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Addendum No. 4

Delaware Department of Correction
Baylor Women's Correctional Institution
New Castle, Delaware
OMB/DFM Contract No.: MC3804000072

Tt Project No. 200-26912-15004

Addendum No. 04
to
Drawings and Project Manual
December 6, 2018

To: ALL BIDDERS

This ADDENDUM forms a part of the BIDDING AND CONTRACT DOCUMENTS and modifies the following documents:

Original DRAWINGS dated November 15, 2018
PROJECT MANUAL dated November 15, 2018

Acknowledge receipt of the ADDENDUM in the space provided on the FORM OF PROPOSAL

This ADDENDUM consists of four (4) pages and the following:

4.1 **CLARIFICATION FROM ADDENDUM NO. 3**

A. Article 2.1; Item 1; This applies to the re-use of Trane Control Panels by Trane Only.

4.2 **PROJECT MANUAL MODIFICATIONS**

A. Spec Section 23 05 93; Testing, Adjusting and Balancing for HVAC

1. **ADD** this Spec Section in its entirety, attached to this addendum.

4.3 **DRAWING MODIFICATIONS**

A. None at this time.

4.4 **QUESTIONS/CLARIFICATIONS/REQUEST FOR INFORMATION (RFI'S)**

A. Email from Seiberlich Trane Energy Services, dated December 5, 2018

Question 1: In Spec Section 23 09 50 Building Automation System (BAS) General, Item 1.3 Description of Work; Paragraph A states "The building automation system (BAS) defined in this specification shall interface

with the Delaware Department of Correction's Network and shall utilize the BACnet communication requirements as defined by ASHRAE/ANSI 135 (current version and addendum) for all communication."

Suggested resolution: Is ASHRAE/ANSI 135 - Addendum 135-2008q-3, Use of IEEE 802.15.4 standard as a BACnet data link layer (Wireless), an acceptable communication standard for use on this project in order to cut down on installation timeline and costs?

Response: **No for bidding. At this time, we don't know the effects that is may have on the Facility 5 Security Systems. Bid networking cabling.**

B. Email from Radius Systems, dated December 5, 2018

Question 1: Can the existing BAS Drawings be issued to provide further detail regarding existing devices and wiring?

Response: **Already done, the existing BAS Shop & As-Built drawings were issued as part of Addendum No. 3.**

Question 2: Specification 01 22 00 -2, Unit Prices, Paragraph 3.1 Please define the complete scope for unit pricing; is the unit price to include:

- a. Furnishing the Material
- b. Spring return or non-spring return
- c. Mechanical installation
- d. Engineering labor
- e. Wiring labor including assumed length of wire installation, plenum or EMT install
- f. Checkout labor

Response:

- a. Furnishing the Material: **Yes.**
- b. Spring return or non-spring return: **They are Heating Valves only, normally open; spring return.**
- c. Mechanical installation: **Yes.**
- d. Engineering labor: **Yes; you will be matching existing.**
- e. Wiring labor including assumed length of wire installation, plenum or EMT install: **Yes.**
- f. Checkout labor: **Yes.**

Question 3: Do any Liquidated Damages apply to the project?

Response: **No.**

Question 4: Specification 23 09 51, page 3, Paragraph 2.1 B. Please confirm that new network cable between controller locations is required to be installed, such that both the existing system and the new system can function independent of each other during the construction phase.

Response: **The Existing Network Cable between Controllers has failed. Existing Panels are running in a Standalone operation. New Network cabling throughout the Facility is required.**

Question 5: Regarding installation methods, Specification 23 09 51 -20, Paragraph 3.2 B. 5. States 'Install all control wiring external to panels in electric metallic tubing or raceway. However, communication wiring, signal wiring and low voltage control wiring may be run without conduit in concealed, accessible locations if noise immunity is ensured.' Specification 26 05 33 -6 Paragraph 3.1 B. states that Galvanized Rigid Conduit is to be used in corridors, mechanical/electrical rooms and as indicated on drawings and EMT is to be used in concealed ceilings and interior walls. We have the following questions regarding installation methods:

- a. Please confirm low-voltage installation is to adhere to specification 23 09 51 and that plenum rated low-voltage wiring is acceptable as stated, supported by bridal rings (without conduit) in concealed, accessible locations.
- b. For new low-voltage installations in mechanical rooms, is EMT conduit acceptable.

