTROL WIRING AND POWER WIRING FOR CONTROL PANELS AND CONTROL DEVICES:

A. All control circuits shall be 120 volt AC, 24 volt AC, 0 to 10 volt DC, or 4 to 20 milliamps, 2 wire or 3 wire, provided as specified under this Section and Sections 23 09 14, 23 09 24 and 23 52 39.

B. Provide 120 volt-single phase, 24 volt and/or 0 to 10 volt DC power supplies and power wiring for HVAC equipment control panels and control devices and for boiler-burner control panels and control devices. Power wiring for control panels and control devices shall be provided as specified under this Section and Sections 23 09 14, 23 09 24 and 23 52 39, and in accordance with the specified requirements of Division 26. All 120 volt-single phase power sources for control panels and control devices shall be provided through coordination with and approval of, Division 26, from the nearest local electrical power panel designated for this purpose. Provide any necessary and required AC and/or DC power transformers for control panels, devices and instrumentation, enclosed within appropriate NEMA rated lockable enclosures, field mounted in close proximity of the control panels and devices that they serve.

C. All 120 volt or 24 volt electrical control wiring, control power wiring, and wiring connections for equipment interlocks, control panels, control instrumentation and other devices required for the specified work, shall be provided by the Contractor as specified under this Section and Sections 23 09 14, 23 09 24 and 23 52 39.

D. Install and connect any control components and control panels furnished as part of packaged HVAC equipment, but not installed at the factory.

E. All control-power wiring and control wiring to be provided as specified under this Section and Sections 23 09 14, 23 09 24 and 23 52 39, shall be installed within 0.75-inch minimum diameter, rigid, galvanized steel conduit. All conduit accessories and junction boxes shall be of galvanized steel construction, intended for use with rigid galvanized steel conduit.

2.09 FUTURE BMS POINTS LIST:

A. The Instrumentation And Controls Contractor of this Section shall provide the necessary piping pressure, temperature and flow-rate wells, ports, taps, instrumentation, meters, associated control wiring, control transformers and power for control, to facilitate the future interface connections of the monitoring and controls instrumentation of the new Steam Boiler Plant of Building No. 5 and of each of the thirteen (13) new domestic water heating systems, as specified herein, to the future BMS. The interfaces with the future BMS shall be for provision of “monitoring-only” BMS points, except where otherwise specifically noted for “shut-down override” control points, so that the Building No. 5 local boiler plant control system provided as specified under Section 23 52 39, and the local domestic hot water heating control systems provided as specified under the Plumbing Sections of the Work, retain the highest level of independent authority for command and control of their systems.

