

DATE: 04-25-18

ADDENDUM NO. 1
TO
CONSTRUCTION DOCUMENTS

FOR PROJECT NO. **ENG 1811980549**

DESCRIPTION: **Air Handler Replacement**

LOCATION: **NERO: Northeast Regional Headquarters**

FOR AGENCY: **Department of Natural Resources**

The information contained in this Addendum shall become a part of the basic plans and specifications the same as if originally incorporated therein. The original plans and specifications shall remain in their entirety, except as modified by this Addendum. The items herein shall supersede information in the specifications and on the plans.

Item #1: Bid Opening Date: Revise bid opening date to **June 12 @ 1:31 PM**, was May 8th, 2018.

ITEM #2: Specification Section 01010 – General Requirements; Part One General, Section 1.4: Commencement and Completion of Work; Sub-section B; Revise to read “All work required by the contract documents shall be completed within **90 calendar days** after the commencement of the work.” Was 60 days.

ITEM #3: Specification Section 01330 – Submittals; Add Section 01330 to read as attached, being a part of this addendum.

ITEM #4: Specification Section 15900 – HVAC Instrumentation and Controls; Revise Section in total to read as attached, being a part of this addendum.

SECTION 01330

SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

- A. General Conditions
- B. Section 01010 – General Requirements
- C. Section 01781 – Project Record Documents

1.02 SHOP DRAWING, PRODUCT DATA & SAMPLE SUBMITTAL REQUIRED:

- A. Items listed for submittal are intended to be a minimum. Non-listing of an item does not relieve the Contractor of the responsibility to verify compliance with the specifications of all products and equipment. Contractor is encouraged to submit shop drawings, product data or samples on all such items prior to their use.
- B. Shop drawings, product data or samples shall be submitted for the following items:
 - 1. Section 15269 – Variable Frequency Controllers
 - 2. Section 15900 – HVAC Instrumentation and Controls
 - 3. Section 15950 – Testing, Adjusting, and Balancing
 - 4. Section 16725 – Modular Indoor Handling Unit
 - 5. Section 16160 – Panel-boards
 - 6. Section 16420 – Enclosed Controllers

1.03 SHOP DRAWINGS:

- A. Shop drawings shall:
 - 1. Be prepared by a qualified detailer;
 - 2. Identify details by reference to sheet and detail numbers shown on Contract Drawings and/or section number of the Specifications; and
 - 3. Be accompanied by installation instructions and all manufacturer's warranties that are required in the specifications.
- B. The cost for all shop drawing submissions shall be deemed included in the Contractor's Bid Price.

1.04 PROJECT DATA:

- A. If the Contractor uses the manufacturer's standard schematic drawings, it shall:
 - 1. Modify drawings to delete information which is not applicable to work; and
 - 2. Supplement standard information to provide additional information applicable to work.

END OF SECTION

SECTION 15900

HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

PART 1 - Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Project Phasing:

1. Summary Phase II work:

- a. The intent of the Phase II control work is to demolish all elements of the existing pneumatic control system associated with the new Air Handler Unit and provide a direct digital BAC net controller.
- b. TCC to provide a complete DDC System that interfaces the existing condensing coiler system and scroll chiller system with new VAV sir handler and zone VAV boxes.
- c. Sequences of operation for the phase II equipment are shown on the plans. VAV zone boxes are shown on the plans along with thermostats
- d. The replacement of the existing pneumatic controls shall be done in a systematic manner to allow a change over from one system to the other without the entire building being without controls for any period of time.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. LAN: Local area network.

C. PICS: Protocol Implementation Conformance Statement.

1.4 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

B. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems.

C. Control system includes the following:

1.5 SEQUENCE OF OPERATION

A. See project plan sheets for control diagrams and "Sequence of Operation".

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Schedule of valves including leakage and flow characteristics.
 - 4. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 5. Listing of connected data points, including connected control unit and input device.
 - 6. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 7. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. ASHRAE BAC net Statement: PICS for each DDC system component (panel, zone controller, field devices, and operator workstation) proposed.
- D. Samples: For each color required, of each type of thermostat cover.
- E. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.
- F. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- H. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5. Calibration records and list of set points.
- I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

- J. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative and a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. 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.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. Comply with ASHRAE 135 for DDC system control components.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- C. Coordinate equipment with Division 16 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.10 WARRANTY

- A. Furnish one year warranty for labor and materials from date of substantial completion.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Provide software backup on CDx of programming and defaults.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Electric, Electronic, and DDC Systems:
 - a. Distech Controls as installed by Technical Controls Solutions, Inc.
 - b. Johnson Controls, Inc.; Controls Group.
 - c. Approved Equal.

