Department of Management Services
Division of Real Estate Development and Management

Division 25 Integrated Automation Standards

October 5, 2018
DIVISION 25 – INTEGRATED AUTOMATION

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PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the general requirements for the Integrated Automation systems.

B. Related Sections:
   1. All sections within Division 25.

C. Where architectural features govern location of work, refer to architectural drawings and coordinate with other trades.

1.2 REFERENCES

A. This section includes any rules and regulations of Federal, State, local authorities, and utility companies in force at the time of execution of contract.

B. Agencies or publications referenced herein refer to the following:
   1. ADA Americans with Disabilities Act
   2. ANSI American National Standards Institute
   3. ASHRAE American Society for Heating, Refrigeration, Air-Conditioning Engineers
   4. ASTM American Society for Testing and Materials
   5. BICSI Building Industry Consulting Services International
   6. EIA Electronic Industries Association
   7. FCC Federal Communications Commission
   8. ICEA Insulated Cable Engineers Association
   9. IEEE Institute of Electrical & Electronics Engineers
   10. ISO International Organization for Standards
   11. NEC National Electrical Code
   12. NECA National Electrical Contractors Association
   13. NEMA National Electrical Manufacturers Association
   14. NETA National Electrical Testing Association
   15. NIST National Institute of Standards & Technology
   16. OSHA Occupational Safety and Health Administration
   17. TIA Telecommunications Industries Association
   18. UL Underwriters Laboratories, Inc.

1.3 DEFINITIONS

A. AHU Air Handling Unit
B. ATC Automatic Temperature Control
C. ATU Air Terminal Unit
D. AWG American Wire Gauge (standard wire size measurement)
E. BAS   Building Automation System
F. Device  Intelligent controller or other automated monitoring piece of equipment
G. CD    Compact Disc used for data storage
H. Commissioning Process to ensure installation and functionality is per design
I. FCU   Fan Coil Unit
J. IBS    Integrated Building Systems
K. I/O    Hardware inputs and outputs
L. Instrument Device used to sense inputs or control outputs or both
M. Integration Connection of disparate systems to a common platform using communication protocols.
N. IP Address Internet Protocol node address
O. IT     Information Technologies
P. Object Hardware or Software component such as a device or point.
Q. Plug fest Demonstration of multiple systems integration and interoperability
R. Point Single hardware input/output or software data objects such as setpoints and attributes
S. Point list List of inputs, outputs and parameters for specific systems
T. RFI    Request for Interpretation
U. Stand-Alone The ability to function upon loss of communication

1.4 SYSTEM DESCRIPTION
A. The integrated automation system shall utilize Tridium Niagara to control HVAC equipment and lighting. Utility metering shall be interfaced with Schneider Electric energy management system.
B. The integrated automation system includes integration, control and monitoring of the various systems throughout the facility including:
   1. Procurement and installation of integrated automated devices.
   2. Integration of data from various systems to allow for seamless monitoring and control of the various systems.
C. The functionality of the integrated automation system must include:
   1. The ability to communicate with systems shown, utilizing protocols specified.
   2. Stand-alone functionality of controlled equipment.
   3. BAS user interfacing shall be accomplished via a web-server environment or employing the platform-specific software launcher (e.g. Niagara N4).
D. Integrated Automation includes but is not limited to labor and materials for terminations, pathways, installations, certifications, testing, system verification, project commissioning, integration equipment, instrumentation and controls and integrated automated devices.
1.5 SUBMITTALS

A. Submit complete schedule/outline of product submittals prior to submittal submission. Submit each section independent and separate from other sections. For each product submission:
   1. Specification Section and Product number.
   2. Include only products within referenced specification section submission.

B. Submit Control drawings with sequence of operations, bill of materials and location of instruments.
   1. Sequence of Operations. (shown on Systems Drawing)
   2. System drawing showing relative locations of instrumentation.
   3. Bill of Material, with part numbers for all instrumentation.
   4. Riser diagram showing all systems and equipment connected to the automation network.

C. Product Data: For each product submission, include the following:
   1. Table of contents for each submission.
   2. Submit each section independent and separate from other sections. Include only products within referenced specification section submission.
   3. Product data sheets for all required components and accessories.
   4. Identify actual product model number used for each drawing.
   5. Identify any proposed modifications to system design. (Specifications or Drawings)
   6. Organize product data based on specification Section, Part, and Article.
   7. A paragraph-by-paragraph specification compliance report indicating compliance for each numbered paragraph. The following format shall be used in completing the compliance report:
      a. Comply—without exception.
      b. Qualify—meet the functional intent. For each paragraph, the contractor shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.
      c. Does not comply—cannot meet specified function.
      d. Does not apply – not used or not required.

D. Integration Plan
   1. Network architecture and communications concepts/diagrams. Network architecture includes but is not limited to:
      a. Nodes
      b. Switches and Routers
      c. Integrated systems and/or sub-systems
      d. Dedicated I/O locations
   2. Coordination of vendor protocol and point list submission. Include an integration matrix detailing systems and protocols to be used.
   3. Workflow processes to integrate systems
   4. Include communication hardware, software, and protocols to implement full systems integration.
   5. Identify proposed enhancements or deviations from project documents. Include specific drawings or specifications impacted.
   6. Provide coordination efforts to accommodate complete integration of systems including:
      a. Vendor protocol requirements
      b. Vendor point list
c. Plug fest for integrated systems

E. Start-up Plan:
   1. Coordination of equipment controlled and monitored
   2. Workflow process to start equipment
   3. Equipment start-up requirements
   4. Manufacturer’s and Commissioning Checklist
   5. Intended sequence of work items
   6. Start dates of individual work items
   7. Duration of individual work items
   8. Planned delivery dates for major material and equipment, and expected lead times
   9. Milestones indicating possible restraints on work by other trades or situations

F. Owner Instruction and Training Plan:
   1. Organized list of specific equipment or systems that require training
   2. Separate agendas for each training session including but be not limited to:
      a. Construction Document review of systems
      b. Installation and as-built conditions
      c. Theory of operation
      d. Demonstration of operation
      e. Operation and Maintenance Document
      f. Servicing and Maintenance Schedules
      g. Interlocks and Safeties
   3. Manufacturer’s recommended classroom training and schedule

G. Record Documents:
   1. Include field condition updates
   2. Document material, make and model numbers where appropriate
   3. Update details, schedules, risers, etc.
   4. I/O point as-buils
   5. Sequence details, modifications, or updates
   6. Control loops including final set-points and parameters
   7. Mark and detail on coordination drawings, exact locations of equipment installed
   8. Panel details for each unique panel

H. Operation Manuals:
   1. Include a table of contents
   2. Tab manual based on specification chapters or sections
   3. Network architecture and communications concepts/diagrams
   4. Uploading and downloading software to the field hardware
   5. Finely detailed descriptions of all software programs
   6. Complete set of software engineering manuals
   7. Complete system design and engineering manual same as used by manufactures personnel
   8. Application Programming
   9. CD of any configuration tools used in project
   10. Operator instructions or User Manual
11. Calibration and/or verification sheets

I. Project Maintenance Manuals:
   1. Include a table of contents
   2. 1 copy on CD
   3. Organize by manual by specification section number
   4. Index sheet listing contents in alphabetical order
   5. Include the following:
      a. Installation instructions
      b. Manufacturer's operating and maintenance instructions (not product submittals)
      c. Factory and field-test records, including calibration and factory setup
      d. Printout of application control programs (typical)
      e. Snapshot printout of each system installed
      f. Signed checklist of each system
      g. Factory training schedule and course description catalog
      h. Archived backup of software, drawings, and record documents
      i. Installation contractor and service representative information
      j. Licensing and warranty information

J. Submit a User Workstation Planning Session Plan for each subject.
   1. Integration of systems
   2. Graphics Generation
   3. Point naming
   4. Alarm management
   5. Energy management
   6. Automated work order generation
   7. Recommended Operation & Maintenance procedures

1.6 QUALITY ASSURANCE

A. Provide material with UL label or be UL listed, unless UL label or listing is not available for that type of material.

B. All systems, equipment, components, accessories, and installation hardware must be new, free from defects, and currently in production.

C. Demonstrate project compliance to Engineers satisfaction including plug fest, construction and integration.

D. Provide the same manufacturer components of a given type product throughout project.

E. Support future compatibility for no less than 7 years with the ability to upgrade existing field panels and extend new field panels on an installed network.

F. Digital equipment furnished under this contract shall have been tested and made to comply with limits of Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.

G. Maintain NEC workspace clearances.
   1. Install and operationally check systems utilizing factory-trained competent technicians skilled in the setting and adjustment of equipment used in this project.
H. Test, adjust, and calibrate all end instruments.

I. Follow project communication protocol for all correspondence. Any changes, decisions, etc. must be properly documented. The Engineer will not issue verbal directions. Verbal interpretations, clarifications, conversations, etc., are non-binding without proper documentation.

J. Request for Interpretation (RFI) shall include:
   1. Referenced drawing and/or Specification Section number
   2. Single request per RFI
   3. Single proposed solution per RFI
   4. Attached sketch of solution (if applicable)
   5. Attached specification verbiage (if applicable)
   6. Incomplete RFI's will be returned without response.
   7. Contact person

K. RFI answers are for clarification only and do not authorize additional work or change orders.

L. Install devices in appropriate enclosure and in an accessible location.

M. Install systems and devices in a neat, workmanlike manner and in accordance with manufacturer's recommendations.

N. Continually monitor the field installation for code compliance and quality workmanship.

O. Remove and re-install any systems or devices where installation is deemed of poor quality by Owner or Engineer.

P. Provide software and firmware updates prior to and within 2 months of substantial completion.

Q. Lead the coordination effort and associated plugfest activities to ensure integration of various systems prior to installation.

R. Comply with all health and safety regulations

S. Include automatic restart logic for loss of power, safeties, fire alarm shutdown, etc.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products according to manufacturer's recommendations.

B. Store products in original manufacturers packaging.

C. Do not store products more than 3 months prior to schedule installation.

D. Coordinate deliveries of material with construction schedule and appropriate trades.

1.8 SCHEDULING

A. Included in this project are connections to equipment provided by others. Coordinate deliveries, final locations, factory mounting, and various connections required.

B. Coordinate activities with contract project schedule.
   1. Ensure integration activities are incorporated into project schedule.
   2. Communicate requirements to prevent potential damage from paint, dust, water, weather, etc. Monitor and take measure to assure protection for all equipment.
C. Coordinate all IT requirements with Owner and contract project schedule.

