

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

SECTION 25 0000 – BUILDING MANAGEMENT SYSTEMS (BMS) GENERAL

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

PART 1 - GENERAL

Note: Reference the "University of Houston Design Guidelines, Element D3060, Controls and Instrumentation – General" document. This document describes how to employ this and other controls-related Specifications. The Engineer is instructed to consult the document for guidance on the nature of these Specifications, methods for deleting non-applicable text, and use and deletion of Editor's Notes before proceeding with modification of this Specification to suit the Project.

Engineer shall confirm with the Manager of Building Management Services located in the departments and Environmental Health and Safety before utilizing Sections: 25 0000, 25 0800, 25 1100, 25 1109, 25 1400, 25 1500, and 25 3000 for a Houston area project.

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's Supplemental General Conditions and Special Conditions for Construction.
- C. 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.

1.2 SUMMARY

- A. Section Includes:

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 1

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

1. Description of Work.
2. Quality Assurance.
3. System Architecture.
4. Distributed Processing Units/Quantity and Location.
5. Demolition and Reuse of Existing Materials and Equipment.
6. Sequence of Work.

- B. Contractor shall furnish and install a direct digital control and building management system (BMS). The new BMS 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 BMS 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.

Keep paragraph below where conversion from pneumatic controls to electronic controls is required.

- C. Where conversion from pneumatic is required, furnish and install a direct digital control and building management system (BMS). The new BMS 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 BMS 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.
- D. 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.

1.3 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. The Authority Having Jurisdiction (AHJ) for building management systems (BMS) shall be the Building Management Systems shop. 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 Management and Control Networks, latest edition. American Society of Heating, Refrigerating

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General

UH Master: 05.2020

25 0000 - 2

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

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-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 - e. EIA-472: General and Sectional Specifications for Fiber Optic Cable.
 - f. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications.
 - g. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications.
 - h. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications.
4. Underwriters Laboratories:
 - a. UL 916: Energy Management Systems.
 - b. UUKL 864: UL Supervised Smoke Control if the BMS is used for smoke control.
5. NEMA Compliance:
 - a. NEMA 250: Enclosure for Electrical Equipment.
 - b. NEMA ICS 1: General Standards for Industrial Controls.
6. 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).
7. 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 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

1.4 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.

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 3

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- 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 and all current addenda and annexes.
- E. BACnet Interoperability Building Blocks (BIBB): 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 or required destinations.
- G. Building Management System (BMS): The entire integrated management, monitoring, 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 LAN backbone and sub-LANs, and 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).
- 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 panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.
- M. Control Systems Server (CSS): This shall be a computer (or computers) that maintains the systems configuration and programming database. This may double as an operator workstation.
- N. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic.
- O. Functional Profile: A collection of variables required to define key parameters for a standard application. For the HVAC industry, this would include applications like VAV

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 4

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

terminal units, fan coil units, etc.

- P. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them (ASHRAE/ANSI 135-(use the most current version)
- Q. Hand Held Device (HHD): Manufacturer's microprocessor-based device for direct connection to a Controller.
- R. IT LAN: Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication.
- S. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BMS.
- 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: Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs and CSSs and the LAN to which the GEMnet will be interfaced. See System Architecture herein.
- V. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard (ASHRAE/ANSI 135).
- W. UNIVERSITY OF HOUSTON WAN: Internet-based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser.
- X. 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.
- Y. Operator Interface (OI): A device used by the operator to manage the BMS including OWSs, POTs, and HHDs.
- Z. Operator Workstation (OWS): The user's interface with the BMS system. As the BMS network devices are stand-alone, the OWS is not required for communications to occur.
- AA. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.
- BB. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.
- CC. 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).

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 5

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- DD. Primary Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture herein.
- EE. Router: A device that connects two or more networks at the network layer.
- FF. Secondary Controlling LAN: LAN connecting AACs and ASCs, generally lower speed and less reliable than the Primary Controlling LAN. Refer to System Architecture herein.
- GG. 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.
- HH. SQL: Standardized Query Language, a standardized means for requesting information from a database.
- II. Smart Device: A control I/O device such as a sensor or actuator that can directly communicate with the controller network to which it is connected. This differs from an ASC in that it typically deals only with one variable.
- JJ. XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.5 QUALITY ASSURANCE

Use "A" to define any specific qualifications needed; otherwise leave "Reserved".

