**PORT AUTHORITY TRANS-HUDSON CORPORATION**
**TWO MONTGOMERY STREET - 1st FLOOR**
**JERSEY CITY, NJ 07302**

July 31, 2020

**ADDENDUM NO. 9**

TO PROSPECTIVE BIDDERS ON CONTRACT **PAT-784.217** – PATH – HARRISON STATION SOUTHWEST HEAD HOUSE, PLATFORM AND PLAZA REPLACEMENT

The following changes are hereby made in the Contract Documents for the subject Contract.

This communication should be physically annexed to back cover of the book and initialed by each bidder before submitting his bid.

In case any bidder fails to conform to these instructions, his Bid will nevertheless be construed as though this communication had been so physically annexed and initialed.

CHANGES IN THE CONTRACT BOOKLET

Page 10 - In "AVAILABLE DOCUMENTS", immediately after subparagraph A.7., insert the following:

"8. PATH-SL-219, PRESENTATION OF BORINGS.
9. PATH-SL-220, PRESENTATION OF BORINGS.
10. PATH-SL-221, PRESENTATION OF BORINGS.
11. PATH-SL-243, PRESENTATION OF BORINGS.

*C. Drawings bearing the general title "Port Authority Trans-Hudson Corporation – Harrison Station Replacement and Upgrade – East Side Platforms", dated 3/2/2018 which are separately numbered and entitled as follows:

1. A101, ABBREVIATIONS, LEGEND AND DRAWING CONVENTIONS.
2. A102, ARCHITECTURAL NOTES.
3. A201, SITE PLAN.
4. A230, EASTBOUND AND WESTBOUND PARTIAL PLATFORM PLANS.
5. A301, OVERALL ELEVATIONS.
6. A310, ENLARGED EASTBOUND PLATFORM ELEVATIONS.
7. A411, EASTBOUND PLATFORM CROSS SECTIONS.
8. A503, PLATFORM DETAILSA512, EASTBOUND PLATFORM TRACK STAIR 02 – PLANS, SECTIONS AND DETAILS.
9. S101, STRUCTURAL NOTES, LEGEND AND ABBREVIATIONS.

10. S102, STRUCTURAL NOTES, LEGEND AND ABBREVIATIONS.
11. S205, SOUTH EAST PLATFORM EXTENSION AND PERMAMANT EGRESS STAIR FOUNDATION PLAN.
12. S206, SOUTH EAST PLATFORM EXTENSION AND PERMANENT EGRESS STAIR FRAMING PLAN.
13. S207, SOUTH EAST PLATFORM EXTENSION SLAB PLAN.
14. S401, CONCRETE TYPICAL DETAILS SHEET 1.
15. S402, CONCRETE TYPICAL DETAILS SHEET 2.
16. S504, STEEL TYPICAL DETAILS, SHEET 4.
17. S505, PRECAST PANEL ELEVATIONS.
18. S601, SECTIONS AND DETAILS, SHEET 1.
19. S603, SECTIONS AND DETAILS, SHEET 3.".

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|---|---|
| Pages 1007 - through 1023 | Delete these pages in their entireties and substitute new pages 1007 through 1023 (17 pages) attached hereto and made a part hereof. |

REVISED CONTRACT DRAWINGS

Drawing C1301 has been revised as of 07/31/20. A copy of these drawings is forwarded herewith electronically (via email or download). Destroy the drawings of these numbers now in your possession and substitute therefor the revised drawings.

REVISED CONTRACT DRAWINGS (marked CONFIDENTIAL)

Drawings E1200 and E1680 have been revised as of 7/31/2020. A copy of these drawings is forwarded herewith electronically (via email or download). Destroy the drawings of these numbers now in your possession in accordance with *The Port Authority of New York and New Jersey Information Security Handbook*, dated October 15, 2008, revised as of April 2, 2018 (Handbook) and substitute therefor the revised drawings.