1.9 WARRANTY

A. Submit warranty documentation upon completion of project or phase and acceptance by Engineer and Owner.
   1. Warranty start date shall be the date of substantial completion.
   2. Warranty period shall be 1 year unless otherwise noted.

B. Repair or replace systems or parts found defective at no cost to Owner including: but not limited to:
   1. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period.
   2. All corrective software modifications made during the warranty period shall be updated on all user documentation and on user and manufacturer archived software disks.
   3. Include parts, labor, and necessary travel during warranty.

C. Scheduled preventive maintenance (p.m.) visit twice a year to audit system performance.
   1. Each p.m. visit shall include exercising each control loop and control sequence for performance.
   2. A log of each loop tested, and each control sequence verified shall be reviewed with the Owner.

D. Provide vendor specific warranty information.

E. Provide services incidental to proper performance.

1.10 SYSTEM STARTUP

A. Start equipment according to manufactures recommendation.

B. Document system start up time and date.

C. Document person(s) performing startup.

D. Provide completed vendor specific start up documentation.

1.11 OWNER’S INSTRUCTIONS

A. Provide a factory-trained instructor to give full instructions to designated personnel in the operation, maintenance, and programming of each piece of equipment or system. Instructors shall be thoroughly familiar with all aspects of the subject matter.

B. The training shall be specifically oriented to the system and interfacing equipment installed.

C. Include classroom instruction and field demonstration.

D. Classroom instruction should include at a minimum:
   1. Detailed review of and as-built documentation and conditions
   2. In depth discussion of theory or sequence of operations
   3. Review organization and usability of O&M documentation
   4. Maintenance procedures and schedules

E. Field instruction should include at a minimum
1. Normal maintenance procedures
2. Demonstration of operation
3. Demonstration of safeties and interlocks
   Troubleshooting process to identify and correct commonly observed system issues

1.12 COMMISSIONING
   A. Participate in the commissioning process.
   B. Refer to Commissioning specifications for additional requirements for Division 25 work.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Prior to start of any work, check, verify, and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
   B. Promptly request clarification and instruction or report any conflicts, inadequate conditions or missing information in the Project Documents. Report unacceptable conditions immediately.
   C. Inspect site to verify that equipment can be installed as shown.
   D. Examine drawings and specifications for work of others.
   E. Perform necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 INSTALLATION
   A. Lead the effort to communicate or integrate to the various building systems. Effort includes, integration plan, communication protocol meetings, request for vendor specific information, etc.
   B. Provide additional, supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable system including but not limited to:
      1. Uninterruptable Power Supplies (UPS)
      2. Surge suppression devices
      3. Transformers and power supplies
      4. Programming modifications
   C. Request IP addresses and other IT requirements from Owner to accommodate project schedule, and 3rd party commissioning, prior to substantial completion.
   D. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
   E. Provide sufficient slack, flexible connections and isolation to allow for equipment vibration.
   F. Verify elevations and measurements prior to installation of materials.
G. Beginning installation means contractor accepts existing conditions.

H. Conceal wiring in conduit in mechanical spaces, above hard ceilings, and other spaces where exposed wiring could be damaged.

I. Provide temporary service, routing of service, or other temporary requirements to minimize downtime of service.

J. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain-tight, explosion proof, dust tight, or any other special type as required.)

K. Arrange for necessary openings in building to allow for admittance of all apparatus.

L. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment, which is to be installed or which is already in place.

M. Coordinate all systems to minimize the need for access doors.

N. Coordinate final locations, sizes and rough-in dimensions for access doors.

O. Verify door swings for proper clearance before installing.

P. Perform work in a safe and competent manner and use of industry accepted installation procedures required for the work.

3.3 FIELD QUALITY CONTROL

A. Testing:
   1. Conduct a complete performance test for all systems to assure compliance with the contract documents.
      a. Any components on systems found defective or not performing satisfactorily shall be readjusted and retested after necessary corrective measures are performed.
      b. Corrective measures may include modification or addition of equipment and devices, control strategies and/or software program.
   2. Coordinate required plug fest, testing with commissioning activities.
   3. When testing is to be witnessed by Engineer or Inspector. Schedule Engineer at least 10 days prior to testing date.
   4. Conduct and lead the coordination effort to present a plug fest of integrated systems. Verify communication capabilities of each integrated vendor prior to installation of each system. Provide documented integration capabilities.
   5. Certify in writing, successful equipment and system test results. Include in certifications the following:
      a. Identification of system tested
      b. Date
      c. Test criteria
      d. Print name, title and company of person signing test certification documents
      e. Alternative solutions implemented to successfully complete test

B. Coordinate with the Owner and execute a User Workstation Planning Sessions including 1-2 day sessions (for each subject) to finalize details for the following:
   1. Integration of systems
   2. Graphics Generation
3. Point naming
4. Alarm management
5. Energy management
6. Automated work order generation
7. Recommended Operation & Maintenance procedures

C. Repair, reprogram or replace any equipment or work that fails test.

3.4 CLEANING

A. Upon completion of each phase, system, panel, etc, clean all system panels, enclosures and field device enclosures.

B. Clean debris from equipment, control panels, security panels, and fire panel enclosures, junction boxes and pull boxes and arrange wire neatly with surplus length cut off prior to installation of covers.

C. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

3.5 DEMONSTRATION

A. Demonstrate operation of systems with Owner or Engineer.

B. Coordinate with commissioning activities. Refer to Commissioning specifications.

3.6 PROTECTION

A. Protect installation against and be liable for damage to work and to material caused by Contractor's work or employees.

B. Maintain protection for work and equipment until inspected, tested, and accepted.

C. Protect material not immediately installed.

D. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

E. Material sensitive to temperature, dust, humidity, or other elements and found unprotected shall be replaced.

F. Material with showing signs of exposure shall be replaced.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Integrated Automation conductors and cable for signal transmission, communications, power, and other miscellaneous cables for complete integration of systems specified.

B. Related Sections:
   1. 25 0528 Pathways
   2. 25 0553 Identification

1.2 REFERENCES

A. NEC 725 Class 1, Class 2, and Class 3 Remote Control, Signaling and Power-Limited Circuits
B. NEC 800 Communication Circuits

1.3 DEFINITIONS

A. AWG American Wire Gauge
B. EMI Electromagnetic Interference
C. kVA One thousand Voltamps
D. Noise Unwanted electrical or electromagnetic energy
E. Signal Wire Wire used to transmit an electrical signal such as voltage, amps, or resistance.
F. PVC Polyvinyl Chloride

1.4 SYSTEM DESCRIPTION

A. Final connectors to control device.
B. Communication cables for integrated systems.
C. Signal cables for Integrated Automated systems.
D. Power cables for Integrated Automated systems.
E. Final terminations of conductors and cables not specifically shown but required for systems operation.

1.5 SUBMITTALS

A. Submit installation plan including:
   1. Recommended modifications to design documents.
2. Documentation for vendor specific limitations or modifications.
3. Sequence of installation.
4. Coordination requirements.

1.6 QUALITY ASSURANCE

A. All work shall meet the requirements of the National Electrical Code.
B. All wiring shall be done in accordance with all local and national codes and authorities having jurisdiction.
C. Ground and Bond according to manufacturer’s recommendations. Refer to Division 26 specifications for grounding and bonding requirements.
D. Splicing communication and instrumentation cables is prohibited.
E. Kinked cable is prohibited and must be replaced.
F. Conform to requirements of National Electrical Code Articles 725 and 800, as well as local electrical codes, where required by the various systems.
G. Insure cable is free of tension at both ends. In cases where cable must bear stress, provide Kellom grips to spread stress over longer length of cable.
H. Adhere to the following minimum distances to reduce effects of EMI:
   1. Five (5) inches from power lines of 2kVA
   2. Eighteen (18) inches from high voltage lighting (including fluorescent)
   3. Thirty-nine (39) inches from power lines of 5kVA or greater
   4. Thirty-nine (39) inches from transformers and motors
I. Maintain separation of signal wire and wire carrying more than 100 VAC.
J. Separate cable from other building systems.
K. Install cables parallel and perpendicular to building walls. Coordinate space requirements with other trades.
L. Conceal wiring in conduit in mechanical spaces, above ceilings, and other spaces where exposed wiring could be damaged. Refer to Section 25 0528 for pathway requirements.
M. Remove all abandoned wiring. Engineer to identify abandoned wiring and coordinate with DMS before removal.
N. Refer to Section 25 0553 for label requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Store all products according to manufacturer’s recommendations.
B. Protect stored cable from vandalism and weather.
C. Store cable and equipment no more than 6 weeks prior to installation.
D. Maintain a minimum storage temperature of 50 Deg F.
PART 2 - PRODUCTS

2.1 FLOOR LEVEL COMMUNICATION CABLE
A. Cabling Requirements:
   1. Min Size: 24 AWG solid annealed copper pairs
   2. Min Number of Conductors 2 twisted pairs or as needed
   3. Jacket UL listed Teflon
   4. Jacket color: Orange

2.2 INSTRUMENTATION SIGNAL CABLE
A. Cabling Requirements:
   1. Min Size: 18 AWG stranded (except vendor specific instrument)
   2. Min number of Conductors 2 – 4 (application specific)
   3. Jacket PVC
   4. Jacket Color Blue
   5. Sheild Per manufacturer recommendations

2.3 POWER WIRE (50 VOLTS OR LESS)
A. Cabling Requirements:
   1. Min Size: 18 AWG stranded
   2. Number of Conductors 2
   3. Jacket PVC
   4. Jacket Color Grey

2.4 POWER WIRE (GREATER THAN 50 VOLTS)
A. Refer to Division 26 specifications.

PART 3 - EXECUTION

3.1 COVERAGE AREA CABLE
A. Install cable in approved pathways only.
B. Provide appropriate shielding to eliminate equipment noise from VFD’s and other equipment.
C. Provide additional shielding and grounding per applicable manufacturer’s recommendations and/or job site conditions.
D. Label cable according to Section 25 0553.

3.2 INSTRUMENTATION SIGNAL CABLE
A. Provide signal cables for instrumentation.
B. Install cable in approved pathways.
C. Provide appropriate shielding to eliminate equipment noise from VFD’s and other equipment.
D. Provide isolated instrument grounding system as per manufacturer’s recommendations.
E. Terminate instrument cables at terminal blocks or terminal strips in cabinets.