- A. **[Reserved]**.
- B. BMS Manufacturer Qualifications: BMS manufacturer must be a nationally recognized manufacturer of BMS systems and products with complete published catalog literature, installation, operation and maintenance manuals for products intended for use. BMS manufacturer must have full-time, in-house employees that specialize in product research and development, technical support, owner training, and product application and engineering, and product manufacturing, testing and quality control.
- C. 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 five (5) years since date of final completion in at least ten (10) installations of comparative size and complexity. Submittals shall document this requirement with references.
- D. Installer's Qualifications: Firm must specialize and be experienced in control system installations for not less than five years. Firm must be an authorized representative of, and trained by, BMS manufacturer. Firm must have experience in DDC installation

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 6

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

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 five years prior experience with that manufacturer's products. Experience starts with Final Completion of previous projects. Submittals must document this experience with references.

1. BMS manufacturer must provide a project-specific letter if requested by Architect or Owner, signed by manufacturer's corporate office, stating that the BMS manufacturer will assume responsibility for and take over execution of work if necessary to comply with the Project requirements.
- E. 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 three (3) projects of similar size and complexity. Submittals shall document this experience with references.
- F. Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall 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. Submittals shall document this experience with references. 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.
 3. Manufacturer Training: Individuals installing the products intended for use must be trained by the BMS manufacturer and certified by the BMS manufacturer to be certified to install products intended for use. If requested, submit written certificates from BMS manufacturer proving individuals have completed and passed manufacturer training.
 4. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum five (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.
- G. Installer's Response Time and Proximity:

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 7

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

1. Installer must maintain a fully capable service facility within a 60 mile radius of the Project Site. Service facility shall manage emergency service dispatches and maintain inventory of spare parts.
 2. Emergency response times are listed below in this Section. Installer must demonstrate ability to meet response times.
- H. The BMS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.
- I. The BMS shall be listed by Underwriters Laboratories (UL 864 UUKL) for Supervised Smoke Control.
- J. Mock-Ups
1. Sequence of Operations Mock-Up: Conduct a BMS mock-up session to prove sequence of operations, graphics and overall acceptance prior to construction. The Owner, MEP Engineer, Commissioning Agent and Contractor shall be present and the mockup session shall be conducted at the controls vendor's facility. Controls vendor shall provide BMS with records of testing results demonstrating 100% functionality. The Mockup session shall take no longer than one week. At completion, all parties present shall sign off that the mockup was completed and proven to meet the design intent.
 - a. If Commissioning Agent must make return trips, a fee may apply that will be charged to the Contractor. Commissioning may be done in phases with the Commissioning Agent's approval.

1.6 SUBMITTALS

- A. General: Submit under provisions of Division 01. Two (2) copies of the materials shall be delivered directly to Owner's Monitoring Services staff, in addition to the copies required by other Sections. In addition, an electronic version of the completed materials shall be provided per Owner's format. Data can be in searchable native file format where necessary. Refer to Section 25 0800 "BMS Testing and Commissioning" for additional commissioning submittal requirements.
- B. Functional Intent: Throughout the Contract Documents, 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 be allowed only with prior written approval by Owner.
- C. 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:

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General

UH Master: 05.2020

25 0000 - 8

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

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.
- D. Qualifications: Manufacturer, Installer, and key personnel qualifications as indicated for the appropriate items.
- E. 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.
- F. 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 per the Owner's BMS Manager.
1. Shop Drawings shall contain the following information:
 - a. System Architecture and System Layout:
 - One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, address, 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.
 - 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, address, 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 reflect accurate, actual installed conditions.
 - b. Schematic flow diagram of each air and water system showing fans, coils,

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General

UH Master: 05.2020

25 0000 - 9

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

dampers, valves, pumps, heat exchange equipment and control devices. Include written description of sequence of operation.