Please have your firm's designated Security Information Manager (SIM) call Nicole Kuruszko at (212) 435-4602 to obtain the password for the confidential documents.

**PORT AUTHORITY TRANS-HUDSON CORPORATION**

James Starace, P.E.
Chief Engineer/Director
The Port Authority of New York and New Jersey

INITIALED BY THE BIDDER:

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# DIVISION 23

# SECTION 230901

# HVAC INSTRUMENTATION AND CONTROLS

## PART 1. GENERAL

### 1.01 SUMMARY

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

B. Programming and graphics, including engineering, software installation and checkout, and staff training, shall be provided to integrate the BAS with the existing remote monitoring work station at the Watch Engineers Office in Journal Square.

### 1.02 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

### 1.03 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Control components shall be state-of-the-art manufactured by companies specializing in manufacturing control systems and devices.

C. Control system shall be pre-wired and pre-tested in the shop. Arrange for shop wiring and interfacing of control components to be performed by control systems manufacturer-authorized technicians

D. The control system manufacturer-authorized system distributer shall have local office staffed with trained, full-time employees who are capable of performing testing, inspection, repair and maintenance services for the life of the system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL or CSA, and marked for intended use.

## 1.04 WARRANTY

A. All system components shall have one (1) year warranty, including diagnostics, field investigation, labor and parts.

B. If within the warranty period as described above, upon written notice from The Authority, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted to satisfy the Engineer at the sole cost of the Contractor.

C. Warranty shall run to The Authority and shall grant The Authority a direct right of action against the manufacturer and the Contractor.

D. Warranty period(s) shall commence at the issuance of the Certificate of Final Completion.

## 1.05 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 equipment manufacturer.

B. All control equipment shall be shop wrapped and packaged against shock, dirt, and weather prior to shipping to the construction site.

C. System Software: Update to latest version of software at Project completion.

## 1.06 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Section 283100 "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Section 260584 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

E. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.

## 1.07 SUBMITTALS

A. See Appendix "A" for submittal requirements

## PART 2. PRODUCTS

### 2.01 MANUFACTURERS

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

1. Manufacturers: Provide Manufacturer specified or an approved equal.

### 2.02 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple or remote workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    a. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
    b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
    c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
    d. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
    e. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
    f. Relative Humidity: Plus or minus 5 percent.
    g. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    h. Airflow (Terminal): Plus or minus 10 percent of full scale.
    i. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
    j. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
    k. Electrical: Plus or minus 5 percent of reading.

## 2.03 CONTROL SYSTEM

A. Manufacturers: Subject to compliance with the project requirements, provide one of the following or approved equal:

1. Johnson Controls, Inc.; Controls Group
2. Honeywell
3. Automated Logic Controls
4. Alerton

B. Control system shall consist of controllers, 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. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

C. System shall be compatible with Johnson Controls, Inc. Metasys system.

## 2.04 DDC EQUIPMENT

A. Operator Workstation: Shall be provided by the Port Authority. Contractor shall coordinate with Engineer for software and hardware requirements.

B. Operator Workstation Accessories: Shall be furnished and installed by the Contractor

1. Monitor - 24-inch LED Minimum 1920x1200 resolution with 2 millisecond response time.
2. Keyboard QWERTY 105 keys in ergonometric shape
3. Laserjet black & white printer - 100 sheet paper capacity , 128 MB memory, print speed 42 ppm. Hewlett Packard P3015n or approved equal

C. Diagnostic Terminal Units: Shall be provided by the Port Authority. Contractor shall coordinate with Engineer for software and hardware requirements.

D. 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 I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
   d. Software applications, scheduling, and alarm processing.

e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.

b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.

c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; runtime totalization; and security access.

d. Remote communications.

e. Maintenance management.

f. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.

b. Discrete/digital, analog, and pulse I/O.

c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

4. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

F. Software shall be furnished and installed, including graphics, databases for all points, operational parameters, and system command, and application software. Submit original and backup copies of source software, excluding the general-purpose operating systems and utility programs supplied by computer manufacturer(s) and the non-job-specific proprietary code supplied by the control system manufacturer. All software shall be compatible with communication over PATH designated Ethernet.