F. Label cable according to Section 25 0553.

3.3 POWER WIRE (50 VOLTS OR LESS)
   A. Unless otherwise specified or noted, provide final power connections including conduit, wire, and/or control panel disconnect switches to all control devices from appropriate electrical j-box.
   B. Provide power cables for instrumentation and devices.
   C. Install cable in approved pathways.

3.4 POWER WIRE (GREATER THAN 50 VOLTS)
   A. Provide final power cables and connections for instrumentation and devices.
   B. Install cable in approved pathways.

3.5 FIELD QUALITY CONTROL (TESTING)
   A. Verify cable shield or coupled bonding conductor for end-to-end continuity.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes complete pathway system and requirements for Integrated Automation including but not limited to:
   1. Conduit and fittings
   2. Outlet boxes
   3. Pull and junction boxes
   4. Sleeves

B. Related Sections:
   1. 25 0513 Conductors and Cables

1.2 DEFINITIONS

A. Pathways - Support and protection system for conductors and cabling.

B. Sleeves - Protection for wall and other penetrations.

1.3 SYSTEM DESCRIPTION

A. All integrated automation systems must be in approved pathways.

B. Approved pathways include:
   1. Conduit as specified in Division 26 specifications.
   2. Cable tray as specified in Division 27 specifications.

C. Includes conduit pathway for the Integrated Automation System where not in cable tray.

D. Includes a complete independent conduit pathway system for the Smoke Control System and any components of the Smoke Control System.

E. Where specifically allowed or specified, pathway system includes hangers, bridle rings, j-hooks and other supports for cabling not required to be in conduit.

1.4 SUBMITTALS

A. Refer to Division 26 specifications.

1.5 QUALITY ASSURANCE

A. Install pathways parallel and perpendicular to building structure. Coordinate space requirements with other trades. Avoid horizontal runs through walls.

B. Provide protection for penetrations appropriate to the type of assembly penetrated.

C. For fire-rated construction, seal penetrations to maintain fire rating of construction penetrated.
D. In addition to other pathway requirements, low voltage cable must be in an enclosed pathway system for exposed areas, inaccessible spaces (including walls), electrical and mechanical spaces, etc.

E. Do not install pathways on floor structure or in any way that may obstruct access to equipment, spaces, walkways, etc.

F. Support pathways appropriately to avoid movement, vibration, etc.

G. Refer to Division 26 specifications for additional requirements.

H. Where conduit is not required:
1. Space J-hook cable supports every 4 ft or in accordance with cable manufacturer's specifications, whichever distance is shorter. Use of tie-raps, structure, ductwork, wire, etc. for support is prohibited.

I. Cable shall be free of tension at both ends. In cases where cable must bear stress, provide Kellems grips to spread stress over longer length of cable

1.6 DELIVERY, STORAGE, AND HANDLING
A. Refer to Division 26 specifications.

PART 2 - PRODUCTS

2.1 Refer to Division 26 specifications for pathway product requirements.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Verify routing and termination locations of pathways prior to rough-in.

B. Coordinate equipment, floor, wall and roof penetrations with appropriate trades.
1. Provide penetrations for pathways.
2. Provide appropriate sleeves for penetrations.
3. Provide fire-stopping as described in Architectural or Electrical specifications.

C. Provide pathways for all work within this division.
1. Provide non-continuous pathway systems from wall sensor conduit stub to associated controller.
2. Provide non-continuous pathway system from controller to Information Management Outlet (IMO).
3. Provide non-continuous pathway system from controllers to Horizontal Connection Points (HCPs).
4. Provide non-continuous pathway system for air terminal reheat valves and discharge air sensors.
5. Provide continuous enclosed conduit pathway systems in mechanical spaces, electrical spaces, exposed areas and in any areas not specifically allowed to be non-continuous pathways.
6. Provide continuous enclosed conduit pathway systems for Smoke Control System.

D. Size conduit and boxes by circular mil size of cable in conduit or box.
E. Minimum conduit size is 3/4” unless otherwise noted.
F. Maximum length of flexible conduit is 3 feet.
G. Refer to Division 26 specifications for additional requirements.

3.2 PROTECTION
A. Conduit and raceway penetrations through walls, floors, and ceilings require firestopping.
B. Provide sleeves for penetrations. Coordinate sleeve selection and application with Division 26 specifications.
C. Furnish information as to size and location of built-in openings required.
D. Do not cut, remove, or pierce general or mechanical insulation, fire rated walls, ceilings, or steelwork without prior permission and instruction.
E. Provide conduit to protect pneumatic tubing outside of panels.
F. Provide appropriate protection for all work within this division.
G. Refer to Division 26 specifications for additional requirements.

END OF SECTION
SECTION 25 0553
IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section defines labeling requirements for control panels, instrumentation, including, control valves, control room instruments, panel instruments, wire, cable, and tubing.

B. Related Sections:
   1. 25 0528 Pathways
   2. 25 3519 Control Valves
   3. 25 3523 Control Dampers
   4. 25 3524 Smoke Dampers
   5. 25 1223 Client-Server Information/Database Integration
   6. 25 1400 Local Control Units
   7. 25 1423 Field Equipment Panels
   8. 25 5100 Monitoring and Control of Facility Equipment

1.2 SUBMITTALS

A. Sample valve, damper and other instrument tags.

B. Sample wire, cable and tubing tags.

C. Sample panel tags.

D. Sample tagging abbreviations (if used).

E. Installation methods for each type and condition.

1.3 QUALITY ASSURANCE

A. Tag each valve, damper and instruments according to contract documents.

B. Where major devices are above ceiling, provide identification on ceiling grid to assist in locating device.

C. Tags shall be machine generated and easily readable.

D. Tags shall be appropriate for the environment installed.

E. Do not mark on instruments with permanent markers, i.e. felt pens or paint sticks.

F. Install tags for easy readability.

G. All identification in a single infrastructure must have the same format where possible.

H. Equipment, panel, and instrumentation tags should be coordinated for consistency with Owners’ automation system and work order management system.
PART 2 - PRODUCTS

2.1 INSTRUMENT IDENTIFICATION

A. Construction:
   1. 1/16" thick laminated phenolic plastic, white with black core.
   2. Nominal size of 1" high by 1 to 4" wide.
   3. Stamped in 1/4" high block characters.

B. Self-adhesive identification is not acceptable where conditions will allow for permanent mounting.

2.2 CONTROL PANELS IDENTIFICATION

A. Construction:
   1. 1/16" thick laminated phenolic plastic, white with black core.
   2. Nominal size of 2" by 4".
   3. Stamped 1" high block letters.

B. Self adhesive is acceptable where conditions will allow for permanent mounting.

2.3 VALVE AND DAMPER IDENTIFICATION

A. Construction:
   1. 1/16" thick laminated phenolic plastic, white with black core or minimum 0.032" thick, polished brass or 316 stainless steel.
   2. Nominal size of 2" by 4".
   3. Stamped 1" high block letters.

B. Hanging type only, self adhesive is not acceptable for permanent mounting.

2.4 WIRE, CABLE AND TUBE IDENTIFICATION

A. Heat Shrink Tubing:
   1. Manufacturer: Rhino or Brady Bradysleeve.
   2. Labels shall be heat shrink tubing type. Heat shrink labels shall be used on wire, cable, and tubing except for vendor specific cables which may not be cut.

B. Self Laminating Wrap-On Labels:
   1. Manufacturer: Rhino or Brady WML series.
   2. Self Laminating Wrap-On Type Labels shall be self-laminating wrap-on type. Self-laminating, wrap-on labels shall be used only on wire, cable, which may not be cut, and on tubing.

C. Self adhesive is acceptable where conditions will allow for permanent mounting.

2.5 CONDUIT IDENTIFICATION

A. Blue paint and black stencil lettering on junction box covers

B. Blue paint on automation conduit.
PART 3 - EXECUTION

3.1 INSTRUMENT IDENTIFICATION

A. Label each instrument with hardware tag and software name.
   1. Instrument hardware tagging shall be according to symbols and tag numbers used on control diagrams.
   2. Instrument software name shall be according to database generated point name. Coordinate with section 25 1223.

B. Size label to accommodate instrument tag number and description.

C. Affix label to permanent to instrument or housing (if direct instrument mounting is unreasonable).

D. Fastening Methods for indoor applications:
   1. Self adhesive or double-side adhesive tape.
   2. Epoxy Cement as required

E. Fastening Methods for weather exposed or other conditions where self adhesive is impractical:
   1. Field tags: Use Round head, No. 0 x 3/16", Type U, metallic drive screw, (0.075 diameter, blunt), size 51 (0.067") drill, stainless steel or chromium plated. Cadmium plated screws are not allowed. Similar screw may be substituted.
   2. Panel face: Use Phillips panhead, No. 2-56 x 5/16", Type T, self-tapping sheet metal screw (0.086 diameter, blunt, notched), size 48 (0.076") drill, stainless steel or chromium plated. Cadmium plated screws are not allowed. Similar screw may be substituted.

F. Provide control panel interior mounted instrument tags. Engraved legend shall be instrument tag number

3.2 CONTROL PANEL IDENTIFICATION

A. Provide control panel face mounted instrument tags as required. Engraved legend form ad follows:

   PROCESS EQUIPMENT IDENTIFICATION
   DEVICE FUNCTION
   INSTRUMENT TAG NUMBER

   1. Instrument tag number shall be: device address # (node) and the equipment controlled.
   2. Coordinate label tags and format prior to purchasing or installation.

B. Provide phenolic tag for each controller.

3.3 VALVE AND DAMPER IDENTIFICATION

A. Provide valve and damper tags for controlled equipment.

B. Valve and damper tags number shall be per contract documents and owner's standard.

C. Coordinate label tags and format prior to purchasing or installation.

3.4 WIRE, CABLE AND TUBE IDENTIFICATION

A. Provide cable sheaths labeling on both ends approximately 6 inches from the termination in case the cable becomes separated from its termination.
B. Provide a complete documented cable record for Integrated Automation systems.

C. Label Coverage area cables at each end:
   1. Label terminating end with distribution location identification serving terminal device.
   2. Label distribution end with terminal device destination.

D. Label instrumentation cable and tubing at each end:
   1. Label terminating end with panel device tag.
   2. Label distribution end with instrument device tag.

END OF SECTION
SECTION 25 1219

INTEGRATION PROTOCOLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Network protocol for all Integrated Automated Systems.