- Identify the airflow pathway and piping connections. Airflow and water flow rates do not need to be included as this information should be included on equipment schedules. The flow rates could be included if desired, or diagrams can be left more generic. A generic diagram permits use of the same diagram for multiple units with similar configurations. Include all inputs and variables that must be controlled. Components that are not inputs or controlled variables should be left out to maintain a simple diagram that is easy to read.
 - Categorize the purpose of the equipment: for example, comfort heating or cooling for human occupants; maintaining acceptable temperatures for a data center; or specific pressure relationships. Include any other equipment that is affected by the sequence: for example, a makeup air unit must interlock with the exhaust fan(s) that create the need for the makeup air unit. A system with multiple purposes should have all purposes noted.
 - Identify the required inputs and output: for example, space sensors, air temperature sensors, static or differential pressure sensors, etc. Note what inputs are already available for use in the control system and whether the required input devices are already included as a part of the equipment or specified for other purposes. Confirm that additional devices are indicated in the Drawings and specified at this time.
 - List any code required functions of the system (such as ASHRAE 90.1).
 - Incorporate Owner's operational requirements and expectations. Identify any desired system features that may conflict with overall successful operation or code requirements. Review the system design for additional components necessary to suit the Owner's desired 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.
2. 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 1500 "BMS Software and Programming" for additional requirements.
- a. Label each control device with setting or adjustable range of control.
 - b. Label each input and output with the appropriate range.
 - c. Provide a Bill of Materials with each schematic. Indicate device

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 10

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

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.

- d. 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.
- e. 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 or factory-installed or field-installed.
- f. Provide details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
- g. Number all drawing sheets consecutively.
- h. Include a title on each sheet indicating the type of information included and the HVAC system controlled.
- i. Provide a Table of Contents listing sheet titles and sheet numbers.
- j. Include a legend and list of abbreviations.
- k. Include User Interface Graphic Screens.
- l. Include Trends.
- m. Alarms: Review monitoring capability and alarms. Alarms may be generally categorized as critical (main equipment failure), intermediate (high humidity or excessive CO2 events), or nuisance alarms. All alarms shall be delayed 15 seconds.
- n. Memory allocation projections: Specify the storage capability of the system. Data should be retained for **[30, 60, or 90]** days. Readings shall be sampled and recorded every 15 minutes. BMS device storage shall be backed up daily.
- o. Submit calculated and guaranteed system response times of the most heavily loaded LAN in the system. Submit this data along with Shop Drawings but under separate cover

3. BACnet Protocol Information:

- a. Submit the following:
 - BACnet object description, object ID, and device ID, for each I/O point.
 - Documentation for any non-standard BACnet objects, properties, or enumerations used detailing their structure, data types, and any associated lists of enumerated values.
 - Submit PICS indicating the BACnet functionality and configuration of each controller.

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 11

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

4. Point Summary: Submit point summary as defined in Section 25 1500 "BMS Software and Programming."
5. Compressed Air Systems:
 - a. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
 - b. Wiring diagrams from manufacturers detailing electrical power supply wiring to equipment. Include ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between portions of wiring that are factory-installed and portions that are to be field-installed.
 - c. Pneumatic piping plan and riser layouts including all main air and branch air piping sizes, and calculated pressure losses for all pneumatic lines to all components, devices, and panels.
 - d. Certificates of shop inspection and data report as required by provisions of the ASME Boiler and Pressure Vessel Code.
6. Framed Control Drawings: Control Drawings, including system control schematics, Sequence of Operation and panel termination Drawings, shall be provided in laminated panels and mounted in a suitable frame with a .125" Lexan polycarbonate cover for major pieces of equipment, such as air handling units, chillers, boilers, etc. Drawings should be of sufficient size to be easily read. Terminal unit Drawings shall be located in the central plant equipment panel or mechanical room panel.
7. Control Logic Documentation:
 - a. 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.
 - b. 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.
 - c. Include written description of each control sequence.
 - d. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
 - e. Sheets shall be consecutively numbered.
 - f. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
 - g. Include Table of Contents listing sheet titles and sheet numbers.
 - h. Submit one complete set of programming and operating manuals for all

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 12

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Division 01.