B. The future BMS system is to be provided by Others, under a future separate Contract Scope of Work.

FUTURE BMS CONTROLS POINTS LIST			
LOCATION	**BMS POINT**	**TYPE**	**REQUIRED PROVISIONS**
Central Boiler Plant	Outdoor Air Temp.	AI	Provide auxiliary contact set for monitoring point if not already provided as specified under Section 23 52 39.
Central Boiler Plant	Boiler Plant Steam Supply Header Pressure	AI	Provide auxiliary contact set for monitoring, for steam header pressure sensor provided as specified under Section 23 52 39.
Central Boiler Plant	Boiler Plant Sequencer Modbus Points, Modbus Capable	AI/BI	Provide auxiliary contact sets for monitoring-only points for boiler plant sequencer input signals as specified under Section 23 52 39.
Central Boiler Plant	Global Hard Shut-Off Dry Contact Set Into Plant Sequencer	BO	Provide auxiliary contact set for shut-off override control point.
Central Boiler Plant	Boiler-Burner Alarm via solenoid relay	BI	Provide auxiliary contact set for monitoring point.
Central Boiler Plant	Boiler Room Flood Float Switch	BI	Provide floor mounted flood detection sensor and auxiliary contact set for monitoring point.
Central Boiler Plant	Boiler Flue Gas Temperature, Each Boiler	AI	Provide auxiliary contact sets for monitoring points for NYCBAR required flue gas temperature sensors and gauges already specified to be provided under Section 23 52 39.
Central Boiler Plant	Boiler Feedwater Meter (pulse, Modbus or BACnet capable)	AI	Provide auxiliary contact set for monitoring point.
Central Boiler Plant	Boiler Feedwater Temperature	AI	Provide port in boiler feedwater supply for future electronic sensor.
Central Boiler Plant	Makeup Water Meter (Neptune Tricon-E3 Pulse / 4-20mA transmitter, or approved equal)	AI	Provide auxiliary contact set for monitoring-only point, for makeup water meter for control of chemical treatment injection systems as specified under Section 23 25 19.
Central Boiler Plant	Steam Flow Meters, BACnet or Modbus	AI	Provide auxiliary contact sets for monitoring of steam flow rates, for three (3) steam flow meters and their transmitters, as shown and as specified under Section 23 09 24.
Central Boiler Plant	Steam Boiler Plant Natural Gas Meter, Pulse Type	AI	Coordinate with National Grid Utility for provision of gas meters with pulse type output for future BMS monitoring.
All Bldg's. (each)	DHW Service Natural Gas Meter, Pulse Type	AI	Coordinate with National Grid Utility for provision of gas meters with pulse type output for future BMS monitoring.
All Bldg's. (each)	Domestic Hot Water System Cold Water Meter (Neptune Tricon-E3 Pulse /4-20mA Transmitter, or approved equal.	AI	Provide cold water meter for each DHW system, as specified under the Plumbing Sections of the Work, to facilitate future BMS monitoring.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic Hot Water Supply Temperature	AI	Provide port for future electronic sensor if not already available for monitoring point through thermostatic mixing valve, to be provided as specified under Plumbing Sections.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic Hot Water Return Temperature	AI	Provide port for future electronic sensor if not already available for monitoring point through thermostatic mixing valve, to be provided as specified under Plumbing Sections.

Condensate Pumps Pits And Gas Water Heater Rooms (Typ.)	Sump Pit Level Sensor for each floor sump pit in each Pumps Pit and Gas Water Heater Room, as applicable.	AI	Provide sump pit level sensor and auxiliary contact set for monitoring point.
Gas Water Heaters (2 Heaters in each Bldg.) (Typ.)	Factory Provided BACnet cards for each condensing type DHW heater's operations data and temperatures.	AI/BI	Provided as specified under the Plumbing Sections of the Work, to facilitate monitoring points by future BMS.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic Hot Water Supply Temperature to storage tank	AI	Provide port for future electronic sensor monitoring point, if not already available through domestic water heaters' integral controllers.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic Hot Water Return Temperature from storage tank	AI	Provide port for future electronic sensor monitoring point, if not already available through domestic water heaters' integral controllers, as specified under the Plumbing Sections of the Work.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic Hot Water Electronic Tempering Valve (Modbus or BACnet capable)	AI	Provide auxiliary contacts set for future BMS monitoring of position of DHW electronic modulating tempering valve to be provided as specified under the Plumbing Sections of the Work.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic hot water storage tank Temperature	AI	Provide port for DHW storage tank for future electronic temperature sensor, for future BMS monitoring.
Gas Water Heater Rooms And Central Boiler Plant (Typ.)	Domestic hot water circulating pump(s) operating status	BI	Provide current sensor(s) for future operational status monitoring of DHW circulating pump(s).
Gas Water Heater Rooms	Space dry-bulb Temperature	AI	Provide space dry-bulb temperature sensor in each Gas Water Heater Room, for control of louver mounted motorized ventilation dampers, as specified and shown on Contract Documents.

2.10 AUTOMATIC TEMPERATURE CONTROL SEQUENCES OF OPERATION FOR DOMESTIC WATER HEATER ROOM VENTILATION SYSTEMS OF SATELLITE BLDG'S: (Not including Central Steam Boiler Plant; Refer to Section 23 52 39)

A. The Automatic Temperature Control Sequences of Operation for the Building No. 7 Steam Boiler Plant and the boilers Feedwater Pumps and Receiver Set shall be as specified under Sections 23 52 39 and 23 53 13, respectively.

B. Upon an increase in Gas Fired Water Heater Room space temperature above 85°F (adj.), as sensed by the dry-bulb space temperature sensor as shown on the Contract Drawings, the Gas Fired Water Heater Room façade outdoor air intake louver mounted motorized two-position dampers shall automatically open.