B. Related Sections:
   1. Section 25 1223 – Client-Server Information / Database Integration
   2. Section 25 1313 - Control and Monitoring Supervisory Control
   3. Section 25 1500 – Software

1.2 REFERENCES


1.3 DEFINITIONS

A. BACnet Building Automation and Control Network open communication protocol
B. BBMD BACnet Building Management Device
C. BTL BACnet Testing Laboratory
D. COV Change of Value
E. DDC Direct Digital Control
F. Fox Proprietary Niagara protocol for communication with JACE controllers
G. FLN Floor Level Network
H. GUI Graphical User Interface
I. JACE Java Application Control Engine
J. Internetwork Integration of subnetworks into a large, site-wide network
K. I/O Input / Output
L. IP Internet Protocol
M. PICS Protocol Implementation Conformance Statement
N. PID Proportional, Integral, and Derivative Control
O. Protocol An agreed-upon format for transmitting data between two devices
P. VACL VLAN Access Control List
Q. VLAN Virtual Local Area Network
1.4 SYSTEM DESCRIPTION

A. All enterprise level interconnected networks shall consist of integrated controls systems communicating via Tridium Fox Protocol.
   1. ASHRAE 135 BACnet/IP communication is permitted when approved by Project Owner.

B.Vykon JACE units shall be used to facilitate translation of BACnet/MSTP protocol communication from floor level devices to Fox.
   1. Appropriate device drivers and/or licenses must be configured to accommodate this open protocol communication translation.

C. Vykon JACE units shall be used to facilitate translation of proprietary Siemens protocol communication from FLN devices to Fox.
   1. Appropriate device drivers and/or licenses must be configured to accommodate this open protocol communication translation.

D. LonWorks and Modbus network protocols may be used for certain system communications where BACnet/IP and MS/TP configurations are not possible.

1.5 SUBMITTALS

A. Integration Plan:
   1. Proposed communication architecture including integration protocols
   2. Include latest version of protocol profiles used
      a. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface included in the submittal.
      b. LonWorks profiles, Modbus profiles and registry lists.

1.6 QUALITY ASSURANCE

A. BACnet products shall be BTL compliant.

B. Refer to 25 1500 Software for additional information.

1.7 WARRANTY

A. Refer to 25 1500 Software for additional information.

PART 2 - PRODUCTS

2.1 ENTERPRISE COMMUNICATION

A. The following communication protocols shall be used for enterprise-level communication –
   1. BACnet/IP
   2. Fox (Tridium/Niagara based systems only, Default TCP port: 1911)

B. BAS servers (physical or virtual) shall communicate via BACnet/IP or Fox protocol via DMS provided BAS Ethernet network VLAN or VACL.

C. As necessary, provide BACnet Router units to facilitate data transfer between field-level (MS/TP) and enterprise-level networks.
D. As necessary, provide BBMD units for each IP subnetwork.
   1. All system shall be configured for static BBMD only, not dynamic.

2.2 FLOOR LEVEL COMMUNICATION

A. The following communication protocol(s) shall be used –
   1. ASHRAE 135 BACnet MS/TP
      a. Set UDP port number for BACnet controllers to 47808 (Default BAC0).
      b. Siemens P1/P2 protocols may be used when BACnet MS/TP is not an option. An appropriate JACE unit must be installed to facilitate necessary translation of proprietary protocols.

END OF SECTION
SECTION 25 1223

CLIENT-SERVER INFORMATION / DATABASE INTEGRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes


B. Related Sections:

1. 25 1219 Integration Protocols

1.2 REFERENCES


1.3 DEFINITIONS

A. Archive  Data storage.

B. Command Priorities  The order in which commands can be executed.

C. EBMS  Enterprise Building Management System

D. Escalation  Alarm advancement after delay to the next level of notification.

E. Event  Alarm, transaction, or sequence.

F. Global Strategies  Strategies requiring integration of different systems.

G. Mapping  The act of integrating data points from different systems back to the Building Management System.

H. Normalize  Create consistency among dissimilar data for a specific use.

I. Real-time  Up to the minute.

J. Trend  Record data for specified time intervals.

1.4 SYSTEM DESCRIPTION

A. The integration of the various systems throughout the facility using protocols specified in Section 25 1219.

B. Remote read/write capabilities of Integrated Automated Systems using open communication protocols, BACnet/IP and BACnet MS/TP. Fox protocol will be used for communication between JACE units and enterprise-level supervisory systems.

C. Integrated Automation System shall have the capability to integrate with the following:
1. Web Services
2. Fox
3. BACnet/IP
4. Lon/IP
5. Modbus/IP

D. Scope includes but not limited to:
   1. Data collection
   2. Database generation
   3. Graphics generation
   4. Global control strategies generation and implementation
   5. Scheduling generation
   6. Permanent trending and storage of all points for 7 years
   7. Alarm generation and management
   8. Web Page Development
   9. Reports generation
   10. Coordination of integration activities

E. Provide supplementary or miscellaneous items, products and labor incidental to, or necessary for complete integration of systems to the Integrated Automation System.

F. Contractor to lead the coordination effort with vendors for integration activities.

G. Server(s) are existing and located at DMS Operations and Controls Center (OPCON)

1.5 SUBMITTALS

A. Submit detailed and annotated manufacturer's data, drawings, and specification sheets for each item listed, that clearly show compliance with the project specifications.

B. Submit shop drawings which include the following in the project's control system drawing set:
   1. Control system drawings title sheet
   2. List of I/O Points and naming convention
   3. Control system components list
   4. Control system schematics
   5. HVAC equipment electrical ladder diagrams
   6. Component wiring diagrams
   7. Terminal strip diagrams
   8. BACnet communication architecture schematic
9. Sequence of operations

C. Submit all product data information for integrated controls, associated hardware and software.

1. Direct digital controllers
2. JACEs
3. BACnet Protocol Analyzer (traffic monitoring)
4. DDC Software
5. BACnet Operator Workstation DDC Software
   a. Include BACnet PICS for Operator Workstation software.
6. Notebook Computer with appropriate software for Maintenance Department
7. Sensors and Input Hardware
8. Output Hardware
9. Surge and transient protection
10. Design Data
11. Contractor's Qualifications
12. Operation and Maintenance Data
13. Controls System Operators Manuals
14. Closeout Submittals
15. Training documentation

1.6 QUALITY ASSURANCE

A. Scope and products included in this section shall be compatible and consistent with existing Integrated Automation System.

B. Limit temperature readings to 1 decimal unless otherwise noted.

C. All new control hardware must be manufactured and labeled 'Made in America'.

1.7 WARRANTY

A. Refer to 25 0000.

1.8 OWNER'S INSTRUCTIONS

A. Refer to Commissioning Specifications for requirements.

B. Provide a qualified instructor (or instructors) with five years minimum field experience with the installation and programming of similar BACnet DDC systems.

C. Provide 32 hours of off-site training by factory trained instructor for 4 people. Include travel and hotel accommodations.
D. Provide an additional 24 hours of on-site training by factory trained instructor of Owner specific subject, after 6 months of occupation and prior to end of warranty.

E. Coordinate and schedule training with Owner.

F. The project’s approved Controls System Operators Manual shall be used as the training basis.
   1. The Contractor shall ensure the manuals are submitted, approved, and provided to the trainees before the start of training.

G. All training shall be recorded by the HVAC or relevant contractor. Two copies of recorded training material shall be provided to the Project Owner’s Facilities personnel.
   1. Provide physical copies of visual aids used (e.g. PowerPoint presentation).

H. At minimum, the off-site training must include the following:
   1. Global control strategies explanation and BACnet fundamentals (objects, services, addressing)
   2. Web services data management, functions and toolkit
   3. Design requirements and sequence of operations
   4. Network architecture and site layout
   5. Project’s list of control system components and list of points and objects
   6. Using O&M documents
   7. Basic and advanced operator functions (e.g. setpoint adjustments, overrides, etc.)
   8. Graphic generation and modifications
   9. Report features and generations
   10. Exporting data to third party software
   11. Creating, editing, and viewing trends
   12. Creating, editing, and acknowledging alarms
   13. Creating, editing, and viewing operating schedules and schedule objects
   14. General adjustments and troubleshooting
   15. Modifying graphic text, backgrounds, dynamic data displays, and links to other graphics
   16. Creating new graphics and adding new dynamic data displays and links
   17. Alarm and event management
   18. Modifying and downloading control program changes
   19. Using each operator interface to find, read, and write to specific controllers and objects
   20. Drawings and Specification review
1.9 COMMISSIONING
   A. Refer to Commissioning Specifications for requirements.

PART 2 - PRODUCTS
2.1 Enterprise Level: Tridium Niagara 4 platform and JACE integrators
2.2 Necessary BACnet routers to ensure proper network communications per control design drawings.

PART 3 - EXECUTION
3.1 DATA COLLECTION
   A. Provide mapping of points from various automated systems. Provide the ability to read and display any value of any used property of any object from any networked device including properties available and supported optional properties, as well as proprietary extensions.
   B. Normalize and archive data simultaneously at minimum every 15 minutes.
   C. Timestamp all data.
   D. Normalize data points shown in contract documents for ease of database management, graphic displays, readability, and simple identification.
   E. Provide real-time dynamic screen updates for all points.

3.2 DATABASE GENERATION
   A. Develop relational database of data objects, time stamps, events, alarms, and transactions.
   B. Provide the ability to modify loop Object setpoints, alarm limits, tuning parameters, routing, scheduling etc. initiated through operator interaction with graphics displays.
   C. Archive all data points, graphics, reports, alarms, trends, events, and transactions.
      1. Store data for 7 years.
      2. Make data available for industry standard 3rd party applications and application implementation.
   D. Develop databases including:
      1. Applications
      2. Configuration
      3. Trending or historical Data
      4. Event storage
   E. Include construction document Tag for Hardware objects.
   F. Coordinate point naming standards with Owner, prior to any database generation.