G. Record Documents:

1. Record copies of product data and control Shop Drawings updated to reflect the final installed condition.
2. 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.
3. Record copies of approved Project-specific graphic software on CDs.
4. Network architecture Record Drawings showing all nodes, including a description field with specific controller identification, description and location information.
5. 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.
6. Provide record copy of riser diagram showing the location of all controllers.
7. Maintain Project record documents throughout the Warranty Period and submit final documents at the end of the Warranty Period.

H. Operation and Maintenance Data:

1. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
2. Submit BMS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
3. Submit BMS advanced Programming Manuals for each controller type and for all workstation software.
4. 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 01.
 - a. Contractor shall provide Owner 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 shall be provided for five (5) years as part of the Contract price and shall be offered to Owner thereafter for the same price as to a dealer or branch.
 - b. Manufacturer's Certificates: For all listed and/or labeled products, provide certificate of conformance.
 - c. Product Warranty Certificates: Submit manufacturers' product warranty

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 13

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

certificates covering the hardware provided.

1.7 SYSTEM ARCHITECTURE

- A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. 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.

Remove the following paragraph for retrofit projects where a BMS is already in place.

- B. The system shall be configured as a distributed processing network(s) capable of expansion as specified below.

1. Coordinate all requirements of the BMS WAN / Primary LAN with the Owner's IT Department and EH&S Building Management Services Department.
2. All BMS utilization of the Owner's IT network specified by Division 25 specifications or by the Drawings shall be compliant with the Owner's current IT network standards. Refer to and comply with Division 27 Communications specifications. The Owner's IT department solely manages and governs the Owner's IT infrastructure.
3. Division 25 Contractor shall not configure, provide or install any devices or network cables within/inside the Owner's IT network infrastructure. Routers provided by Division 25 that utilize the Owner's WAN or Primary LAN shall be approved by the Owner's IT department prior to connection. Refer to current Owner telecommunications standards available at <https://uh.edu/facilities-planning-construction/vendor-resources/owners-design-criteria/design-guidelines/>.
4. The Owner's IT department shall grant approval to utilize the Owner's IT network and provide Ethernet IP address after all Owner requirements are satisfied. Upon approval, an Ethernet drop will be provided with a jackplate, IP address, and computer name specified by the Owner's IT department for utilization by the Division 25 Contractor.

Remove the following paragraph for retrofit projects where a BMS is already in place.

- C. The system architecture shall consist of an Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) or multi-leveled 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 BMS structure.

1. University of Houston WAN: Internet-based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser. This is an existing infrastructure and the Division 25 Contractor shall not

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 14

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

configure any components of this WAN. Division 25 Contractors or designers working on existing BMS equipment may request reconfiguration of the University of Houston WAN, but reconfigurations requests, if approved, shall be executed only by the Owner's IT department. Refer to Section 25 3000 "BMS Communication Devices" for requirements.

2. Local Supervisory LAN/Primary Controller LAN ('Primary LAN'): The Local Supervisory/Primary Controller LAN shall be an Ethernet-based, 10/100/1000base-T Ethernet LAN connecting Local Supervisory Controllers, Primary Control LANs, BCs, and OWSs. The LAN serves as the inter-BC gateway and OWS-to-BC gateway and communications path and as the connection point for the University of Houston WAN. Contractor shall use a dedicated LAN for the control system. The Local Supervisory LAN shall be installed by others, in accordance with Division 27 Communications specifications, which is not governed by Division 25. The BMS network configuration shall be the following:
 - a. BACnet/IP, as defined in the BACnet standard, which shall share a common network number for the Ethernet backbone, as defined in BACnet Standard. Point/Object naming conventions are specified in Section 25 1500 "BMS Software and Programming." Refer also to the current ASHRAE 135 data communication protocol.
 3. Secondary Controller LAN ('Secondary LAN'): Network used to connect AACs and ASCs. Acceptable communication protocols are BACnet over Ethernet (IEEE802.3), Master Slave/ Token Passing or polling as defined in the BACnet standard. Secondary LAN shall not directly connect to the University of Houston WAN or University of Houston Primary LAN. Division 25 Contractor shall provide and install all components of the Secondary LAN as specified in Division 25. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements and other requirements of the Specifications. The BMS Secondary LAN shall not utilize Network Data cable trays without Owner approval. BMS Secondary LAN using Network Data cable trays shall comply with Division 27 Communications specifications.
- D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.
- E. Remote Data Access: The system shall support the following methods of remote access to the building data. All remote access shall be approved by the Owner's Information Security department prior to installation. Remote access authorization requires completion of a "Person of Interest" form.
1. Browser-based access: A remote user using a standard browser will be able