C. Upon a decrease in Gas Fired Water Heater Room space temperature below 80°F (adj.), as sensed by the dry-bulb space temperature sensor as shown on the Contract Drawings, the Gas Fired Water Heater Room façade outdoor air intake louver mounted motorized two-position dampers shall automatically close.

D. Upon detection of either a natural gas or carbon monoxide gas leak within a Gas Fired Water Heater Room, as sensed by the natural gas and carbon monoxide gas leak detection system to be provided as specified under Section 23 09 14, the alarms and safety shutdown controls shall automatically operate as specified under Section 23 09 14.

E. Upon manual actuation of any local emergency break-glass shut-down switch, located as shown on the Contract Drawings, the DHW system gas meter safety shut-off valve shall automatically close and the gas-fired domestic water heaters' burner control circuits shall be automatically disabled, by direct hardwired interlocks.

2.11 BOILER ROOM COMBUSTION AR MAKEUP AND VENTILATION SYSTEM CONTROL SEQUENCE OF OPERATION: MU-1, 2, 3 & 4 AND EF-1 & 2:

A. The four makeup air unit supply fans shall be provided with VFD's with integral H-O-A switches, indexed to "Automatic" mode. The MU Units are designed to operate as "constant volume" air handling units, as specified. MU Unit VFD's shall be used only to facilitate ease of initial balancing and shall not be used to modulate MU unit capacity during operation.

B. The two exhaust fans shall be provided with VFD's with integral H-O-A switches, indexed to "Automatic" mode. The exhaust fans are designed as specified herein, to operate in either "100%-speed mode" or "50%-speed mode", via their VFD's.

C. Each EF exhaust fan shall be provided with a discharge duct mounted two-position motorized isolation damper, as shown on the Contract drawings. Whenever the EF exhaust fan is started, its respective associated discharge motorized damper shall automatically open. Whenever the EF exhaust fan motor starter is de-energized, its respective associated discharge motorized damper shall automatically close.

D. The four MU Units are each associated with two façade outdoor air intake louver mounted two-position motorized combustion and ventilation air intake dampers, as shown on the Contract Drawings. Whenever a makeup air unit is started, its respective associated pair of motorized intake air dampers shall automatically open. Whenever a makeup air unit motor starter is de-energized, its respective associated pair of motorized intake air dampers shall automatically close.

E. At any time, the boiler plant lead/lag control system is specified to designate each of the four boiler-burners as the "Lead Boiler", "1st Lag Boiler", "2nd Lag Boiler" and "3rd Lag Boiler, respectively, and those designations are to be automatically rotated, on pre-programmed regular time intervals, to equalize runtime wear among the four boiler-burners. Each of the four Makeup Air (MU) Units shall be automatically interlocked to operate in unison with each of the four respective associated boiler-burners, as specified hereinbelow.

F. The Temperature Controls Contractor (TCC) shall provide a lead/lag sequencer for the two EF exhaust fans that shall, at any time, automatically assign each of the two EF exhaust fans the designations of "Lead Exhaust Fan", and "Lag Exhaust Fan", respectively. The Lead/Lag designations of the two EF exhaust fans shall be automatically switched, alternately, once each week, so as to equalize runtime wear between the two EF exhaust fans.

G. When the outdoor ambient temperature is above 65ºF dry-bulb (adj.), as sensed by the master outdoor-air dry-bulb temperature sensor, wall-mounted on the North façade of Building No. 5, at elevation 10-feet above grade with sun-shield, the system shall be automatically indexed to the "summer mode". During the "summer mode", makeup air

units MU-1, 2, 3 & 4 and exhaust fans EF-1 & 2 shall be off and their control circuits shall be de-energized.

H. Upon a drop in outdoor ambient temperature below 60°F dry-bulb (adj.), as sensed by the master outdoor-air dry-bulb temperature sensor, and with all four boiler-burners, B-1, B-2, B-3 & B-4 momentarily “off-line”, the makeup air units control circuits shall be automatically energized and enabled, the Lead Makeup Air Unit (ie., the makeup air unit associated with the designated "Lead Boiler") shall automatically start and shall operate continuously at 100% speed, and the Lead Exhaust Fan shall automatically start and shall operate at 100% speed.