3.3 TRENDS
   A. Configure all analog inputs, digital inputs, analog outputs, digital outputs and software value trends as shown on control drawings.
B. Analog points shall be trended at 15-minute intervals.
C. Digital points shall be trended on change of value or state.
D. Normalize trend data for common reporting and archiving.
E. Provide initial trend graphs and reports per Owner request.
F. Coordinate with Owner and Engineer for list of points to have dual trends. The first set of trends will be per items 2 and 3 above. Configure the following points for an additional set of trends at 1-minute intervals:
   1. Air Handling Units
      a. Outside air damper command
      b. Outside air flow meter
      c. Outside airflow setpoint
      d. Return air flow meter
      e. Return air fan speed
      f. Return air static pressure
      g. Return air static pressure setpoint
      h. Return air damper command
      i. Relief air damper command
      j. Return air CO2
      k. Mixed air temperature
      l. Heating hot water coil control valve command
      m. Heating hot water leaving air temperature
      n. Heating hot water coil leaving air temperature setpoint
      o. Cooling coil control valve command
      p. Cooling coil leaving air temperature
      q. Cooling coil leaving air temperature setpoint
      r. Supply air flow meter
      s. Supply fan VFD speed command
      t. Supply static pressure setpoint
      u. Supply static pressure
      v. Supply discharge air temperature

2. Air Terminal Devices
a. Supply airflow
b. Supply damper command
c. Supply airflow setpoint
d. Hot water control valve command
e. Electric reheat command
f. Discharge air temperature
g. Return/exhaust airflow
h. Return/exhaust air damper command
i. Return/exhaust airflow setpoint

3. Laboratories and Related Exhaust Systems
a. Exhaust air static pressure
b. Exhaust fan VFD speed command
c. Exhaust air static pressure setpoint
d. Lab offset
e. Total supply air
f. Total fume exhaust
g. Total general exhaust

4. Chilled Water Systems
a. Differential pressure
b. Differential pressure setpoint
c. Pump speed
d. Building chilled water return temperature
e. Building supply chilled water flow
f. Building supply chilled water temperature
g. Bypass chilled water valve command

5. Condenser Water Systems
a. Cooling tower fan speed
b. Cooling tower leaving water temperature
c. Cooling tower leaving water temperature setpoint

6. Hot Water Systems
a. Building supply hot water temperature  
b. Building return hot water temperature  
c. Differential pressure setpoint  
d. Differential pressure  
e. Boiler return water flow  
f. Pump speed  

3.4 GLOBAL STRATEGIES  
A. Coordinate initial global control strategies with Owner.  
B. Implement initial global strategies including but not limited to:  
   1. Economizer (based on weather data)  
   2. Energy Calculations  

3.5 SCHEDULES  
A. Coordinate initial schedules requirements with Owner.  
B. Input initial equipment schedules per Owner request.  
C. Input initial report schedules per Owner request.  

3.6 ALARM MANAGEMENT  
A. Provide alarms including:  
   1. Any point reaching a high or low limit  
   2. Anytime feedback does not equal command  
   3. Points overridden  
B. Provide alarms for all points. Coordinate with Owner and include the following:  
   1. Point Name and Description  
   2. Alarm differentials (automatically adjust with setpoints)  
   3. Units  
   4. Coordinate settings (limits or state) with Owner  
   5. Instrument tag  
   6. Priority  
   7. Message  
C. Coordinate and implement alarm notifications and routing with the Owner. Include:  
   1. Email
2. Group and network notifications
3. Alarm acknowledgement
4. Existing Maintenance Management System

D. Provide hardware or interface required to implement alarm notification and routing.

E. Provide state-based alarming to prevent alarms during specific equipment states.
   1. Interlock equipment status and/or modes to lock out associated alarms during shutdowns.
   2. Interlock acknowledgement to lock out associated alarm for limited adjustable time period.

F. Provide alarms suppression, to minimize nuisance alarms resulting from higher level alarms.
   1. Hot water and chilled water alarms master to AHU temperatures.
   2. AHU alarms master to associated ATU and room temperatures.
   3. Fire alarms master to associated HVAC equipment.

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<th>AHU Temperature Alarm High</th>
<th>AHU Temperature Alarm Low</th>
<th>Zone Temperature Alarm High</th>
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</tbody>
</table>

G. Filter and route alarms based on user log in.

H. Allow alarms to be sorted and displayed chronologically, priority, filtering, etc.

I. Provide alarms for conditions such as offline and poor communication performance.

J. Archive all data in standard database platform Microsoft Data Engine or Microsoft SQL. Including but not limited to:

1. I/O points
2. Software points such as
   a. Alarm limits
   b. Setpoints
   c. Parameters
3. Schedules
4. Alarm messages

K. Configure the following alarms in categories as identified.

1. Critical Mechanical
   a. Air Handling Units
      1) Supply air static pressure
      2) Supply air temperature
      3) Supply air fan status
      4) Return air fan status
      5) Outside air fan status
      6) Exhaust air fan status
      7) Supply VFD status
      8) Exhaust VFD status
      9) Supply fire smoke damper command
   b. Energy Recovery Units
1) Exhaust air fan low static status
2) Exhaust air fan status
3) Outside air VFD status
c. Chilled Water Systems
   1) Chiller status
   2) Pump status
   3) Plant chilled water supply temperature
   4) Leaving chilled water temperature
   5) Entering chilled water temperature
   6) Manual reset
d. Condenser Water Systems
   1) Cooling tower fan status
   2) Pump status
   3) System flow
   4) Tower sump level transmitter
e. Hot Water Systems
   1) Boiler alarm status
   2) Pump status
   3) Building supply hot water temperature
   4) Condensate pump status
   5) Heat exchanger hot water supply temperature

2. General
   a. Condenser Water System
      1) Leaving condenser water temperature
      2) Entering condenser water temperature

3. Maintenance
   a. Air Handling Units
      1) Pre-filter differential pressure
      2) Final-filter differential pressure
   b. Energy Recovery Units
1) Exhaust air filter status
2) Outside air filter status
c. Condenser Water System
   1) Cooling tower vibration transmitter

3.7 REPORTS

A. Coordinate report requirements with Owner.

B. BAS shall provide on-screen commands to generate and format reports for displaying on active Workstation, printing, and exporting.
   1. Dynamic operation of the system shall not be interrupted by report generation.

C. BAS shall allow for automatic or manual generation of reports. For automatic reports, the operator shall be able to specify the time the initial report is to be generated, the time interval between reports, ending period, and the report’s output format. For manual reports, the operator shall be able to request and generate at any time while using the system.

D. Provide reports in standard or 3rd party formats for the following:
   1. Points and objects
   2. Alarms and frequency
   3. Schedules
   4. Utilities or Energy Management
   5. Trends
   6. Historical
   7. Transactions
   8. Point overrides and lock-outs
   9. Diagnostic or system status
   10. Commissioning reports
   11. Disabled points
   12. Equipment runtime

E. Provide initial reports per Owner request.

F. Schedule initial reports printouts daily per Owner request including:
   1. Alarms and frequency
   2. Point overrides and lock-outs
   3. Disabled points

G. Schedule initial reports printouts monthly per Owner request including:
1. Utilities or Energy Management
2. Diagnostic or system status
3. Commissioning reports
4. Equipment runtime

3.8 AUDITING

A. The BAS software shall maintain a historical file logging all system and user activity.
   1. Software must maintain log files for a minimum of 2 years and provide suitable storage space.

B. The file shall maintain the following at a minimum –
   1. Operator Logins
   2. Alarm Acknowledgments
   3. Commands Issued
   4. Database Modifications

3.9 USER ACCESS CONTROL AND SECURITY PERMISSIONS

A. BAS software shall interface with a suitable user authentication platform such as the following –
   1. Microsoft Active Directory
   3. Local BAS Software Platform

B. User accounts and system access shall be assigned by software administrators and unique for all users.

C. Standard user permission levels (from most restrictive to most permissive) shall include –
   1. Visitor
      a. View Data and Trends
   2. Operator
      a. View Data, Trends, and Reports
      b. Acknowledge Alarms
      c. Override Points
      d. Change Setpoints
      e. Change Schedules
   3. Engineer (tasks in addition to those in Operator level)
      a. Add Devices
b. Change Device Addresses

c. Create Applications

d. Download Applications

e. Configure ASCs

f. Setup Trends and Reports

g. Modify Alarm Settings

h. Create and Modify System Graphics.

4. Administrator (tasks in addition to those in Engineer level)

a. Assign, Manage, and Edit User Access Control

D. Passwords shall be unique to each account and not displayed during log-in process

E. BAS shall provide automatic log-out functionality when no user activity is detected at the workstation (keyboard and mouse). The default time-out period (5 minutes) may be modified by the system administrator. The workstation shall notify the user of an automatic log-out via display message on graphical display.

3.10 CALCULATIONS

A. Provide calculations for dynamic points including:

1. Real Time chilled water consumption (KTons)

2. Real Time cost per KTons of cooling

3. Real Time steam consumption (lbs/hour)

4. Real Time Electric consumption

5. Real Time Domestic Water consumption

6. Real Time total building energy cost ($/sq. ft.)

7. Real Time outside and return air enthalpy

B. Provide calculations for totalization points including:

1. Runtime Hours on major equipment

2. Monthly Energy Cost

3. Yearly Energy Cost

3.11 NIAGARA COMPONENT NAMING

A. In a Niagara station, components shall be properly named using the following set of rules:

1. Only alphanumeric (A-Z, a-z, 0-9) and underscore(_) characters are allowed. Spaces, hyphens, and other symbols are prohibited.
2. The first character in the name must be a letter.

3. Name must be unique for every component in the same parent component.

4. Naming is case sensitive. For example, zone1 and Zone1 are unique names.

5. Abbreviations are the preferred method of naming components. Only the approved abbreviations in paragraph G shall be used in component names.

6. Absent an approved abbreviation, word names shall be treated as title case with the first letter of each word capitalized. For example, ReturnAirTemp.

7. Component names shall not use leading zeros. For example, AHU1.

3.12 POINT OBJECT NAMING CONVENTION

A. Point objects describe a point, such as analog or binary inputs and outputs. Point objects may be derived from the standard BACnet catalog or customized via vendor. BACnet defines the following object types as standard objects and defines their required minimum behavior.

1. Binary Input, Output, and Value
2. Analog Input, Output, and Value
3. Averaging / Totalization
4. LifeSafetyZone and LifeSafetyPoint
5. Multi-state Input, Output, and Value
6. Loop
7. Calendar
8. Notification Class
9. Command
10. File
11. Program
12. Schedule
13. Trend Log
14. Group
15. Event Enrollment
16. Device

B. Point Object Naming Configuration
1. Level 1 – Site / Building
2. Level 2 – Area / Floor / Room
3. Level 3 – Equipment and System Type
4. Level 4 – Object/Point Map Legend

C. Object/Point Identifiers
1. BACnet Object names and IDs shall be unique within each programmed device
2. BACnet Device names and IDs shall be unique within the entire BACnet system
3. BACnet Network Numbers shall be unique and consistent within the entire BACnet network.
4. Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor’s discretion but shall be approved by the Project Owner.

