

SECTION 23 09 00 – BUILDING CONTROL SYSTEM & FACILITY MANAGEMENT SYSTEM

1. GENERAL

- 1.1. A fully integrated Building Control System (BCS) shall control all HVAC systems and components, including control of all terminal heating and cooling units and other equipment not supplied with factory-supplied stand alone controls.
- 1.2. The existing Facility Management System (FMS) on the Missouri State University campus is a Johnson Controls Metasys network. Johnson Controls is under contract with the University to guarantee a savings in utility costs from energy improvements made throughout the campus. The existing FMS is used to monitor and control these operational costs. Any incompatibility, interference, or disruption of the network may adversely affect these guaranteed savings. It is essential that all components of the new controls system and any associated hardware for all systems specified interface and are fully compatible with the existing Metasys network. New wiring, transmission systems, control panels, etc. shall not create interference or incompatibility with the existing system's circuitry and devices.
- 1.3. The Building Control System (BCS) manufacturer shall assist the Facilities Management System (FMS) Installer and the University in furnishing and installing a fully integrated open protocol Building Control System, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, utility metering, and subsystems with open communications capabilities. The system must be capable of interfacing and integrating with other equipment automation system manufacturers and technology systems that are incorporated into the project.
- 1.4. The BCS system shall utilize an open architecture that shall support equipment and systems from multiple vendors. The physical network for the systems, the cable plant, the logical network for the systems and the networking protocols shall be open architectures, supporting multiple applications and equipment manufacturers. The BCS shall communicate using BACNet protocol via the contractor provided communication trunk within the facility. The BCS shall be connected to the existing Facility Management System (FMS) via University provided interface equipment using BACNet protocol.
- 1.5. The existing FMS communicates using the campus wide Ethernet network. The BCS shall be accessible through the FMS with any internet browser from the campus wide Ethernet network. Coordination of the BCS Contractor with Missouri State University Planning, Design & Construction, Facilities Management, and Networking and Telecommunications is required and critical. Missouri State University Facilities Management shall provide the Facilities Management System (FMS) interface point(s) in the form of a supervisory controller(s). Each supervisory controller shall consist of a Network Automation Engine (NAE) as manufactured by Johnson Controls, Inc. The BCS contractor shall provide the BCS and BCS Integration. The Building Control System (BCS) network shall be the responsibility of the BCS Contractor.

2. DEFINITIONS

- 2.1. FMS - Facility Management System Network - The upper-tier communication network between servers, operator workstations, user interfaces, supervisory controllers, and the campus chilled water loop system operating on the existing campus TCP/IP Network. The FMS is the responsibility of Missouri State University Facilities Management and is not in the scope of work for the BCS Contractor with the exception of coordination, commissioning assistance, and programming required for integration with the FMS.
- 2.2. BCS - Building Control System Network - The total digital on-line real-time interconnected configuration of BCS digital processing units, panels, sub-panels, controllers, devices, and associated elements individually known as network nodes wired downstream from the supervisory

controllers. The BCS network does not include the FMS network. The BCS is the responsibility of the BCS contractor to install and make operational, including coordination, commissioning assistance, and programming and integration with the FMS.

- 2.3. BCS Contractor - The single Contractor to provide the work of this standard. The contractor shall be the primary local representative responsible for installation installer, commissioning participation, programming, and warrantee service provided for the BCS work.
- 2.4. BCS Integration - The complete functional and operational interconnection and interfacing of all BCS work elements and nodes into the FMS in compliance with all applicable codes, standards, and ordinances so as to provide a single coherent BCS accessible through the existing FMS. This work includes any required software as well as assistance with wiring terminations, programming, system startup and commissioning, and coordination.