- c. Is Galvanize Rigid Conduit required for new power wiring for VFD installations? Or is EMT conduit also acceptable for this application?

Response:

- a. **Yes.**
b. **Yes.**
c. **EMT will be acceptable in Mechanical Rooms. Rigid Metal Conduit is required in occupied areas where exposed to the occupants.**

Question 6: Regarding valve scope, where drawings indicate valve replacement, Drawing M-511 for example, please confirm it is the intent to only replace the actuator?

Response: **No Actuator or Valve replacement, just re-wiring. Valves covered under Unit Pricing. Actuators will need to be addressed on an as needed basis, via a Change to the Contract.**

Question 7: Does the project scope include any control valve replacement?

Response: **No. If needed, should be covered under the Unit Pricing.**

Question 8: During the site survey, several existing electric Belimo reheat coil actuators have been disconnected from the valve body. What scope should be included for these existing electric control valves?

Response: **Reconnecting and Testing Operation.**

Question 9: Regarding re-use of existing, Drawing M-512 for example, states existing devices are intended for re-use. Specification 23 09 50 -16 Paragraph 3.4 B. states, "*reuse of wire, conduit and control panel cabinet may be reused at the State Project Engineer's discretion*" Please confirm the note on drawing M-512 and similar notes include the reuse of conduit and end device input/output wiring.

Response: **Yes. If re-using, it is the BAS Contractor's responsibility to verify that they work or replace.**

Question 10: Does the project scope include smoke detector testing?

Response: **Yes. Unit Shut Down and Smoke Purge Operations must be tested.**

Question 11: Does the project scope include fire alarm system modification of any kind?

Response: **None, except Unit Shutdown and Smoke Purge Operation.**

Question 12: If so, please provide current fire alarm management system contact information.

Response: **Will be provided to the successful Contractor.**

Question 13: Regarding balancing scopes of work, Drawing M-700 for example, please confirm the air side scope extends from and includes fans and the entire distribution system.

Response: **Yes, as part of the corresponding Alternates**

Question 14: Regarding balancing scopes of work, please confirm the water side scope extends from and includes pumps and the entire distribution system.

Response: **Yes, as part of the corresponding Alternates**

Question 15: Does the scope include any pre-balancing of the systems?

Response: **Not Required.**

Question 16: Please confirm the gas fired unit heaters are no longer included in the scope of work.

Response: **They have been deleted from the project and were identified by Removal Work #6 and New Work Note #6, which have now been closed out.**

Question 17: Please confirm all VAV box locations on the secure side of the facility are within mechanical spaces and not located above ceilings.

Response: They are not, except for the three (3) VAV's located in Mechanical Room #8, all VAV's are located above the acoustical tile ceilings, in the occupancies areas which include Administrative, Education, Medical, Booking and Receiving Wings.

Question 18: Will a material storage area be provided within the facility?

Response: A Storage Trailer may be provided within the Fence line. Location to be coordinated with the successful Contractor at the Pre-Construction Meeting.

Question 19: Will the contractors be permitted to store a locked gang box of tools within mechanical rooms to reduce time spent on daily tool check? (the gang box will utilize one lock owned by the contractor and one lock owned by the facility to guarantee the box can only be accessed by both parties together)

Response: Yes, tool check is still required.

Question 20: Regarding pneumatic actuator replacement, please confirm it will be acceptable to cut/cap and abandon in place pneumatic lines at each actuator.

Response: The Removal Work Notes indicate to remove tubing in its entirety. The tubing shall be removed to the point where it becomes inaccessible.

Question 21: Addendum 3 indicated the inclusion of smoke purge sequences, are the new BACnet controllers required to be UL 864 rated?