2.2 DDC EQUIPMENT

- A. Application Software: Include the following:
 - 1. Input/output capability from BACnet Controller via built in LCD display.
 - 2. Alarm processing.
 - 3. Automatic restart of field equipment on restoration of power.
 - 4. Override capabilities.
 - 5. Scheduling capabilities.
 - 6. Viewing Alarms.
 - 7. Nonproprietary software; software must be available for owner to obtain and make adjustments without the requirement of the installing contractor.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. Monitoring, controlling, or addressing data points.
 - d. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - e. LCD display of all IO Points.
 - f. Override capabilities.
 - g. Scheduling capabilities.
 - h. Viewing Alarms.
 - 3. BACnet Conformance: Reside on BACnet LAN in Ethernet IEEE 802.3, Class 3, minimum, with routers between LAN and other panels, with at least one communication port, and have minimum capabilities defined in PICS for the following areas:
 - a. Network.
 - b. Functional groups.
 - c. Standard application services supported.
 - d. Standard objects supported.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each input/output point; process information;
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse input/output.
 - c. LCD display of all IO Points.
 - d. Override capabilities.
 - e. Scheduling Capabilities.
 - f. Viewing Alarms.
 3. BACnet Conformance: Reside on BACnet LAN using MS/TP, Class 2, minimum, with at least one communication port, and have minimum capabilities defined in PICS for the following areas:
 - a. Network,
 - b. Functional Groups.
 - c. Standard application services supported.
 - d. Standard objects supported
- D. Software: Update to latest version of software at Project completion. Include and implement the following capabilities from the control units:
1. Units of Measure: Inch-pound and SI (metric).
 2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.
 3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 4. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.

2.3 CONTROL PANELS

- A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.
- B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 1. Fabricate panels of 0.06-inch- thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including

2.4 ANALOG CONTROLLERS

- A. Step Controllers: Six- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.5 TIME CLOCKS

- A. Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.

2.6 SENSORS

- A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
 - 1. Thermistor temperature sensors as follows:
 - a. Wire: Twisted, shielded-pair cable.
 - b. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - c. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - d. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - e. Room Sensors: Match room thermostats, locking cover.
 - f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 2. Resistance Temperature Detectors: Platinum.
 - a. Accuracy: Plus or minus 0.2 percent at calibration point.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - d. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - f. Room Sensors: Match room thermostats, locking cover.
 - g. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - h. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.
 - 3. Humidity Sensors: Bulk polymer sensor element.

- a. Accuracy: 5 percent full range with linear output.
 - b. Room Sensors: With locking cover matching room thermostats, span of 25 to 90 percent relative humidity.
 - c. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
4. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.
- a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0 to 0.25 inch wg.
 - d. Duct Static-Pressure Range: 0 to 5 inches wg.
5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.
- B. Equipment operation sensors as follows:
- 1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches
 - 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 - 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable, and set to 175 percent of rated motor current.
- C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- D. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless steel or bronze paddle. For chilled-water applications, provide vapor proof type.
- E. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-state infrared sensors, suitable over a temperature range of 23 to 130 deg. F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.

2.7 THERMOSTATS

- A. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
- 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- B. Room Thermostat Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment:
2. Set-Point Indication: Exposed.
3. Thermometer: Exposed.
4. Color: manufacturer's standard color.
5. Orientation: Vertical or Horizontal.

C. 1.Room thermostat accessories include the following:
LCD displaying space temperature & zone discharge air temperature, and have set-point adjustment and override capabilities.

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

E. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

2.8 HUMIDISTATS

A. Duct-Mounted Humidistats: Electric insertion, 2-position type with adjustable 2 percent throttling range, 20 to 80 percent operating range, single- or double-pole contacts.

2.9 ACTUATORS

A. Electronic Damper Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
 - c. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1000 to 2500 FPM: Multiply the minimum full-stroke cycles above by 1.5.
 - d. Dampers with 3 to 4 Inches wg of Pressure Drop or Face Velocities of 2500 to 3000 FPM: Multiply the minimum full-stroke cycles above by 2.0.
3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
6. Power Requirements (Two-Position Spring Return): 24-V ac.
7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
9. Temperature Rating: 40 to 104 deg F.
10. Run Time: 12 seconds open, 5 seconds closed.

2.10 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valves NPS 2 and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back seating capacity packable under pressure.
- C. Globe Valves NPS 2-1/2 and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 - 2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
 - 3. Sizing: 3-psig maximum pressure drop at design flow rate.
 - 4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump Shut-off head.

2.11 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 16 Section "Control/Signal Transmission Media."
- B. **All** control cable to be "plenum rated" fire resistant type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices and wiring and pneumatic piping are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:

1. Where indicated.
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."
- H. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."
- I. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."
- J. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- C. Install signal and communication cable:
 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 2. Install exposed cable in raceway.
 3. Install concealed cable in raceway.
 4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 1. 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- D. Verify DDC as follows:
 - 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
 - 2. Verify operation of operator workstation.
 - 3. Verify local control units including self-diagnostics.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.
 - 3. Review data in maintenance manuals.
 - 4. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

END OF SECTION 15900

END OF ADDENDUM