3. BCS DESCRIPTION

- 3.1. The Building Control System (BCS) shall be an extension of the existing Facilities Management System via an Owner provided supervisory controller(s). The BCS shall be fully wired, terminated, programmed and checked out by the BCS contractor.
- 3.2. The Owner provided supervisory controller(s) will be a web-based unit that supports the integration of the BACnet open protocol field controllers. The design consultant shall show the anticipated location(s) of the owner-provided supervisory controller(s) on the drawings and shall indicate a data outlet rough-in and power at each location. As part of the submittal process during construction, the BCS Contractor shall work with the Consultant and the University to verify the exact quantity, type, and location of each FMS supervisory controller. The BCS Contractor shall communicate any changes required in location or quantity of supervisory controller(s).
- 3.3. The BCS contractor shall provide only BACnet BTL Certified field controllers for use on this project. Deviations from this requirement will be rejected.
- 3.4. Points within the BCS field controllers shall fully support a read/write function. All setpoints and outputs (actuator outputs, enable/disable, fan control, etc.) shall accept override signals from the supervisory controller. All scheduling shall take place within the supervisory controller. Field controllers shall accept an input for occupied/unoccupied without the need for reprogramming. All device addresses must fall in sequence with the supervisory controller so that all field devices are recognizable by the user interface and all points can be read, written, and adjusted from the user interface.
- 3.5. Any required site licenses, including upload/download licenses, shall be included by the BCS Contractor.
- 3.6. All control for devices on the BCS network shall be fully contained within the controller. Global sharing through the FMS is not allowed. Peer-to-Peer sharing is allowed, provided that all sharing is well documented and reliable.
- 3.7. Wiring for field controllers on the BCS shall be through twisted shielded cable. Shielding shall be continuous. The BCS network shall be grounded at one end.
- 3.8. Each piece of equipment shall be controlled by an individual field controller, matching the requirements above.
- 3.9. The Owner shall be supplied a means to upload/download controllers for troubleshooting purposes.
- 3.10. Field devices shall be limited to a maximum of 64 devices per trunk. Addressing shall be by the BCS contractor. All addressing shall reference University assigned room numbers. University assigned room numbers will be provided to the contractor after the contract has been awarded. Do not use room numbering identified in the Construction Documents (such as the architectural

and engineering plans) unless approved in writing by the Owner. All documentation for addressing shall be furnished to the owner.

- 3.11. Point Naming shall be in accordance with the following convention and shall be coordinated with the mechanical equipment naming convention used for the project:

CONTROL POINT NOMENCLATURE LEGEND

Building Code	Supervisory Controller	Location Code	Equipment Code	Sequential Number	Item Code	Value	Description
CARR	NC-19	01NE	AHU	002	OA-T	67.2	Outside air temperature

Building Code:

The building code shall correspond to the standard 4 character building code used for all buildings on campus as entered in R25.

Supervisory Controller:

The building code shall correspond to the standard 4 character building code used for all buildings on campus as entered in R25.

Location Code:

The purpose of the location code is to provide a general description of where the equipment is located within the building. The first two characters indicate the floor in the building on which the item is located. For example, the code 01 indicates first floor, 02 indicates second floor, etc. In areas where floor numbers are not used, for example, outdoors, mezzanines, basements, attics, etc. the following codes have been used:

AT Attic
BA Basement
GR Ground
MZ Mezzanine
PH Penthouse
RF Roof

The last two characters are directional in order to help indicate where in the building the item is located. Example directional codes are as follows:

NC North Central
NE Northeast
EC East Central
SE Southeast
SC South Central
SW Southwest
WC West Central
NW Northwest
CE Near the center of the building

Equipment Code:

Equipment codes shall indicate the type of equipment in accordance the standard equipment naming list adopted by the University.

Sequential Number:

The sequential number shall start at 001 for each system and shall number sequentially for each unit within the system code and within the building.

Item Code:

The item code is the abbreviated name for the control point. The item code shall be selected from University's standard list of item codes that will be made available to the contractor.

TEMPLATE

Description:

The description shall provide a clear description of the data and or function associated with the given control point.

The example in the table above is the designation for air-handling unit number 2 located on the first floor Carrington Hall in the northeast area of the floor. The field device controlling the air handling unit is connected to supervisory controller NC-19.