G. Submit a copy of the final control system program with ladder diagram/logic.

H. PATH will furnish a Lenovo T430 laptop with a Windows 7 operating system. Furnish and install a control software program on the laptop for maintenance, diagnosing and troubleshooting equipment problems. This software shall be compatible with the furnished laptop (Lenovo T430 with Windows 7) and shall communicate with the main control panel via Ethernet cable. Submit a backup copy of the control software on a CD or DVD.

I. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Universal I/Os: Provide software selectable binary or analog outputs.

J. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

K. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## 2.05 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; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.

2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.

3. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.

4. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

## 2.06 CONTROL PANELS

A. Control panel shall be NEMA 12 construction, designed for wall-mounting and shall be equipped with a hinged front door with lockable latch. The panel shall be completely factory assembled, wired and tested, and shall be cleanly finished with all edges ground smooth. Surfaces shall be free of projections and flaws. The panel shall be equipped with terminals, overloads, contactors, relays and transformer.

B. Unit control panel front door shall have and identification tag. The tag shall have a white background with 1/2" high engraved black lettering. Additionally, the panel front door shall be equipped with red and green lights for power on/off, an audible alarm to sound on all alarm conditions, a manual silencer, and a reset button.

C. All components and wiring shall be readily accessible and replaceable from the front. All terminals for remote wiring connections shall be identified in accordance with the designations shown on the approved shop drawings. The control panel shall have sufficient terminals for connections to remote- mounted control components, plus 20% spare.

D. Except for the remote mounted control components, all components shall be internally mounted and fastened in the control panel, including but not be limited to the following:

1. Microprocessor-based, Programmable Controller
2. Relays
3. Low Voltage Transformer
4. Power On/Off Switch
5. Red/Green Indicating Lights for Power On/Off

## 2.07 ANALOG CONTROLLERS

A. 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.

## 2.08 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

a. BEC Controls Corporation or approved equal

2. Accuracy: Plus or minus 05 deg F (0.3 deg C) at calibration point.

3. Wire: Twisted, shielded-pair cable.

4. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).

5. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).

6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Concealed.

b. Set-Point Indication: Concealed.

c. Thermometer: Concealed.

d. Orientation: Vertical.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:

1. Manufacturers:

a. BEC Controls Corporation or approved equal

2. Accuracy: Plus or minus 0.2 percent at calibration point.

3. Wire: Twisted, shielded-pair cable.

4. Insertion Elements in Ducts: Single point, 8 inches (200 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).

5. Averaging Elements in Ducts: 18 inches (460 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.

6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).

7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

a. Set-Point Adjustment: Concealed.

b. Set-Point Indication: Concealed.

c. Thermometer: Concealed.

d. Orientation: Vertical.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation or approved equal

2. Static-Pressure Transmitter: Nondirectional 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 (0 to 62 Pa).

a. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).

d. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

3. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

E. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.

2. Set-Point Indication: Concealed.

3. Thermometer: Concealed.

4. Orientation: Vertical.

F. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.

## 2.09 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

## 2.10 THERMOSTATS

A. Manufacturers:

1. Erie Controls or approved equal

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "cooling", "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

D. 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 and 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.

## 2.11 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Section 230510 "Motors and Motor Controllers".

2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

3. Spring-Return Motors: Size for running and breakaway torque of 100 in. x lbf (16.9 N x m).

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

1. Manufacturers:

a. Belimo Aircontrols (USA), Inc or approved equal

2. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.

b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.

c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.

d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.

e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.

f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque 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 nonspring-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: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).

10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).