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 15

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

access all control system facilities and graphics with proper password. Owner will secure and pay for the continuous Internet connection. The following paradigms are acceptable for browser-based access:

- a. Native Internet-based user interfaces (HTML, XML, etc.) that do not require a plug-in.
- b. User interfaces that, via a standard browser, use a freely distributed and automatically downloaded and installed plug-in or 'thick' client that presents the user interface across the web.

Engineer shall consult with the Owner's project manager prior to specifying the response times. Quicker response times may be dictated by the type of systems and facility. Edit on a project by project basis.

- F. 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 the BMS control design as necessary to accomplish these performance requirements.
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 setpoint 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.
- G. Control Systems Server (CSS): This computer (or computers) shall maintain the systems configuration and programming database and shall be restricted to Owner control. 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 25 1109 "BMS Operator Interfaces."

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 16

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

- H. The Operator Interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. Refer to Section 25 1109 "BMS 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 25 1400 "BMS Field Panels".

Remove the following paragraph for a retrofit project where a BMS is already in place.

- J. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a server or workstation on the Local Supervisory LAN. BMS shall provide user tools to the Owner that 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 (via ODBC or SQL) and provided to the Owner to facilitate easy access to the data.
 - 2. Database shall be ODBC compliant or a data access driver shall be provided to act as an ODBC or OLE DB data provider.
- K. Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other BMS nodes on the network. If a LAN is severed, separated networks shall continue to operate and communications within each network shall continue uninterrupted.
- L. 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.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver each piece of equipment and control device in original factory shipping and packaging. Vendor shall 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.

1.9 WARRANTY

Consult with UH project manager for warranty requirements.

- A. Contractor shall warrant all products and labor for the full manufacturer's warranty period or for **[one year][two years] (whichever is greater)** after substantial completion.

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 17

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

- B. The Owner reserves the right to make changes to the BMS 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 BMS. Any disagreement between Owner and Contractor on such matters shall be subject to resolution through the Contract 'Disputes' clause.
- C. At no cost to the Owner, during the Warranty Period, Contractor shall provide maintenance services for software, firmware and hardware components as specified below:
1. Maintenance services shall be provided for all devices and hardware specified in the Contract Documents. Service all equipment per the manufacturer's recommendations.
 2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in life safety issues, property damage or loss of comfort control shall be corrected and repaired following notification (via telephone or email) by the Owner to the Contractor. Emergency service shall be provided 24 hours per day, 7 days per week, and 365 days per year with no exceptions and at no cost to the Owner.
 - a. Response to any request for service shall be provided within two (2) hours of the Owner's initial telephone request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected by remote BMS operator, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's Site within four (4) hours of the Owner'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 notification (via telephone or email) by the Owner to the Contractor.
 - a. Response to any request for service shall be provided within eight (8) working hours (Contractor specified 40 hours per week normal working period) of the Owner's initial request for service.
 - b. In the event that the malfunction, failure, or defect is not corrected by remote BMS operator, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's Site within three (3) working days of the Owner's initial telephone request for such services, as specified.