D. Object/Point Naming Example
1. Feedback valve on the cooling coil of AHU-1 in area B1002 at the site ABC
   a. ABC.B1002.AHU-1.CC-VLV-FB

E. BACnet NAME AND ADDRESS CONVENTION
1. Coordinate with Project Owner and employ unique names and addresses for BACnet networks, integrated devices, and objects per instructions from the Project Owner.
2. MAC Address
   a. Every BACnet device shall have a unique assigned and documented MAC Addresses to its network. For Ethernet/IP, document the MAC Address assigned at its creation. For MS/TP, assign from range as provided in vendor documentation.
3. Network Numbering
   a. Assign unique numbers to each new network installed on the BACnet internetwork. Provide capability for modifying network number via devices switches, network computer, or field operator interface. The BACnet internetwork (all possible network configurations) can contain up to 65,534 possible unique network broadcasts.

4. Device Object Identifier Property Number
   a. Assign unique Device "Object_Identifier" property numbers or device instances for each device on the BACnet internetwork. Provide capability for future modification of the device instance number via device switches, network computer, or field operator interface. (Note: BACnet permits up to 4,194,302 possible unique devices per internetwork.)

5. Object Name Property Text (non-Device Objects)
   a. The Object Name property field shall support 32 minimum printable characters. Assign Object Name properties with plain-English names descriptive of the application. Examples include "Zone 1 Temperature" and “Fan Start/Stop”.

6. Object Identifier Property Number (non-Device Objects)
   a. Assign Object Identifier property numbers according to design drawings or tables if provided. If not provided, Object Identifier property numbers may be assigned at the Contractor's discretion but shall be approved by the Project Owner. In this case, they shall be documented and unique for like object types within the device.

F. Level 3 – System Types
# Name | Description
--- | ---
AHU | Air Handling Unit
BLR | Boiler
CAV | Constant Air Volume Terminal Unit
CH | Chiller
CHW | Chilled Water Circuit
CHWP | Chilled Water Pump
CRAC | Computer Room Air Conditioning Unit
CT | Cooling Tower
CW | Condenser Water Circuit
CWP | Condenser Water Pump
DTW | Dual Temperature Water Circuit
EF | Exhaust Fan
EH | Electric Heater
FCU | Fan Coil Unit
FP_VAV | Fan Powered Variable Air Volume Terminal Unit
HHW | Heating Hot Water Circuit
HHWP | Heating Hot Water Pump
HX | Heat Exchanger
LAB | Laboratory Space
MX | Mini-split
RF | Return Fan
RM | Room
RTU | Roof Top Unit
SF | Supply Fan
VAV | Variable Air Volume Terminal Unit

## G. Level 4 – Point Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
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<td>Alarm</td>
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<tr>
<td>BP_DMPR</td>
<td>Bypass Damper</td>
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<tr>
<td>CC</td>
<td>Cooling Coil</td>
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<tr>
<td>Name</td>
<td>Description</td>
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<td>------------------------------------</td>
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<tr>
<td>CHW</td>
<td>Chilled Water</td>
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<tr>
<td>CHWR</td>
<td>Chilled Water Return</td>
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<tr>
<td>CHWS</td>
<td>Chilled Water Supply</td>
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<td>CLG</td>
<td>Cooling Mode</td>
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<td>COP</td>
<td>Coefficient of Performance</td>
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<tr>
<td>CV</td>
<td>Constant Volume</td>
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<td>DA</td>
<td>Discharge Air</td>
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<td>Enable</td>
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<td>Float Switch</td>
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<td>FLOW</td>
<td>Measured Flow (air or water)</td>
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<td>Pressure Relief Valve</td>
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<td>Supply Air</td>
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<td>Smoke Detector</td>
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<tr>
<td>UNOCC_HTG</td>
<td>Unoccupied Heating Mode</td>
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<td>VFD</td>
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<td>Valve</td>
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END OF SECTION
SECTION 25 1300

CONTROL AND MONITORING NETWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a complete microprocessor controlled BACnet compatible control and monitoring network for the various systems connected to the BAS communication network including, but not limited to:
   1. Air Handlers
   2. Variable Air Terminals
   3. Fan Coil Units
   4. Pumps
   5. Heat Exchangers
   6. Air Conditioners
   7. Heaters

B. For renovation projects, utilize a JACE controller with appropriate drivers to facilitate communication between enterprise level and existing Siemens floor-level networks.

C. The Control and Monitoring Network shall integrate to the following systems:
   1. Variable Frequency Drives
   2. Electrical Power
   3. BAS

D. Related Sections
   1. 25 0000 Integrated Automation
   2. 25 1223 Client-Server Information Database Integration
   3. 25 1400 Local Control Units
   4. 25 1416 Application Specific Controllers

1.2 REFERENCES

A. UL 916 Energy Management Systems

1.3 DEFINITIONS

A. FLN Floor Level Network
B. MS/TP Master Slave Token Ring-Passing

1.4 SYSTEM DESCRIPTION

A. The Control and Monitoring Network shall utilize an open architecture capable of the following:
   1. Utilizing standard Ethernet communications and operating at a minimum speed of 10/100 Mb/sec.
   2. Communication via Fox protocol at the Tier 1 level.
   3. BAS network shall support copper and optical fiber communication media at the Tier 1 level.
1.5 SUBMITTALS

A. Submit BAS device schedule. Include:
   1. Device name and physical address
   2. Device I/O points
   3. Associated Building Level Controller
   4. Device location
   5. Associated system
   6. Location served
   7. Make and model number of controller
   8. Shop Drawings:
      a. Control drawings
      b. Wiring details
      c. Installation details
      d. Bill of materials
      e. Sequence of Operations
      f. Panel layout for major control panels
      g. Connection Approval Worksheet (DMS Document)

B. Submit riser and protocol requirements for all devices on the FLN.

C. Submit grounding and shielding requirements.

D. Submit termination requirements.

E. Submit distance limitations if any.

1.6 QUALITY ASSURANCE

A. Documented history of compatibility by design for a minimum of 2 years.

B. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels and extend new field panels on a previously installed network.

C. Prior to start-up, provide hardware representative for an on-site plugfest as described in Section 25 0000.

D. Conform to UL 916.

E. Advanced and application specific controllers: Do not exceed 80% of manufacturer recommended device count on MSTP bus.

F. Minimum 38,400 BAUD rate for MSTP network.

1.7 SYSTEM STARTUP

A. Document system start up.

B. Coordinate with other trades.
PART 2 - PRODUCTS

2.1 NETWORK ARCHITECTURE
   A. Complete communication architecture for BAS devices as well as other integrated vendor devices.
   B. Complete device programming capabilities via Operator Workstation.

2.2 CORE SWITCHES
   A. Owner will provide all core switches.

2.3 ACCESS SWITCHES
   A. Owner will provide all access switches.
   B. No additional switches shall be added to Owner’s network.
   C. All middleware devices shall be approved by owner prior to purchase and installation.

2.4 MANAGEMENT INTERFACE REQUIREMENTS
   A. Refer to Owner’s IT standards on the requirements for interface and management.

2.5 CONTROLS FAULT-TOLERANCE
   A. Provide fault-tolerant controls (devices and network configuration) to prevent entire system shutdown when functionality of a single controller or device is lost.
   B. DDC Devices must have sufficient I/O capacity to perform and manage specific control sequences and include all points listed in point schedules.
   C. Analog control loops for major equipment (boilers, air handlers, etc.) shall have PID control.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Provide system to monitor and/or control of BAS devices.
   B. Connect to 3rd party equipment per network diagram.
   C. Provide and coordinate all points for inclusion in database generation per section 25 1223.
   D. All panels and devices shall be configured to utilize static IP addresses. IP addresses shall be provided by Owner. This process is to be managed through the Owner’s PM on the project. PM will provide Device Connection Application to request authority to connect new devices to Owner's network.
   E. All BACnet instance numbers for network controllers shall be provided by Owner. Instance numbers will utilize the vendor BACnet ID as the first digit(s).
   F. All systems utilizing BACnet are to be set up for a static BBMD, not dynamic.
3.2 NETWORK ARCHITECTURE

A. Coordinate all network communication and low voltage power requirements with appropriate contractor including the installation of cabling, and overall communication system architecture, signal quality, attenuation, power level or special needs of the control system.

B. Coordinate communications systems design and requirements (segmenting, broadcasting, multicasting, etc.) with Owner’s Information Technology Services.

C. Layer 2/3 devices shall be used to connect segments of the LAN or multiple LANs and to filter and forward packets among them.

D. Network switches shall provide for wired services, performance criteria and capabilities to support:
   1. Real-time QOS (Quality of Service)
   2. Multimedia priority support
   3. Protocol Independent Multicast and Source-Specific Multicast
   4. Voice Prioritization (SVP)

E. Network switches shall assure security including:
   1. Lightweight Extensible Authentication Protocol (LEAP)
   2. Protected Extensible Authentication Protocol (PEAP)
   3. Remote Authentication Dial-In User Service (RADIUS)
   4. Virtual Private Networking (VPN)
   5. Internet Security Protocol (IPSec)
   6. Point-to-Point Tunneling Protocol (PPTP) (Core/switches)

F. Follow manufacturer’s installation, programming and setup practices.

END OF SECTION
SECTION 25 1313

CONTROL AND MONITORING SUPERVISORY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. System includes:
   1. Building (or network) level control units for Integrated Automation systems
   2. Incidental labor and material required, for a complete and operable system.

B. System Configuration & Definition
   1. Changes made at the server shall be automatically recorded and downloaded to the appropriate Controller. Changes made at the Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
   2. System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back up must be done with the PC workstation off-line, the Controls contractor shall provide at least 2 operator workstations.

C. Related Sections:
   1. 25 1219 Integration Protocols

1.2 REFERENCES


1.3 SYSTEM DESCRIPTION

A. Microprocessor based, field programmable controllers to:
   1. Integrate systems specified.
   2. Accept commands from existing enterprise server the following:
      a. Commands
      b. Overrides
      c. Schedules
      d. Interlocks
      e. Adjustments
   3. Perform standalone facility wide control strategies and sequences.

1.4 SUBMITTALS

A. Refer to section 25 0000.

1.5 QUALITY ASSURANCE

A. Comply with ISO 9000 (Model for Quality Assurance in Production, Installation, and Servicing).

B. Documented history of compatibility by design for a minimum of 2 years. Future compatibility shall be supported for no less than 7 years.
C. Comply with the ANSI/ASHRAE Standard 135-2016 BACnet protocol in one open, interoperable system.