- 3.12. The BCS contractor shall coordinate with the owner in BCS integration, including furnishing the owner with upload / download software for control devices.
- 3.13. The BCS work shall consist of the provision of all labor; materials; tools; equipment; software; software licenses; software configurations and database entries; wiring; tubing; installation; labeling; engineering; calibration; documentation; samples; submittals; testing; commissioning; training services; permits and licenses; transportation; shipping; handling; administration; supervision; management; insurance; temporary protection; cleaning; cutting and patching; warranties; services; and any items, even though they may not be specifically mentioned, which are required for a complete, fully functional, and commissioned BCS.

4. INSTALLATION REQUIREMENTS

- 4.1. Prior to any controls work beginning a pre-installation and coordination meeting shall be held. Attendees at this meeting shall include the general contractor; the mechanical contractor; the BCS contractor; the design consultant; Planning, Design & Construction; and Facilities Maintenance/Energy Management. The purpose of this meeting is to ensure that all parties to the installation understand the building management system and the role each must play in providing the system. Topics discussed in the meeting shall include the quantity and location of Owner-provided supervisory controller(s), the anticipated schedule for the work, the role each entity shall play in the installation, and how best to coordinate the various aspects of the work.
- 4.2. All control components for major equipment air handling units, chilled water plants, heating plants, pumping systems, etc. shall be mounted in manufacturer's standard control panel enclosures. Each control panel shall be provided with "As-built" control drawings, sequences of operation, points list, and other applicable information for each device controlled by that particular panel. This documentation shall be contained in sleeves mounted on the inside of the door of the control enclosure. Control components for fan coil units, VAV terminal units, reheat coils, other terminal units, etc. shall be mounted in manufacturer's standard utility enclosures for protection. Exposed control components mounted on the exterior of equipment without enclosures shall not be acceptable.
- 4.3. All ancillary equipment, including relays, E/P's, power supplies, etc. as well as other power switching devices shall be located either at the device controlled or in the associated control panel, whichever is most practical from both a maintenance and cost standpoint. All devices shall be securely mounted using brackets, screws, or other mechanical means. Mounting devices using tape or other adhesives, cable ties, hook and loop fasteners such as "Velcro", straps (unless specifically designed for the device due to its application), etc. shall not be acceptable.
- 4.4. All wiring shall meet the requirements of the National Electric Code and all applicable codes.
- 4.5. Power for all control devices shall be connected to a circuit serving only controls. Temperature control panels shall be connected to a dedicated circuit where possible.
- 4.6. Wiring greater than 24 VAC shall be installed in an appropriate raceway. In unfinished areas, exposed EMT shall be acceptable. In finished locations where wiring cannot be concealed, exposed wiring shall be in non-metallic white raceway as approved by MSU. Provide all necessary boxes, fittings, anchors, etc. as required for a top quality installation. All line voltage wiring will be a minimum of 14 AWG stranded or larger, as required, for interlock and control functions. All power wiring will be sized and installed per applicable codes for the load to be served.