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 18

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

4. At any time during the Warranty Period that Contractor is on Site for maintenance, emergency, or normal service, Contractor shall notify Owner via Owner's Building Management Services and the local building operating personnel. 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 Owner grants express permission via email or other written method. After the work is completed a work order ticket describing in detail all work performed (i.e. hardware replaced or serviced, software or firmware modifications made, etc.), hours worked, follow-up work required, etc., must be signed by an authorized building operator or Building Monitoring Services personnel.
5. Owner's Request for Service: Contractor shall specify a maximum of three telephone numbers for Owner to call in the event of a need for service. At least one of the lines shall be attended at any given time. One of the three contacted technicians shall respond to every call within 15 minutes.
6. Technical Support: Contractor shall provide technical support by telephone or other remote means throughout the Warranty Period.
7. Preventive maintenance shall be provided throughout the Warranty Period in accordance with the hardware component manufacturer's requirements.
8. In the last month of the Warranty Period, all System software and controller firmware, software, drivers, etc. shall be upgraded to the latest release (version) in effect at the end of the Warranty Period.

PART 2 - PRODUCTS

2.1 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.

2.2 MANUFACTURERS

- A. The BMS 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.

Choose one of the following paragraphs for the Laboratory Control Systems on retrofit projects.

- B. Where only a single existing laboratory control system (LCS) serves a building, new LCS work shall be incorporated into and match the existing laboratory control system.
- C. Where multiple existing laboratory control systems (LCS) serve a building, the

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 19

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

laboratory control system that serves over sixty percent (60%) of the existing to remain building HVAC equipment shall be considered the dominant LCS. Any new LCS work shall match the existing dominant laboratory control system. In the case that no LCS serves over sixty percent (60%), the LCS that serves the majority of the equipment shall be considered the dominant LCS.

D. Where there is no existing laboratory control system and subject to compliance with requirements provide LCS from one of the following:

1. Critical Room Control (CRC).
2. Phoenix Controls.

Choose the following paragraph for new construction.

E. Subject to compliance with requirements, provide Laboratory Control Systems (LCS) from one of the following:

1. Critical Room Control (CRC).
2. Phoenix Controls.

Choose one of the following paragraphs for the Building Management Systems on retrofit projects.

B. Where only a single existing building management system (BMS) serves a building, new BMS work shall be incorporated into and match the existing building management system.

C. Where multiple existing building management systems (BMS) serve a building, the building management system that serves over sixty percent (60%) of the existing to remain building HVAC equipment shall be considered the dominant BMS. Any new BMS work shall match the existing dominant building management system. In the case that no BMS serves over sixty percent (60%), the BMS that serves the majority of the equipment shall be considered the dominant BMS.

D. Where there is no existing building management system and subject to compliance with requirements provide BMS from one of the following:

1. Distech Controls.
2. Honeywell WEBS.

Siemens Apogee should only be used at the University of Houston at Sugar Land Campus. If the project is not located at the Sugar Land Campus, Siemens Apogee shall be removed.

3. Siemens Apogee.

Choose the following paragraph for new construction.

F. Subject to compliance with requirements, provide BMS from one of the following:

1. Distech Controls.
2. Honeywell WEBS.

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 20

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

Siemens Apogee should only be used at the University of Houston at Sugar Land Campus. If the project is not located at the Sugar Land Campus, Siemens Apogee shall be removed.

3. Siemens Apogee.

2.3 MATERIALS AND EQUIPMENT

A. Materials shall be new 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.

2.4 UNIFORMITY

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

2.5 PERFORMANCE REQUIREMENTS

A. General: BMS shall be an ANSI/ASHRAE Standard 135, BACnet-compliant web-based system that is stand alone in all aspects and shall consist of a high-speed, peer-to-peer network of direct digital controls (DDC).

B. Delegated Design: Engage a qualified professional engineer to design BMS to satisfy the requirements indicated herein.

C. Surface Burning Characteristics: Products installed in ducts, equipment and return air paths shall comply with ASTM E84 and be tested by a qualified testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. BMS Speed:

1. All AI/AO connected to BMS shall be updated at least every two seconds for use by controllers.
2. All DI/DO connected to BMS shall be updated at least every one second for use by controllers.