D. Refer to section 25 0000 for additional requirements.

1.6 WARRANTY

A. Upon completion of final test of installation and acceptance by Engineer and Owner, provide any service incidental to proper performance for a period of two years.

B. Include:
   1. Software revisions or updates during the warranty period.
   2. Two-year warranty for parts replacement.
   3. Registration and warranty documents and warranty rights to the Owner.
   4. Extended warranties, if necessary, to meet the warranty requirement.
   5. Software and firmware updates which resolve known deficiencies.
   6. 5-year software maintenance agreement.

C. Refer to section 25 0000 for additional requirements.

1.7 OWNER’S INSTRUCTIONS

A. Provide 8 hours training on Local Control Units.

PART 2 - PRODUCTS

2.1 SUPERVisory CONTROLLERS

A. Controller hardware products shall be “Made in the USA” or come through the Tridium Richmond, Virginia shipping facility.

B. The network controllers shall be provided with no connectivity restrictions on which brand stations or tools can interact with the system. The station and tool "NiCS" would be as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATION COMPATIBILITY IN</td>
<td>ALL</td>
</tr>
<tr>
<td>STATION COMPATIBILITY OUT</td>
<td>ALL</td>
</tr>
<tr>
<td>TOOL COMPATIBILITY IN</td>
<td>ALL</td>
</tr>
<tr>
<td>TOOL COMPATIBILITY OUT</td>
<td>ALL</td>
</tr>
</tbody>
</table>

C. The Supervisory Controller connects to high speed Local Area Network (LAN), serves as communications hub for other DDC on slower speed LANs, and has sufficient processor capabilities and RAM to implement all types of custom software applications.

D. Include uninterrupted real time clocks capable of time of day, week, and year information to the system as needed to perform software functions.
   1. Clocks in multiple DDC’s shall be synchronized to automatically match designated central server.
   2. Accuracy shall be within 1 second per day.
3. The general purpose DDC Controllers shall have the ability to perform all of the following energy management routines:
   a. Time-of-day scheduling
   b. Calendar-based scheduling
   c. Holiday scheduling
   d. Temporary schedule overrides
   e. Start-Stop Time Optimization
   f. Automatic Daylight Savings Time Switch-over
   g. Night setback control
   h. Enthalpy switch-over (economizer)
   i. Peak demand limiting
   j. Temperature-compensated duty cycling

E. Maintain volatile memory and real time clocks for a period of at least 72 hours during power failure.
   1. Batteries shall be maintenance free and have minimum life of 2 years.
   2. Upon power restoration, the following occurs automatically:
      a. Orderly startup of controlled equipment (user defined)
      b. Continuation of control algorithms
      c. Database revision
      d. Logging of power interruption and restoration times
      e. Battery recharging
   3. Provide local visual indication and system annunciation of low battery power for each battery.

F. The general purpose DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

G. Support firmware upgrades without the need to replace hardware.

H. Communication Speed: Controllers shall communicate at a minimum of 100 – 200 Mbps using Ethernet implemented over EIA-802.3 using a CAT.5 cable at the Data Link Layer.

I. Include a communications port to connect display device for operator access to information and operating system functions.

J. The communication protocols utilized will be Niagara 4 Fox, or latest version of Fox protocol compatible with all existing devices. BACnet TCP/IP, Modbus TCP and SNMP shall be optional. Use of a proprietary communication protocol is not allowed.

PART 3 - EXECUTION

3.1 SUPERVISORY CONTROLLERS

A. Provide Supervisory Controllers as needed to accommodate network architecture and cable design. Floor level network will be by floor only (not floor to floor).

B. Provide communication cards, repeaters, connectors, jumpers, terminals, and other hardware for complete system.

C. Provide all software for a complete system.
D. Coordinate final controller locations prior to installation.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
   A. System includes Digital Controllers for Integrated Automation systems.
   B. Related Sections:
      1. 25 1400 Local Control Units
      2. 25 1423 Field Equipment Panels

1.2 REFERENCES

1.3 DEFINITIONS
   A. AI   Analog Input
   B. AO   Analog Output
   C. DI   Digital Input
   D. DO   Digital Output
   E. Dry Contact  Contact closure without an electrical output (switch)
   F. I/O  Inputs and Outputs
   G. Ma   Milliamps
   H. MS/TP Master/Slave Token Passing protocol used on the EIA-485 network.
   I. NC   Normally Closed
   J. NO   Normally Open
   K. Ohm  Unit of electrical resistance
   L. PID  Proportional Integral Derivative
   M. Setpoint  The goal of any control loop
   N. Stand-Alone  To operate or control without the need for higher level communications
   O. TAB  Test Adjust and Balance
   P. Terminal Equipment  HVAC equipment used for localized or zone control
1.4 SYSTEM DESCRIPTION

A. Microprocessor based, field programmable controllers, include controllers dedicated to monitor and control of specific equipment such as:
   1. Air Handling Units
   2. Air Terminal Units
   3. Laboratory Controllers
   4. Fan Coil Units
   5. Unit Ventilators
   6. Lighting Panels
   7. Pumps
   8. Fans
   9. Remote Dampers
   10. Other miscellaneous equipment

B. Stand-alone controllers, performing specified control sequence independently of other controllers on the structured MS/TP network.

C. Capable of performing control and monitor functions including:
   1. Stand-alone PID control.
   2. Perform specific, standalone control sequences in contract documents.
   3. Accepting voltages, current, thermisters or resistive inputs.
   4. Accepting discrete inputs from isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or normally closed (NC) configuration.
   5. Have isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or
   6. Convert controller information into output signals to actuators and field control devices.
   7. Accepting voltages 0-5 VDC or 0-10 VDC, current (0-20ma or 4-20 mA), thermistors or resistive input (0-1000 ohm).
   8. Maintain setpoints, flow limits, and occupancy schedules, etc. indefinitely in each controller’s non-volatile memory.
   9. Unless otherwise specified, control to within 5% of setpoint.

1.5 QUALITY ASSURANCE

A. Comply with the ANSI/ASHRAE Standard 135-2012.

B. Comply with UL 916.

C. Comply with category UUKL of UL 864 for controlling smoke and fire/smoke dampers.

D. Limit quantity of controllers to 85% of capacity of network or segment. Include any additional hardware required.

E. Mount controllers for easy accessibility within enclosure and outside of air stream.

F. At time of final observation, demonstrate the sequence of operation for each system to Owner.

G. Provide services to assist Testing, Adjust and Balancing of systems.

H. In the event of a loss of communication, all lower controller and components shall revert to occupied mode.
1. Power failures shall cause the control module to go into an orderly shutdown with no loss of program memory.
2. Upon resumption of power, the Control module shall automatically restart and report the time and date of the power failure and restoration.
3. The restart program shall automatically restart affected field equipment.

I. Include spare I/O’s for each major piece of equipment (non-terminal) controlled per the following:
   1. 2 spare AI’s
   2. 2 spare AO’s
   3. 2 spare DI’s
   4. 2 spare DO’s

1.6 WARRANTY
   A. Include:
      1. Software revisions or updates during the warranty period.
      2. Two-year warranty for parts replacement.
      3. Registration and warranty documents and warranty rights to the Owner.
      4. Extended warranties, if necessary, to meet the warranty requirement.
      5. Software and firmware updates which resolve known deficiencies.
      6. 5-year software maintenance agreement.

1.7 OWNER’S INSTRUCTIONS
   A. Refer to Section 25 0800 for requirements.
   B. Provide 8 hours training on Local Control Units.
   C. Provide 4 hours training for TAB contractor prior to start of Test, Adjust and Balance.

PART 2 - PRODUCTS

2.1 FIELD EQUIPMENT CONTROLLERS
   A. Basis of Design – System Edge Controller (SEC)
   B. Must include the following:
      1. Communicate on the local BAS cable system.
      2. Programs and parameters stored in nonvolatile memory.
      3. Access to parameters and program via laptop computer, hand held device or network.
      4. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
      5. The controllers shall be capable of peer-to-peer communications with other SEC’s and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
      6. The communication protocols utilized for peer-to-peer communications between SEC’s will be Niagara 4 Fox, or latest version of Fox protocol compatible with all existing devices. BACnet TCP/IP, Modbus TCP and SNMP shall be optional. Use of a proprietary communication protocol for peer-to-peer communications between SEC’s is not allowed.
      7. The SEC shall employ a device count capacity license model that supports expansion capabilities. Shall support up to 44 IO points (10 on board IO, 34 via expansion module)
8. The SEC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
   a. BACnet
   b. Lon
   c. MODBUS
   d. SNMP

9. The SEC shall be capable of executing application control programs to provide:
   a. Calendar functions.
   b. Scheduling.
   c. Trending.
   d. Alarm monitoring and routing.
   e. Time synchronization.
   f. Integration of LonWorks, BACnet, and MODBUS controller data.
   g. Application specific and custom control algorithms.

10. The SEC shall provide the following hardware features as a minimum:
    a. Two 10/100 Mbps Ethernet ports. The SEC shall include two Ethernet ports that are capable and by default will route data between the two ports to allow for daisy chaining.
    b. Isolated RS-485 port
    c. 512 MB DDR SDRAM
    d. 2GB total eMMC flash storage
    e. High Speed Field Bus Expansion
    f. -20-60°C Ambient Operating Temperature
    g. Integrated 24 VAC/DC Global Power Supply
    h. Employ Encrypted Safe Boot Technology
    i. 5 Universal inputs: Type 3 (10K) thermistors, 0-100K ohm, 0-10VDC, 0-20mA with external resistor, Dry Contact
    j. 2 Analog outputs: 0-10VDC, 4mA max output current
    k. 3 Digital outputs: Triac, 24VAC @.5 amp
    l. Option 34 IO expansion module- Niagara IO-R-34

11. The SEC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

12. The SEC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.

13. The SEC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
    a. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
       1) Alarm.
       2) Return to normal.
       3) To default.
    b. Alarms shall be annunciated in any of the following manners as defined by the user:
       1) Screen message text.
       2) Email of complete alarm message to multiple recipients.
       3) Pagers via paging services that initiate a page on receipt of email message.
       4) Graphics with flashing alarm object(s).
    c. The following shall be recorded by the SEC for each alarm (at a minimum):
1) Time and date.
2) Equipment (air handler #, access way, etc.).
3) Acknowledge time, date, and user who issued acknowledgement.

