

SECTION 25 00 10 – BUILDING AUTOMATION SYSTEMS (BAS) GENERAL - RETROFIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Although Specifications throughout the Mechanical, Electrical, Communications, Electronic Safety and Security divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them; additional Divisions also may be reciprocally applicable to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. This Section applies to situations where controls are being replaced on existing equipment but not where core equipment is being replaced.
 - 2. Description of Work
 - 3. Quality Assurance.
 - 4. System Architecture.
 - 5. Distributed Processing Units/Quantity and Location.
 - 6. Demolition and Reuse of Existing Materials and Equipment.
 - 7. Sequence of Work.
- B. Where conversion from pneumatic is required, furnish and install a direct digital control and building automation system (BAS). The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves (except where noted otherwise) to perform control sequences and functions specified. The BAS for this Project will generally consist of monitoring and control of systems described herein. Reference shall also be made to control Drawings, Sequence of Operation, and points lists.
- C. The HVAC systems being controlled are [describe the type of mechanical systems included in the Project]. This Section defines the manner and method by which these controls function.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
2. ASHRAE 135: BACnet - A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. and all current addenda and annexes.
3. Electronics Industries Alliance:
 - a. EIA-709.1-A-99: Control Network Protocol Specification.
 - b. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification.
 - c. EIA-232: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - d. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes.
 - e. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 - f. EIA-472: General and Sectional Specifications for Fiber Optic Cable.
 - g. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.
 - h. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.
 - i. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.
4. NEMA Compliance:
 - a. NEMA 250: Enclosure for Electrical Equipment.
 - b. NEMA ICS 1: General Standards for Industrial Controls.
5. NFPA Compliance:
 - a. NFPA 90A: "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 - b. NFPA 70: National Electrical Code (NEC).
6. Institute of Electrical and Electronics Engineers (IEEE):
 - a. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - b. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN.
 - c. IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN.
 - d. IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

1.04 QUALITY ASSURANCE

USE "A" TO DEFINE ANY SPECIFIC QUALIFICATIONS NEEDED; OTHERWISE LEAVE "RESERVED".

- A. [Reserved].
- B. Niagara 4 (that drives an HTML 5 driver)-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 one (1) year since date of final completion in at least ten (10) installations of comparative size and complexity. Documents with references shall be submitted verifying this requirement has been met at Owner's request.
- C. BAS Installers Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall be certified and specialize in and be experienced with control system installation for not less than five (5) years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than two (2) projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty at Owner's request. 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.
- D. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.
- E. The BAS shall be listed by Underwriters Laboratories (UUKL 864) for Supervised Smoke Control.

1.05 SUBMITTALS

- A. General: Submit documents under provisions of Division 01. Two (2) copies of the materials shall be delivered directly to UNIVERSITY OF HOUSTON Management Services staff, in addition to the copies required by other Sections. In addition, an electronic version of the completed materials shall be provided to the FPC Archivist on CD, DVD or thumbdrive. Refer to Section 25 08 10 for additional Commissioning submittal requirements.
- B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and operation and maintenance (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 drawing per Owner's CAD standards. 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 Format.
- C. 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. Include installation and start-up instructions.

D. Record Documents:

1. BAS Vendor shall submit separately and directly to Owner a pricing breakdown of all cost associated to Project for review. This is to include but not be limited to material quantity, description, unit list price, multiplier, cost, extended cost, material costs adjustment less Owner's discount price, outside material price totaled and itemized, itemized subcontract price associated to Project, and total Project support price.
 - a. BAS Vendor's labor hours quantities shall be itemized by mechanical labor, electrical labor, and design and management labor. Hour quantities shall be itemized by journeyman rate, technician rate and design/management rate with quantity of hours listed separately.
 - b. All estimated overtime shall be disclosed prior to overtime work. Profit for Project shall be as described in the project agreement. Total Project price shall not exceed the sum of the listed itemized costs.
 - c. Provide an accurate spreadsheet breakdown of physical point counts of all analog inputs, analog outputs, digital inputs, digital outputs, building controllers and application specific controllers [\[insert link\]](#). The total point count for the project shall be itemized in a logical manner to allow the owner to confirm point count accuracy. Below is an example.

Project Physical Point Count	Drawing M-006	Drawing M-007	Drawing M-008	Drawing M-010	Drawing M-014	Drawing M-015
Physical Digital Input(s)						
Physical Digital Output(s)						
Physical Analog Input(s)						
Physical Analog Output(s)						
Building Controller(s)						
Application Specific Controller(s)						
TOTALS						

- d. All subcontracts greater than \$5K shall be competitively priced by a minimum of three subcontractors. Owner shall review and make recommendation regarding the use of subcontractors. Both subcontract proposals shall be fully disclosed.
 - e. This subcontractor pricing summary, including any attachments, is intended only for the Owner and contains confidential and/or privileged information. Any unauthorized review; use, disclosure or distribution is prohibited.
2. Qualifications: Manufacturer, installer, and key personnel qualifications as indicated for the appropriate item above.