Response: If required by code.

ATTACHMENTS

END OF ADDENDUM No. 4

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SECTION 23 09 50

BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General Requirements
- B. Description of Work
- C. Quality Assurance
- D. System Architecture
- E. Distributed Processing Units/Quantity and Location
- F. Demolition and Reuse of Existing Materials and Equipment
- G. Sequence of Work

1.2 RELATED DOCUMENTS

- A. Section 23 09 51 - Building Automation System (BAS) Basic Materials, Interface Devices, and Sensors
- B. Section 23 09 53 - BAS Field Panels
- C. Section 23 09 54 - BAS Communication Devices
- D. Section 23 09 55 - BAS Software and Programming
- E. Section 23 09 58 - Sequences of Operation
- F. Section 23 09 59 - BAS Commissioning
- G. Section 23 09 69 - Variable Frequency Controllers

1.3 DESCRIPTION OF WORK

- A. The building automation system (BAS) defined in this specification shall interface with the Delaware Department of Correction's Network, and shall utilize the BACnet communication requirements as defined by ASHRAE/ANSI 135 (current version and addendum) for all communication.

- B. Contractor shall furnish and install a building automation system (BAS). The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified. The BAS for this project will generally consist of monitoring and control of systems listed below. Reference also control drawings, sequences of operation, and points lists.
- C. The systems to be controlled under work of this section basically comprise (describe the scope of the project). The HVAC systems being controlled are (describe systems to be controlled). This Section defines the manner and method by which these controls function.

1.4 APPLICATION OF OPEN PROTOCOLS

- A. Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing BACnet. System components shall communicate using native BACnet in accordance with ASHRAE Standard 135 and current addenda and annexes, including all workstations, all building controllers, and all application specific controllers. Gateways to other communication protocols are not acceptable.

1.5 QUALITY ASSURANCE

- A. Product Line Demonstrated History: The product line being proposed for the project must have an installed history of demonstrated satisfactory operation for a length of 2 years since date of final completion in at least 10 installations of comparative size and complexity. Submittals shall document this requirement with references.

The following requirement relates to the actual installing contractor.

- B. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years. Firms with experience in BAS installation projects with point counts equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer's product, installer must demonstrate at least three years prior experience with that manufacturer's products. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.
- C. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than one year from date of final completion on at least 3 projects of similar size and complexity. Submittals shall document this experience with references.
- D. Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 2 projects of similar size and complexity. Installer shall submit the names of the proposed individual and at

least one alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:

1. Product Line Training: Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration
 2. Programming Training: Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.
- E. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.
- F. Installer's Response Time and Proximity
1. Installer must maintain a fully capable service facility within a 45 mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
 2. Emergency response times are listed below in this section. Installer must demonstrate the ability to meet the response times.

1.6 CODES AND STANDARDS

- A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
1. ASHRAE 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. current edition including all related addenda shall apply.
- B. Electronics Industries Alliance
1. EIA-709.1-A-99: Control Network Protocol Specification
 2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
 3. EIA-232: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
 5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
 7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
 8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
 9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications

- C. Underwriters Laboratories
 - 1. UL 916: Energy Management Systems.
 - 2. UUKL 864: UL Supervised Smoke Control
- D. NEMA Compliance
 - 1. NEMA 250: Enclosure for Electrical Equipment
 - 2. NEMA ICS 1: General Standards for Industrial Controls.
- E. NFPA Compliance
 - 1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 - 2. NFPA 70 National Electrical Code (NEC)
- F. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - 2. IEEE 802.3: CSMA/CD (Ethernet - Based) LAN
 - 3. IEEE 802.4: Token Bus Working Group (ARCNET - Based) LAN

1.7 DEFINITIONS

- A. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.
- B. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).
- C. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications. .
- D. BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135 (Current edition and addendum).
- E. BACnet Interoperability Building Blocks (BIBB): A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.
- F. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended opr required destinations.