E. Network Bandwidth: Design each network of BMS to include at least **[25]** percent spare bandwidth with BAS operating under normal and heavy conditions.

F. BMS Reliability:

Coordinate with UH project manager and BMS project manager to determine if any systems require a higher level of reliability.

1. Design, install and arrange BMS network, including controllers and routers, to yield a Mean Time Between Failure (MTBF) of at least **[40,000]** hours, based on

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 21

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

a confidence level of at least 90 percent. MTBF value shall include any failure for any reason to any part of products indicated.

G. Electric Power Quality:

1. Protect susceptible BMS products connected to ac power from power surges to comply with requirements of IEEE C62.41.
2. Protect susceptible BMS products connect to ac power from irregularities and noise with power line conditioners.

[Edit to suit project.](#)

H. Input Accuracy: Displayed values shall meet the following overall accuracy when including errors due to meter, sensors, transmitters, wiring, etc.

1. Energy:
 - a. Thermal: Within 3 percent of reading.
 - b. Electric Power: Within 1 percent of reading.
2. Flow:
 - a. Air Ducts and Equipment: Within 5 percent of actual (displayed) flow rate.
 - b. Air (Terminal Units): Within 5 percent of actual (displayed) flow rate.
 - c. Natural Gas: Within 2 percent of actual (displayed) flow rate.
 - d. Water: Within 5 percent of actual (displayed) flow rate.
 - e. Steam: Within 5 percent of actual (displayed) flow rate.
3. Gas:
 - a. Carbon Dioxide: Within 60 ppm.
4. Moisture (Relative Humidity):
 - a. Air Ducts and Equipment: Within 3 percent RH.
 - b. Space: Within 3 percent RH.
 - c. Outdoor: Within 5 percent RH.
5. Pressure:
 - a. Air Ducts and Equipment: 0.5 percent of instrument span.
 - b. Space: Within 0.5 percent of instrument span.
 - c. Water: Within 0.5 percent of instrument span.
6. Speed: Within 5 percent of reading.
7. Temperature:
 - a. Air Ducts and Equipment: Within 0.5 degrees F.

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 22

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

- b. Space: Within 1 degrees F.
- c. Outdoor: Within 2 degrees F.
- d. Chilled Water: Within 0.5 degrees F.
- e. Condenser Water: Within 0.5 degrees F.
- f. Heating Water: Within 0.5 degrees F.
- g. Temperature Difference: Within 0.25 degrees F.
- h. Other Temperatures Not Indicated: Within 0.5 degrees F.

[Edit to suit project.](#)

- I. Control Stability: Control variables indicated within the following limits:
 1. Flow:
 - a. Air, Ducts and Equipment, except Terminal Units: Within 5 percent of design flow rate.
 - b. Air, Terminal Units: Within 5 percent of design flow rate.
 - c. Natural Gas: Within 5 percent of design flow rate.
 - d. Water: Within 5 percent of design flow rate.
 2. Gas:
 - a. Carbon Dioxide: Within 50 ppm.
 3. Moisture (Relative Humidity):
 - a. Air: Within 3 percent RH.
 - b. Space: Within 3 percent RH.
 4. Pressure:
 - a. Air, Ducts and Equipment: 1 percent of instrument span.
 - b. Space: Within 0.25 percent of instrument span.
 - c. Water: Within 0.5 percent of instrument span.
 5. Temperature:
 - a. Air: Within 0.5 degrees F.
 - b. Space: Within 1 degrees F.
 - c. Chilled Water: Within 0.5 degrees F.
 - d. Condenser Water: Within 0.5 degrees F.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine areas and conditions under which control systems are to be installed. Do not

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 23

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 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.

3.3 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 effect on hardware, software, communications, and data storage.

Digital control stations should specifically be shown on the Drawings. Engineer should select appropriate wall/floor locations that minimize wire and tubing runs, and coordinate these locations with other disciplines. Engineer shall provide a three foot access door swing clearance at station location.

If the Project is a controls renovation only, locate spare breakers in a power panel where the BMS Contractor can obtain 120V power and indicate on the Drawings.