- 4.7. Wiring 24 VAC or less located in finished areas that cannot be concealed shall be in non-metallic white raceway as approved by MSU. Provide all necessary boxes, fittings, anchors, etc. as required for a top quality installation. In mechanical rooms, low voltage wiring shall be installed in EMT "stub-ups" from the end devices to minimum of 8'-0" AFF. Any wiring in mechanical rooms or other unfinished spaces that may be subject to damage shall be run in EMT, regardless of height above finished floor. Above conduit stub ups wiring may be run exposed shall be properly supported. In concealed areas both accessible and inaccessible, low voltage plenum cable shall be used. All wiring shall be tied to the building structure. All open wiring shall be run parallel and perpendicular to building lines in a neat and workmanlike manner. Where a single run is made, wiring shall be neatly tied and supported to building structure. Where multiple cables are run together cables shall be bundled together and tied, and supported to the building structure. Wiring left lying on ceiling tiles, tied to conduits, piping, ductwork, etc. or pulled across equipment panels, etc. shall not be acceptable. Where cable passes through a fire rated wall, floor, ceiling, or other solid structure a steel sleeve shall be used to protect the cable. The sleeve shall be sealed with a UL approved fire stopping material to insure that the fire rating on the construction is maintained.
- 4.8. All conduit used for the work shall be UL listed, standard trade size conduit. Where conduit is required, EMT will be acceptable in all areas except for underground burial and the entrance riser to buildings. Conduit buried underground shall be PVC (minimum schedule 40) with the appropriate boxes and fittings. For buried conduits at the building entrance, rigid conduit shall be used to rise above grade to the point of the building penetration. All conduits shall be run parallel and perpendicular to building lines, and shall be adequately supported and clamped to the building structure so as to remain in place without sagging or moving. Unsupported conduit or conduit secured to other conduits, piping, ductwork, etc. shall not be acceptable. Conduit shall be routed so as not to interfere with service access to equipment and controls. Where conduits passes through a fire rated wall, floor, ceiling, or other solid structure penetration shall be sealed with a UL approved fire stopping material to insure that the fire rating on the construction is maintained.
- 4.9. All boxes used shall be standard size UL listed electrical enclosures rated for the application and environment where used. All conduit fittings shall be set screw type.
- 4.10. All low voltage cable shall be stranded 18AWG or 20 AWG to match application. All line voltage wiring will be stranded wire, size to be as previously indicated. Line voltage wiring may be spliced using the correct size spring type twist on cap. Low voltage wiring may not be spliced, except when a run exceeds 1000 feet.
- 4.11. Pneumatic tubing shall be installed using either copper, single poly tubing, poly tubing in conduit, or bundled poly tubing, whichever is most cost effective and appropriate for the application. Any pneumatic tubing that may be exposed to heat or excessive UV rays shall be run in copper. In concealed areas both accessible and inaccessible, poly tubing may be used. All tubing shall be tied to the building structure. All open tubing shall be run parallel and perpendicular to building lines. Where a single run is made, tubing shall be neatly tied and supported to building structure. Where multiple tubes are run together, tubes shall be bundled, tied, and supported to the building structure. Tubing left lying on ceiling tiles, tied to conduits, piping, ductwork, etc. or pulled across equipment panels, etc. shall not be acceptable. Where tubing passes through a fire rated wall, floor ceiling, or other solid structure a steel sleeve shall be used to protect the tubing and the sleeve shall be sealed with a UL approved fire stopping material to insure that the fire rating of the construction is maintained.
- 4.12. All wires, cables, and tubes entering control cabinets and connected to field devices shall be permanently tagged and numbered to match controls contractor installation drawings.
- 4.13. All existing control devices that are currently in service and are abandoned by the project shall be removed. The University shall have the first right of refusal on all control devices removed from the building during the project. Any associated tubing, conduit, and wiring not re-used shall be removed.
- 4.14. All control air compressors shall be Quincy model QR-25 or approved equal, shall be pressure lubricated, and shall be equipped with a spin on oil filter and electronic tank drain. Provide a

sensor on the pneumatic control system that will send an alarm to the facility management system in the event of low air pressure.

- 4.15. All facility management system temperature sensors shall be mounted a minimum of 6 feet from the inlet and outlet of heat exchangers.
- 4.16. Zone valves for fan coil units, VAV boxes, and similar equipment shall have valve mounted quick release actuators that can be replaced without opening the valve body or draining the system. Zone valves shall be equipped with a means to manually operate the valve.
- 4.17. Upon project completion and prior to final payment, the controls contractor shall provide to MSU As-built drawings including control diagrams and sequences of operation, wiring schematics, a table indicating termination points of each field device at the filed controller, and any associated product literature. The As-built shall also include a schematic of the communication trunk that accurately indicates the order in which field controllers are connected to the trunk. Each devices connected to the trunk shall be labeled with the designation of the equipment it serves and the room number where the device is located. These As-builts shall be in accordance with the requirement for record documents as outlined in the General Conditions.
- 4.18. The controls contractor shall provide the opportunity for field training during the installation phase of the project. This type of training shall be available to MSU staff appointed to be actively involved in the installation process. Onsite training of basic system operations shall be provided on a building-by-building basis. This training will be a minimum of eight (8) hours per building with duration of training to be determined during the project design.

END OF SECTION 23 09 00