- G. Building Automation System (BAS): The entire integrated management and control system
- H. Building Controller (BC): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the controlled devices / equipment and the CSS, and temporary data storage for trend information, time schedules, and alarm data.
- I. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135 (current version and addendum)).
- J. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
- K. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).
- L. Controller or Control Unit (CU): Intelligent stand-alone control device. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.
- M. Control Systems Server (CSS): A server class computer(s) that maintains the systems configuration and programming database. This server is located at the State of Delaware's data center in a virtual environment and serves as an access point to BAS.
- N. Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs, AACs and ASCs. Refer to System Architecture below.
- O. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic
- P. Functional Profile: A collection of variables required to define a the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.
- Q. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them.
- R. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.
- S. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS
- T. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.

- U. Local Supervisory LAN: Also known as the State's Network: Ethernet-based network connecting Primary Controlling LANs with each other and OWSs and CSSs. See System Architecture below.
- V. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard.
- W. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.
- X. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
- Y. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, dedicated OWS is not required for communications to occur. The
- Z. OWS can be any computer on the State's Network that has a compatible Web browser.
- Point-to-Point (PTP): Serial communication as defined in the BACnet standard.
- AA. Portable Operators Terminal (POT): Mobile computer used both for direct connection to a controller as well as network connection.
- BB. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device (ASHRAE/ANSI 135 (current version and addendum)).
- CC. Router: A device that connects two or more networks at the network layer.
- DD. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Controlling LAN. Refer to System Architecture below.
- EE. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
- FF. Standardized Query Language (SQL): A database computer language designed for managing data in relational database management system (RDBMS). Its scope includes data insert, query, update and delete, schema creation and modification, and data access control.
- GG. Smart Device: A control I/O device such as a sensor or actuator that can directly communicate with a controller through the network. This differs from an ASC in that it typically deals only with one variable.
- HH. Extensible Markup Language (XML): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It is a set of rules for encoding documents in

machine-readable form that allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.8 FUNCTIONAL INTENT

- A. Throughout Sections 23 09 50 through 23 09 55, the Sequences of Operation, and Section 23 09 59 detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. However these will only be allowed with prior approval.

1.9 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows.
 - 1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD (current version) and/or Adobe Portable Document Format file. All 'X reference' and font files must be provided with AutoCAD files.
 - 2. Other Submittals: All other submittals shall be provided in Adobe Portable Document V Format (PDF).
- C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.
- D. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.
- E. Shop Drawings: Submit shop drawings for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Each shop drawing shall contain the following information:
 - 1. System Architecture and System Layout:
 - a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, , instance number, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. Indicate media, protocol, baud rate, and type of each LAN. All

- optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.
- b. Provide electronic floor plans locating all control units, workstations, LAN interface devices, gateways, etc. Include all network communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, instance number, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.
2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include verbal description of sequence of operation.
 3. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
 4. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 23 09 55 - Part III for additional requirements.
 5. Label each control device with setting or adjustable range of control.
 6. Label each input and output with the appropriate range.
 7. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
 8. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers.
 9. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring, which are existing, factory-installed and portions to be field-installed.
 10. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
 11. Sheets shall be consecutively numbered.
 12. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
 13. Table of Contents listing sheet titles and sheet numbers.

14. Legend and list of abbreviations.
 15. Memory allocation projections.
 16. Submit along with shop drawings but under separate cover calculated and guaranteed system response times of the most heavily loaded LAN in the system.
- F. Open Protocol Information
1. BACnet Systems:
 - a. BACnet object description, object ID, and device ID, for each I/O point.
 - b. Documentation for any non-standard BACnet objects, properties, or enumerations used detailing their structure, data types, and any associated lists of enumerated values.
 - c. Submit PICS indicating the BACnet functionality and configuration of each controller.
- G. Framed Control Drawings: Laminated control drawings including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.
- H. Control Logic Documentation
1. Submit control logic program listings (for graphical programming) and logic flow charts (for line type programs) to document the control software of all control units.
 2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation.
 3. Include written description of each control sequence.
 4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
 5. Sheets shall be consecutively numbered.
 6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
 7. Include Table of Contents listing sheet titles and sheet numbers
 8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Section 01 30 00.
- I. Operation and Maintenance Materials:
1. Submit documents under provisions of Section 01 03 00. One copy of the materials shall be delivered directly to the State facilities operation staff, in addition to the copies required by other Sections.