I. Each of the four MU Units shall be automatically interlocked to operate in unison with each of the four respective associated boiler-burners, so that whenever a boiler-burner is started (whether via the boiler plant's lead/lag control system or via manual intervention), its respective associated makeup air unit shall automatically start. Upon a call for a boiler-burner to start, its respective associated makeup air unit shall automatically start. (Note here that the "Lead Makeup Air Unit" would already be required to be operating indexing of the system to the "winter mode" even before the "Lead Boiler" receives a call to fire from the boiler plant lead/lag controller.) Upon proof of makeup air unit startup, via a current sensing switch at the makeup air unit VFD, the boiler-burner control circuit shall then be allowed to start firing the boiler-burner.

J. During the "winter mode" of operation:

1. Upon a call for the “Lead Boiler" to start firing, via the boiler-plant's lead-lag controller, the "Lead Makeup Air Unit" shall continue to operate at 100%-Speed, and the "Lead Exhaust Fan" shall continue to operate and its VFD shall be automatically indexed to operate at 50%-Speed. The "Lag Exhaust Fan" shall be Off.

2. Upon a call for the “First-Lag Boiler" to start firing, via the boiler-plant's lead-lag controller, the "First-Lag Makeup Air Unit" shall automatically start and shall operate at 100%-Speed, and the "Lead Exhaust Fan" VFD shall be automatically indexed to operate at “100% speed”. The "Lag Exhaust Fan shall remain "Off".

3. Upon a call for the “Second-Lag Boiler" to start firing, via the boiler-plant's lead-lag controller, the "2nd Lag Makeup Air Unit" shall automatically start and shall operate at 100%-Speed, and the "Lag Exhaust Fan" shall automatically start with its VFD automatically indexed to operate at 50%-Speed.

4. Upon a call for the “Third-Lag Boiler" to start firing, via the boiler-plant's lead-lag controller, the "3rd Lag Makeup Air Unit" shall automatically start and the "Lag Exhaust Fan" VFD shall be automatically indexed to operate at 100% speed.

5. Upon a call for the "3rd Lag Boiler" to stop firing, via the boiler-plant's lead-lag controller, the "3rd Lag Makeup Air Unit" motor starter shall be automatically de-energized, and the "Lag Exhaust Fan" shall continue to operate with its VFD automatically indexed to operate at 50%-Speed.

6. Upon a call for the "2nd Lag Boiler" to stop firing, via the boiler-plant's lead-lag controller, the "2nd Lag Makeup Air Unit" motor starter shall be automatically de-energized, and the "Lag Exhaust Fan" shall automatically shut-down.

7. Upon a call for the "1st Lag Boiler" to stop firing, via the boiler-plant's lead-lag controller, the "First-Lag Makeup Air Unit" motor starter shall be automatically de-energized, and the "Lead Exhaust Fan" VFD shall be automatically indexed to operate at 50%-Speed. The "Lag Exhaust Fan shall remain "Off".

8. Upon a call for the "Lead Boiler" to stop firing, via the boiler-plant's lead-lag controller, the "Lead Makeup Air Unit" shall continue to operate, and the "Lead Exhaust Fan" VFD shall continue to operate and shall be automatically indexed to operate at "100%-Speed".

K. By design of the combustion air makeup ventilation system's air flow balance, a net positive pressurization will be maintained in the boiler room during the winter heating mode. During periods of boiler operation at less than 100% firing rates of on-line (firing) boilers, associated increases in the positive pressurization of the boiler room space shall be maintained within a preset limit by means of relief of excess supply air ventilation via a roof curb mounted ventilation relief air hood with inlet duct mounted manually adjustable counterweighted barometric relief air damper. Counterweight adjustment of the barometric relief air damper shall be manually adjusted to limit the positive pressure within the boiler room to a maximum of 0.10-inch WG (adj.).

L. During the "winter mode", the makeup air units two-way modulating steam coil temperature control valve shall automatically modulate in sequence with the modulating face-and-bypass damper, to maintain 60°F (adj.) discharge air temperature, as sensed by the makeup air units steam preheat coil discharge air temperature sensor. The steam preheat control modulating temperature control valve and integral face-and-bypass dampers shall always be subject to override control of the low-limit freeze-protection discharge temperature controller, to maintain a low-limit freeze-protection discharge air temperature of 40°F.