3. Shop Drawings: Submit Shop Drawings electronically on AutoCAD software 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. Shop Drawings shall contain the following information:
 - a. System Architecture and System Layout:
 - 1) One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, device instance, 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 diagram. All control units shall map back into BMS main server (supervisor).
 - 2) Provide floor plans locating all control units, workstations, servers, LAN interface devices, gateways, etc. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, device instance, 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 conditions shall be maintained accurately throughout the construction period and the Record Drawings shall be updated to accurately reflect accurate, actual installed conditions.
 - b. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include written description of sequence of operation.
 - c. 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.
 - d. 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). If this information is not available at the time of Shop Drawings submittals, furnish with O&M manual documentation for Owner review and approval. See Section 25 15 10 for additional requirements.
 - e. Label each control device with setting or adjustable range of control.
 - f. Label each input and output with the appropriate range.
 - g. 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.
 - h. With each schematic, provide (using spreadsheet provided by BMS) 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.

- i. 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 that are existing, factory-installed and portions to be field-installed.
 - j. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
 - k. Sheets shall be consecutively numbered.
 - l. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
 - m. Table of Contents listing sheet titles and sheet numbers.
 - n. Legend and list of abbreviations.
 - o. Record copies of product data, as built control Shop Drawings and final sequence of operation updated to reflect the final installed condition.
 - p. Provide network architecture Record Drawings showing all nodes including a description field with specific controller identification, description and location information.
 - q. Provide record riser diagram showing the location of all controllers. Indicate device instance, MAC address and drawing reference number.
- E. Operation and Maintenance Data (provide electronically in Owner's format)
- 1. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
 - 2. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
 - 3. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
 - 4. Manufacturer's Certificates: For all listed and/or labeled products, provide certificate of conformance.
 - 5. Product Warranty Certificates: Submit manufacturer's product warranty certificates covering the hardware provided.

1.06 SYSTEM ARCHITECTURE

- A. The communication speed between the controllers, LAN interface devices, CSS, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with Shop Drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall modify their BAS control design as necessary to accomplish these performance requirements. Generally requirements do not apply when a remote connection must be established via modem:
1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
 2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
 3. 20 seconds between a Level 3-5 alarm occurrence and enunciation at operator workstation.
 4. 10 seconds between an operator command via the operator interface to change a set point and the subsequent change in the controller.
 5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.
 6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
 7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least ten (10) points.
- B. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other BAS nodes on the network. If a LAN is severed, two (2) separate networks shall be formed and communications within each network shall continue uninterrupted.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Provide equipment and control devices in original factory-shipping cartons. 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.

1.08 WARRANTY

- A. Contractor shall warranty all products and labor for a period of [One (1) year minimum] after Substantial Completion.

- B. The Owner reserves the right to make changes to the BAS during the Warranty Period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS. Any disagreement between Owner and Contractor on such matters shall be subject to resolution through the Contract 'Disputes' clause.
 - 1. At any time during the Warranty Period that Contractor is on the Project Site for maintenance, emergency, or normal service, Contractor shall notify Owner via UNIVERSITY OF HOUSTON Monitoring Services and the local building operating personnel.
 - 2. Contractor shall notify said personnel of all work anticipated being involved for the service work. In addition, no work affecting system operation shall commence until written permission is granted.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of Authorities Having Jurisdiction.

2.02 MANUFACTURERS

- A. The BAS and digital control and communications components installed as Work of this Contract shall be an integrated distributed processing system of the following manufacturer or communication protocol. No other products will be considered as substitutions.
 - 1. NIAGARA 4 (THAT DRIVES AN HTML 5 DRIVER): Provide control products and systems that completely integrate and operate from the existing system currently in operation at the institution. All access, programming, alarming, and system configuration shall be utilized from the existing system software and database without any third party programs or gateways.
 - 2. Substitutions: None

2.03 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 Specifications specifically allow existing materials to remain in place.

2.04 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

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Fasteners requiring explosive powder (shooting) or pneumatic-driven actuation will not be acceptable under any circumstances.
- D. Refer to additional requirements in other Sections of this Specification.

3.02 SURGE PROTECTION

- A. 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 percent above or below measured nominal value, with no affect on hardware, software, communications, and data storage.

3.03 CONTROL POWER SOURCE AND SUPPLY

- A. BAS Provider shall extend all power source wiring required for operation of all equipment and devices provided under Division 25 and the Drawings if not specified under Division 26.
- B. General requirements for obtaining power include the following:
 - 1. All control power for a given stand alone controller and all associated controls for this stand alone controller shall originate from the same circuit.
 - 2. All mechanical equipment which is supplied with emergency power shall have the DDC controller supplied with emergency power.
 - 3. Provide an uninterruptible power supply (UPS) as indicated on the Drawings or as necessary. UPS shall protect against blackouts, brownouts, surges and noise.
 - a. UPS shall include LAN port and modem line surge protection.
 - b. UPS shall be sized for a 7-minute full load runtime, 23-minute 1/2 load runtime, with a typical runtime of up to 60 minutes. Transfer time shall be 2-4 milliseconds.
 - c. UPS shall provide a 480-joule suppression rating and current suppression protection for 36,000 amps and provide 90 percent recharge capability in 2-4 hours. Suppression response time shall be instantaneous. UPS low voltage switching shall occur when supply voltage is less than 94 volts.
 - d. Provide a Maintenance Bypass Switch that allows input voltage to bypass the UPS and directly power the connected equipment if an abnormal condition prevents the UPS from supporting the load, or if the UPS is required to be taken out of service.
 - e. Provide all software, cables, peripherals etc. for a complete system.

END OF SECTION 25 00 10