2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
 3. Submit BAS User's Guides (Operating Manuals) for each controller type .
 4. Submit BAS advanced Programming Manuals for each controller type.
 5. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.
- J. Controls contractor shall provide the State with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches. This service will be provided for 5 years as part of the contract price, and will be offered to the State thereafter for the same price as to a dealer or branch.
- K. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.
- L. Product Warranty Certificates: submit manufacturers product warranty certificates covering the hardware provided.

1.10 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 01 30 00.
- B. Record copies of product data and control shop drawings updated to reflect the final installed condition.
- C. Record copies of approved control logic programming and database on paper and on CD's.
Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
- D. Record copies of approved project specific graphic software on CDs.
- E. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.
- F. Provide record riser diagram showing the location of all controllers.
- G. Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period

1.11 SYSTEM ARCHITECTURE

- A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.
- B. The system shall be configured as a distributed processing network(s) capable of expansion as specified below.
- C. The system architecture shall consist of the Ethernet-based State Network, and Controlling LANs that support BCs, AACs, ASCs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the BAS structure.
 - 1. State Network: Internet-based network connecting multiple facilities with a central data and application server, accessible via standard web-browser. This is an existing infrastructure and contractor is not required to configure any components of this network. Refer to Section 23 09 54 for requirements. This contractor shall integrate the controlling devices and the CCS together.
 - 2. Local Supervisory LAN: The Local Supervisory LAN shall be an Ethernet-based, 100 Mbps LAN connecting Primary Control LANs and OWSs. The LAN serves as the inter-BC gateway and OWS-to-BC gateway and communications path. Contractor shall provide this as a dedicated LAN for the control system. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 5 cable with switches and routers that support 100 Mbps throughput. Power-line carrier communication shall not be acceptable for communications. The physical media will be that installed for the IT infrastructure of the facility and as such network drops will be provided under that scope of work to facilitate work of this scope. This network will be 100 Mbps and therefore all network interface cards shall support that speed. The higher level layers of this network shall be BACnet as described below:
 - a. BACnet Supervisory LAN: Shall be BACnet/IP as defined in the BACnet standard, and shall share a common network number for the Ethernet backbone, as defined in the BACnet standard. Point/Object naming conventions are specified in 23 09 55 - Part III.
 - 3. Controlling LAN: High-speed, peer-to-peer communicating LAN used to connect AACs, ASCs and Building Controllers (BCs) and communicate exclusively control information. Acceptable technologies include:
 - a. Ethernet (IEEE802.3)
 - b. ARCNET (IEEE802.4)

- G. Control Systems Server (CSS): A server class computer(s) that maintains the systems configuration and programming database. This server is located at the State of Delaware's data center in a virtual environment and serves as an access point to BAS. It shall hold the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information. Refer to Section 23 09 52 - BAS Operator Interfaces for its requirements.
- H. The Operator Interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. Refer to Section 23 09 52 - BAS Operator Interfaces.
- I. The BCs, AACs, ASCs, [and SDs] shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 23 09 53 - BAS Field Panels.
- J. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on the CSS. User tools provided to the State shall allow configuring, updating, maintaining, etc. current configurations and settings whether they are initiated at the server or the end device.
 - 1. Database Schema shall be published and provided to the State to facilitate easy access to the data.
 - 2. Database shall be ODBC compliant.
- K. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted.
- L. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.
- M. Anytime any controller's database or program is changed in the field, the controller shall be capable of automatically uploading the new data to the CSS.

1.12 WARRANTY MAINTENANCE

- A. Contractor shall warrant all products and labor for a period of (insert warranty period) after Substantial Completion.
- B. The State reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the

State, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS.