3.4 DIRECT DIGITAL CONTROLLERS, CONTROLLER QUANTITY AND LOCATION

- A. Individual Digital Control Stations (DCS) are referenced to indicate allocation of points to each DCS and DCS location. Digital control stations shall consist of one or multiple controllers to meet requirements of this Specification.
- B. Where a DCS is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Restrictions in applying controllers are specified in Section 25 1400 "BMS Field Panels." Contractor shall extend power to the DCS from an acceptable power panel. If the BMS provider wishes to further distribute panels to other locations, Contractor is responsible for extending power to that location also. Furthermore, Contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the Project and maintain adequate clearance for

<Insert A/E Name>

Building Management Systems (BMS) General

25 0000 - 24

AE Project #: <Insert Project Number>

UH Master: 05.2020

University of Houston Master Specification

<Insert Project Name>

<Insert Issue Name>

<Insert U of H Proj #>

<Insert Issue Date>

maintenance access.

- C. Contractor shall locate DCS's as referenced in Division 25 and the Drawings. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.

Engineer shall consult with Owner prior to specifying the DDC requirements and locations. Controller requirements shall be dictated by the type of systems and facility. Edit to suit the Project.

- D. Contractor shall provide a minimum of the following:
1. One DDC (including at least one controller) in each chilled water/hot water plant mechanical room.
 2. One DDC (including at least one controller) for each air handler located in applicable mechanical room.
 3. One DDC (including at least one controller) for each critical fan system.
 4. One DDC (including at least one controller) for each pumping system.
 5. One DDC (including at least one controller) for each steam pressure reducing station.
 6. One DDC for each piece of terminal equipment unit located at the terminal equipment.

3.5 CONTROL POWER SOURCE AND SUPPLY

It is preferable to have the Division 26 Contractor supply power to DCS locations and provide the appropriate level of power for all control system components as located by the Engineer. For instance, it is good practice to supply emergency power (and sometimes uninterruptible power when available) at critical controllers, control system servers, routers, workstations etc. This Section, however, applies mainly to retrofits with no Division 26 Contractor.

- A. BMS Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Division 25 and the Drawings.

The following item will have to be customized for each system and Project. The consideration is where to provide power for controllers. 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 power sources by the controller. The object is to make a robust system that does not interpret power failures as device failure and therefore in some instances take down the unit for manual acknowledged reset. This can compromise reliability.

- B. General requirements for obtaining power include the following:
1. In the case where additional power is required, 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

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 25

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

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 is 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.

The following item will have to be customized for each system and Project. The consideration is where to provide UPS's for controllers. Engineer shall consult with Owner prior to specifying the UPS requirements. UPS requirements shall be dictated by the type of systems and facility. Edit to suit the Project.

1. Provide an uninterruptible power supply (UPS) for each gateway, network controller, application controllers controlling chilled water systems, heating water systems, steam systems, air handling systems, laboratory exhaust systems, stair pressurization systems and elevator hoistway pressurization systems. Additionally, any system served from a back-up power source shall be provided with a UPS.
 - a. BMS instruments connected to a controller powered by UPS shall also be powered by UPS.
 - b. UPS shall include LAN port and modem line surge protection.
 - c. UPS shall be sized for a 7-minute full load runtime, 23-minute /2 load runtime, with a typical runtime of up to 60 minutes. Transfer time shall be 2-4 milliseconds.
 - d. 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.
 - e. 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. Provide all software, cables, peripherals etc. for a complete system.
4. Standalone Functionality: Refer to Section 25 1400 "BMS Field Panels."

<Insert A/E Name>

AE Project #: <Insert Project Number>

Building Management Systems (BMS) General
UH Master: 05.2020

25 0000 - 26

University of Houston Master Specification

<Insert Project Name>

<Insert U of H Proj #>

<Insert Issue Name>

<Insert Issue Date>

3.6 BMS START-UP, COMMISSIONING AND TRAINING

- A. Refer to Section 25 0800 "BMS Commissioning."

END OF SECTION 25 0000