11. Run Time: 12 seconds open, 5 seconds closed.

### 2.12 DAMPERS

A. Manufacturers:

2. Ruskin Inc. or approved equal

B. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 8 cfm per sq. ft. (40 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

### 2.13 PUSH BUTTON SWITCH

A. Manufacturers:

1. General Electric or approved equal

B. 22-mm Momentary push button switch with full guard and flush mount, color green, with NO/NC contact, no notch mounting, NEMA rated for installed location, rated to 10A at 600VAC. GE Model number CR104PBG

## PART 3. EXECUTION

### 3.01 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

## 3.02 INSTALLATION

A. Install software in control units and operator workstation(s) and operable diagnostic terminal unit. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

F. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

## 3.03 GRAPHIC DISPLAYS

A. Graphic displays shall be provided for each piece of mechanical equipment or system. At a minimum, the graphical display shall meet the following requirements:

1. The graphic display shall be a dynamic color graphic schematic diagram for each system (example - Rooftop units, associated fans and other mechanical accessories, valves, dampers, etc.).
2. There shall be a minimum of three (3) levels of zoom:
    a. The equipment position on the floor plan
    b. The equipment/system dynamic color graphical schematic shall indicate all points shown on controls diagrams.
    c. Trending and history logs indicating temperature, trending charts and alarm log shall be available.
3. The operator interface shall allow users to access the various system schematic via a point-and-click graphical interface, menu selection or text-based commands.

3.04 UPGRADE OF GRAPHIC DISPLAYS,HARDWARE, SOFTWARE AND PROGRAMMING - Existing workstation located in Watch Engineers office at Journal Square Transportation Center (JSTC)

A. All equipment at the Harrison Stationhouses controlled or monitored by the BAS shall be monitored and controlled remotely at the JSTC. All functions of the BAS defined in the contract documents shall be available remotely through the existing workstation at JSTC. Refer to drawings for detailed information.

B. Graphic displays shall be provided for each piece of mechanical equipment or system. At a minimum, the graphical display shall meet the following requirements:

1. The graphic display shall be a dynamic color graphic schematic diagram for each system (example - Rooftop units, associated fans and other mechanical accessories, valves, dampers, etc.).

2. There shall be a minimum of three (3) levels of zoom:

a. The equipment position on the floor plan

b. The equipment/system dynamic color graphical schematic shall indicate all points shown on controls diagrams.

c. Trending and history logs indicating temperature, trending charts and alarm log shall be available.

3. The operator interface shall allow users to access the various system schematic via a point-and-click graphical interface, menu selection or text-based commands.

C. Upgrade existing workstation software, hardware and programming to provide control, monitoring and graphic display for Harrison Stationhouses in addition to existing systems

3.05 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260534 "Boxes and Fittings", Section 260533 "Raceways", and Section 262716 "Control Panel Enclosures - Cabinets and Terminal Boxes".

B. Install building wire and cable according to Section 230519
Wires, Cables, Splices, Terminations, 600V or less

C. Install signal and communication cable according to Section 282310 "Control-Signal Tranmissions Media".

1. Install all cable in rigid steel conduit.

2. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

3. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

4. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

5. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

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.

## 3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check temperature instruments and material and length of sensing elements.
6. Check DDC system as follows:
    a. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    b. Verify that spare I/O capacity has been provided.
    c. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

E. Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with the requirements of this section and the contract documents. This acceptance test procedure shall verify that the control system is capable of performing functions stipulated. Additionally, the acceptance test procedure shall verify that sensors and control devices maintain specified accuracy and the system performance do not degrade over time.

F. After control system and its associated control components have been tested, the Contractor shall provide an electronic version of system backup on CD(s) to the Engineer for reloading.

## 3.07 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliamp ere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.

9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.

10. Provide diagnostic and test instruments for calibration and adjustment of system.

11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of the issuance of the Certificate of Final Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

## 3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Port Authority's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. The training shall include four (4) 4- hour session. The first two (2) sessions shall be provided at the completion of the installation. The last two (2) shall be provided six (6) months after the issuance of the Certificate of Final Completion, and shall review the operation and troubleshooting issues encountered. Location of the training to be determined by the Engineer.

END OF SECTION