- C. At no cost to the State, during the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below:
1. Maintenance services shall be provided for all devices and hardware specified in sections 23 09 51 through 23 09 59. Service all equipment per the manufacturer's recommendations. All devices shall be calibrated within the last month of the warranty period.
 2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the State to the Contractor.
 - a. Response by telephone to any request for service shall be provided within two (2) hours of the State's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the State's site within eight (8) hours of the State's initial telephone request for such services, as specified.
 3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the State to the Contractor.
 - a. Response by telephone to any request for service shall be provided within eight (8) working hours (contractor specified 40 hr per week normal working period) of the State's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the State's site within three (3) working days of the State's initial telephone request for such services, as specified.
 4. Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for The State to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. Alternatively, pagers can be used for technicians trained in system to be serviced. One of the three paged technicians shall respond to every call within 15 minutes.
 5. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
 6. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.14 LISTING AND LABELING

- A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 – PRODUCTS

2.1 MANUFACTURERS (Pre-Approved by the State)

- A. Automated Logic by Radius Systems
- B. BuildingLogix / Lynxspring / KMC Controls by Seiberlich Trane
- C. Johnson Controls by Modern Controls

2.2 MATERIALS AND EQUIPMENT

- A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where drawings or specs specifically allow existing materials to remain in place.

2.3 UNIFORMITY

- A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
- B. Network Connectivity: The BAS contractor shall provide two network connections with Cat-6 cables from the Building Controller to the State's IT network.
 - 1. The BAS contractor shall terminate one end of the two Cat-6 cables at or around the State's patch panel and make connections to the State's switch with green patch cables, following the instruction of the DFM's IT personnel.
 - 2. The BAS contractor shall terminate the other end of the two Cat-6 cables near or within the building controller cabinet with dual RJ-45 terminal box and make connection of one cable to the building controller. Note: the second connection is for on-site operator interface through a mobile computer. Exposed cable shall be protected by conduit or wire mold.
 - 3. The BAS contractor shall label the two network connections BAC-1 and BAC-2 on both ends.
- C. Refer to additional requirements in other sections of this specification.

3.3 SURGE PROTECTION

- A. The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.4 DEMOLITION AND REUSE OF EXISTING MATERIALS AND EQUIPMENT

- A. Contractor shall assume that existing equipment that specifically is indicated to be reused is in good condition and is operable. Contractor, during the course of work, shall inspect these devices and determine if any devices are in need of replacement or repair. Contractor shall prepare an itemized list of suggested repairs/replacement. This repair/replacement will be at the discretion of the State and will be accomplished by expanding this contract.
- B. Existing wire, conduit, and control panel cabinets may be reused at the State Project Engineer's discretion, but only if such materials or equipment comply with the applicable specification for new materials and equipment. Such materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service.
- C. Where such materials are reused, the contractor's shop drawings shall reflect the existing wiring designation. If existing labeling is illegible or otherwise does not comply with the applicable specification for labeling, wiring runs shall be relabeled in accordance with the requirements specified elsewhere.

- D. Existing pneumatic tubing located between the existing BAS panels and the pneumatic operators shall not be reused; however, conduit for such tubing may be reused. All other pneumatic tubing may be reused, but only if such materials comply with the applicable specification for new materials. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. All pneumatic tubing to be reused shall be pressure tested and all leaks shall be repaired. All reused pneumatic tubing shall be purged with dry air or nitrogen.
- E. The existing pneumatic main air supply system shall be modified as required and reused to serve existing pneumatic controls that are to remain, and shall be extended as necessary to serve new pneumatic controls. Where existing pneumatic controls are removed, main air piping shall be removed back to the point of connection to the main air supply which remains in use, and shall be capped or plugged.
- F. Existing valves and dampers and their operators may be reused only when preapproved by the State. Contractor shall lubricate all damper linkages of dampers being controlled under this project.
- G. Other materials and equipment not specifically mentioned herein may be reused only if specifically allowed by indications on the drawings.
- H. For HVAC systems which are indicated to receive a new BAS, all existing materials and equipment associated with the existing pneumatic controls and EMCS shall be removed unless otherwise specified or indicated to remain, or unless reused in accordance with the above requirements, except for the following: 1) conduit and electrical boxes (but not wiring within conduit) may remain in place if not reused (leave a pull line); 2) inaccessible pneumatic tubing may remain in place if not reused. Existing materials and equipment to be removed shall be removed subject to the requirements in paragraph "Sequence of Work". For HVAC systems, which are not to receive a new DDC BAS, the existing pneumatic control system shall remain fully functional.