M. Low-Limit Freeze-Protection Controller: The makeup air units steam preheat coil discharge air stream mounted freeze protection thermostat with serpentine capillary sensing bulb shall be wired into the supply fan motor VFD and exhaust fan motor VFD's to override the normal operating discharge air temperature control of the face-and-bypass dampers and the modulating steam coil temperature control valve, and to automatically shut-down the supply fan and associated exhaust fans upon reaching its low-limit setpoint of 40°F (adj.). At the same time a local alarm signal shall be sent to the MU Units DDC controller and an alarm shall be displayed on the local MU Unit mounted operator display device. Once shut-down via the low-limit freeze-protection safety control, manual reset of the freeze protection thermostat shall be required to return the MU Unit to normal operation.

N. Upon receipt of a fire alarm signal, the makeup air (MU) units shall automatically shut down via the Fire Alarm Control System. All control wiring from the Fire Alarm System to the MU units VFD's shall be provided as specified under Division 26, Fire Alarm/Electrical.

O. There are four (4) duct-mounted smoke detectors, mounted in the discharge ductwork

of each of the four (4) MU makeup air units in the Boiler Room of Bld'g. #5. All wiring to and from the smoke detectors shall be provided as specified under Div. 26 Fire Alarm/Electrical. Upon detection of smoke, as sensed by any one of the four (4) duct-mounted smoke detectors, the respective associated makeup air (MU) unit shall automatically shut down via the Fire Alarm Control Panel (FACP). Once shutdown via the FACP, after the fire alarm signal is cleared, the MU units shall be automatically restarted and shall automatically resume normal operation.

1. Upon receipt of a fire alarm shutdown signal to any single makeup air (MU) unit via the FACP, the respective associated boiler-burner control circuit shall be automatically de-energized and disabled by an override shutdown control signal to be provided as specified under the Mechanical Div. 23. Once a boiler-burner is shutdown via the override shutdown signal and after the fire alarm signal is cleared and the respective associated makeup air (MU) unit has resumed normal operation, the boiler-burner control circuit shall be automatically re-enabled and re-energized to be capable of automatically resuming normal operation via the boiler plant lead/lag control system.

P. The Contractor shall coordinate the automatic temperature control and interlocking requirements for the (4) makeup air units (MU) and the (2) exhaust fans (EF) with the specified requirements of Section 23 53 29, "Firetube Boilers", for provision of seamless, fully coordinated, integrated and coherent interfaces and interlocks between the boiler plant lead/lag controller and the (4) makeup air units (MU) and the (2) exhaust fan (EF) units. The Contractor shall provide any control relays, sets of auxiliary contacts, interlocking control wiring and control power transformers and low-voltage 120-Volt or 24-Volt power sources as may be necessary to provide the automatic interlocking control interfaces as required under the control sequences of operation, as specified herein and under other Sections of Div. 23.

2.12 BOILER ROOM STEAM UNIT HEATERS, UH-1, 2, 3 & 4 CONTROL SEQUENCE OF OPERATION:

A. When the outdoor ambient temperature is above 65ºF dry-bulb (adj.), as sensed by the master outdoor-air dry-bulb temperature sensor, wall-mounted on the North façade of Building No. 5, at elevation 10-feet above grade with sun-shield, the system shall be automatically indexed to the “summer mode”. During the "summer mode", unit heaters UH-1, 2, 3 & 4 shall be off and their control circuits shall be de-energized.

B. Upon a drop in outdoor ambient temperature below 60ºF dry-bulb (adj.), as sensed by the master outdoor-air dry-bulb temperature sensor, the unit heaters control circuits shall be automatically energized and enabled. Each unit heaters respective associated space heating thermostat, wall or column mounted at elevation 5-feet above-finished-floor level in locations as shown on the Contract Drawings, shall operate to automatically cycle their respective unit heater fans on and off, intermittently, to maintain their respective space heating temperature setpoints of 55ºF (adj.), minimum.

C. Provide each boiler room unit heater (UH) space heating thermostat with a lockable heavy-duty steel aspirating type cover-guard, to prevent damage and/or tampering.

END OF SECTION

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