3.5 SEQUENCE OF WORK For Existing Systems Conversion

- A. General: All work involving changeover of control functions from existing pneumatic control system to the new DDC BAS shall be performed in accordance with the following sequence in order to minimize the duration of equipment outages. The following descriptions are intended to indicate the sequence in which the work shall be performed, not to define fully the scope of the work.
- B. Install operator's terminal, peripherals, graphic software, and LAN prior to placing any equipment under the control of the new BAS.
- C. Work which requires shutting down a pump motor, fan motor, or chiller shall be considered a utility shutdown and shall be subject to the restrictions specified in Division 0.1

- D. The following sequence applies to an individually controlled HVAC subsystem, such as an air handling unit. Only one such system shall be placed under manual control (as described below) at any given time.
1. Install controllers adjacent to (or within) existing control panel. Programming shall be complete (except for loading and debugging) prior to installation. Install all field devices, which do not require interruption of the existing control system.
 2. Install all conduit, wiring, and pneumatic tubing which does not require interruption of the existing control system.
 3. Provide temporary variable pressure type hand pumps at each pneumatically controlled output, for temporary use by The State's maintenance and operation contractor personnel. Schedule this step at least 48 hours in advance with the Building Engineer.
 4. Remove existing controls including wiring, conduit, and tubing (except materials to be reused in accordance with provisions specified elsewhere) which must be removed to facilitate installation of new BAS materials and equipment.
 5. Remove existing digital control system points (if applicable). Install and calibrate remainder of new BAS materials and equipment for this subsystem. Load controller software. Connect controller(s) to LAN.
 6. Perform all field testing and calibration that does not require connection of permanent pneumatic outputs.
 7. Remove temporary hand pumps and install permanent pneumatic output connections.
Place the system under the control of the new DDC/BAS equipment. Conclude field testing and submit field testing report prior to placing the next subsystem under temporary manual control. The State shall be given a password with a priority level that allows monitoring (but not control until notification of substantial completion has been approved).
 8. Remove remaining existing pneumatic and digital control system materials and equipment (except materials to be reused in accordance with provisions specified elsewhere). All existing digital controls equipment for those subsystems that have not yet been converted shall remain intact, on-line, and fully functional.
 9. Schedule work in The State's occupied spaces 3 days in advance with the State's representative.

3.6 CONTROL POWER SOURCE AND SUPPLY

- A. Section 23 09 50 Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 23 09 50 through 23 09 55 and Sequences of Operation.

The following item will have to be customized for each system and project. The consideration is where to power controllers from. For distributed controllers that are associated with one unit, it is convenient to power them along with the system so the controller can take action based on the presence of power. However on large centralized panels, it may be best to put these on the most reliable source of

power that serves the equipment being controlled and then provide for individual monitoring of the various system's power sources by the controller. The object here is to make a robust system that does not interpret power failures as device failure and therefore in some instances have to take down the unit for manual acknowledged reset. This can compromise reliability.

B. General requirements for obtaining power include the following:

1. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls, provide separate transformer.
3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
4. Standalone Functionality: Refer to Section 23 09 53.

3.7 BAS STARTUP, COMMISSIONING AND TRAINNING

- A. Refer to Section 23 09 59

3.8 SEQUENCE OF OPERATION

- A. Refer to Section 23 09 58 - Sequences of Operation
B. Refer to Sequence of Operations on the drawings.

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