14. Programming software and all controller "Setup Wizards" shall be embedded into the SEC.
15. The SEC shall support the following security functions.
   a. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
   b. Role-Based Access Control (RBAC) for managing user roles and permissions.
   c. Require users to use strong credentials.
   d. Data in Motion and Sensitive Data at Rest be encrypted.
   e. LDAP and Kerberos integration of access management.
   f. Secure Boot technology
16. The SEC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
   a. Metadata: Descriptive tags to define the structure of properties.
   b. Tagging: Process to apply metadata to components
   c. Tag Dictionary
   d. Niagara Analytics
17. The SEC shall employ Niagara template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms that are set to be deployed as a unit based upon manufacturer’s controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD…) shall have an associated template file for reuse on future project additions.
18. SEC shall be based on Niagara compatible JACE hardware and Niagara 4, or higher, software platform.
   a. The latest Niagara 4, or higher, revision shall be used.
19. Applications include but are not limited to the following:
   a. Air Handling Units
   b. Large Unit Ventilators
   c. Large Fan Systems
   d. Other system specific control

2.2 AIR TERMINAL CONTROLLERS

A. Must include the following:
   1. Programs and parameters stored in nonvolatile memory.
   2. Access to parameters and program via laptop computer, hand held device or network.
   3. Integral actuator for air volume control (if available).
   4. Prevent overlapping of heating and cooling setpoints.
   5. Maintain airflow calibration without disrupting airflow.
   6. Include Analog Output for reheat control where applicable.

B. Applications include:
   1. Air terminal boxes
   2. Terminal Reheat Coils
   3. Other zone-specific control

C. Performance Requirements:
1. Min. Actuator Torque 35 in-lb
2. Min. Operating Temperatures 40 to 120 Deg F
3. Min. Operating Humidity 10 to 90% RH
4. Maintain Airflow +/- 5%
5. Maintain Zone Temperature +/- .5 Deg F

2.3 UNITARY EQUIPMENT CONTROLLERS

A. Must include the following:
   1. Communicate on the local BAS cable system.
   2. Programs and parameters stored in nonvolatile memory.
   3. Access to parameters and program via laptop computer, hand held device or network.

B. Applications include:
   1. Fan Coil Units
   2. Unit Conditioners
   3. Heat Pumps
   4. Simple Unit Ventilators
   5. Small Fans
   6. Floor Static Control stations
   7. Other unit specific control

C. Performance Requirements:
   1. Min. Operating Temperatures 40 to 120 Deg F
   2. Min. Operating Humidity 10 to 90% RH
   3. Maintain Airflow +/- 5%
   4. Maintain Zone Temperature +/- .5 Deg F

PART 3 - EXECUTION

3.1 FIELD EQUIPMENT CONTROLLERS

A. Provide controllers to accomplish monitoring and control of systems

B. Provide additional miscellaneous equipment necessary for complete system control.

C. Provide factory mounting in appropriate enclosures per Section 25 1423.

D. To ensure stand-alone capability, provide a controller for each equipment (or group) such as Air Handling Unit, Heating Hot Water, Chilled Water, Exhaust Systems, etc.

3.2 AIR TERMINAL CONTROLLERS

A. Provide Air Terminal Controllers to accomplish sequences for zone specific air terminal equipment including:
   1. Supply Air Terminals
   2. Return Air Terminals
   3. Exhaust Air Terminals
   4. Reheat Coils
B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.

C. Provide coordination such as shipping, scheduling, and technical support for Air Terminal factory mounting and proper operation.

D. To ensure stand-alone capability, provide a controller for each terminal or fan coil unit.

E. Coordinate power requirements with Mechanical Specifications.

3.3 UNITARY EQUIPMENT CONTROLLERS

A. Provide Unitary Equipment Controllers to accomplish sequences for zone specific air terminal equipment.

B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.

C. Provide factory mounting in appropriate enclosures per Section 25 1423.

D. To ensure stand-alone capability, provide a controller as needed for miscellaneous equipment.

END OF SECTION
SECTION 25 1423
FIELD EQUIPMENT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Control panel requirements for Integrated Automation Systems
B. Related Sections
   1. 25 0553 - Identification
   2. 25 1400 - Local Control Units

1.2 REFERENCES

A. NEMA 1 General Purpose - for use in dry indoor locations.
B. NEMA 4 Watertight - for use in locations where subjected to direct water spray and outdoors

1.3 DEFINITIONS

A. Rung – Logical decision resembling the rung of a ladder within a ladder logic diagram.
B. Wiring Duct – Pathway for wire management inside of panels.
C. Wiring Trough – Wiring enclosure used to manage wiring outside of panels.
D. Refer to section 25 0000 for additional definitions.

1.4 SYSTEM DESCRIPTION

A. Field equipment panels include, but not limited to control panels for:
   1. Air Handler systems
   2. Chiller systems
   3. Boiler systems
   4. Exhaust Fan systems
   5. Pumping Systems
   6. Miscellaneous systems
   7. Monitoring systems
B. Enclosures for all controllers and instruments except those furnished by equipment manufacturers for factory mounted controls.

1.5 SUBMITTALS

A. Submit control panel fabrication drawings including: back-panel layout, panel face arrangement, panel name, and panel tag number (if applicable) prior to fabrication or device installation.
   1. Drawings shall show operator interface configuration on panel face and device locations on back-panel. Also include panel tagging schedule or identification detailing nameplate text and size.
   2. Include panel power schematic showing power sources and protection device capacity.
   3. List manufacturer supplied devices in bill of material table.
B. Submit schematic and wiring interconnection drawings in ladder format. Include rung numbers. Number relays with rung number.
   1. Each relay function shall be fully described to right of relay right rung. Each relay contact location shall be referenced at coil location.
   2. Each contact shall have associated coil reference and shortened description of coil function. Each contact shall have relay pin-out identifiers.
   3. Wire colors and designators shall be identified.
   4. Terminal blocks shall be uniquely identified. Field and panel wiring shall be differentiated by solid line for panel and dashed line for field.
   5. Each connection to field device or other remote panel shall be identified.

1.6 QUALITY ASSURANCE

A. Include instrument/equipment tag numbers, when available, on submittal documents whenever specific component appears.

B. Install panels according to manufacturer's instructions.

C. Space wire-ways and terminal strips 3" apart.

D. Locate terminal strips either horizontally in upper half of back panel or vertically. Do not locate terminal strips below 2'-0" or above 6'-6" above finished floor.

E. Separate 24 VDC and 120 VAC terminal strips, wire, cable, and devices by 6" minimum space.

F. Provide terminal strips for total controller I/O count plus 20% spare capacity with analog and discrete spare capacity calculated separately.

G. Size raceway to maximum fill of 40% per NEC.

H. Space controllers according to manufacturer's requirements with 3" minimum between controllers and other devices on back panel and 6" between controller front and door mounted devices. Ensure adequate space is allowed for device heat dissipation.

I. Ensure interior temperature of enclosure to 80°F maximum.

J. Do not place controller or control devices on enclosure sides.

K. Provide 25% minimum spare capacity of panel space, spare controller chassis space, wiring duct space, and terminal blocks to allow for future expansion by adding I/O cards and associated cabling.

L. Locate panels adjacent to equipment served with minimum of 3 ft clearance in front of door. Provide sufficient clearances to allow full door swing and full access to internal components. Remote mounted panels are acceptable where accessibility will be significantly improved.

M. Mount top of panels between 5 and 6 ft above floor so that gauges and indicators are at eye level.

N. Route and terminate wiring parallel and at right angles within panels.

O. Terminate power within 4 inches of panel entrance.

P. Refer to section 25 0000 for additional requirements.
PART 2 - PRODUCTS

2.1 ENCLOSURES

A. Manufacturer: Hoffman, Hammond Manufacturing or approved equal.

B. Construction:
   1. Minimum 14gauge steel
   2. Hinged door
   3. Include inner panel
   4. ANSI 61 external powder paint finish
   5. Cylinder locks and master 4 master keys for all panels less than 8 foot above finished floor
   6. Include print pockets on enclosure doors
   7. Miscellaneous steel components, e.g. standoffs, shall be 12gauge minimum rolled steel

2.2 WIRING DUCT

A. Manufacturers: Panduit, Tyton, or approved alternate.

B. Construction:
   1. Slotted plastic or vinyl (PVC)
   2. Grey or white
   3. Snap-on covers

2.3 WIRING TROUGH

A. Manufacturer: Hoffman, Hammond Manufacturing or approved equal.

B. Construction:
   1. Minimum14 gauge steel
   2. Unpainted galvanized finish
   3. Flat cover

2.4 AC POWER SUPPLIES

A. Transformers for use with digital controllers, actuators, etc.
   1. Input Power: 120 VAC to 480 VAC
   2. Output Power: 24 VAC
   3. Minimum capacity 40 VA

PART 3 - EXECUTION

3.1 ENCLOSURES

A. Enclosures for all controllers and instruments except those furnished by equipment manufacturers for factory mounted controls.

B. Provide NEMA type 1 enclosures for dry indoor locations.

C. Provide NEMA type 4 control panel enclosures in outdoor locations or indoor locations (including maintenance spaces) where water damage is possible.
D. Label enclosures with respective unique ID numbers in accordance with section 25 0553.

E. Mount local control panels at convenient locations adjacent to and independent of equipment served. Install control panels in locations as shown on drawings and with proper clearance.

F. Mount cooling devices, receptacles and incandescent lights (if applicable) on enclosure sides.

G. Mount top of panels between 5 and 6 ft above floor. Mount panels at consistent height.

H. Provide control panels where more than one control device requires field mounting.

I. Instrument mounting:
   1. Ensure connections can be easily made and ample room exists for servicing each item. Every component in and on enclosures shall be able to be removed individually without affecting other components and without the need to move other components.
   2. Install devices prior to terminating wire or tubing.
   3. Rigidly attach instruments with properly sized stainless-steel screws or bolts so they may be removed.
   4. Do not install instruments on panel sides, except for cooling devices, receptacles, and lighting, devices.
   5. Provide gaskets for instruments penetrating panel exterior and seal in accordance with NEMA standards. Entire enclosure shall meet NEMA standard after installation of required devices.

J. Knockouts:
   1. Distortion of panels is not permitted as a result of machining cutouts or mounting instruments and devices.
   2. Cutouts shall be smooth and without irregularity from desired shape.
   3. Flame cutting or arc-cutting is not permitted.
   4. Align knockouts, sub-panels, and drilling for mounting to keep devices grouped and in vertical and horizontal alignment.
   5. Provide rubber grommets in cutouts for wiring or tubing to prevent chaffing or scarring of insulation or jacketing of wiring or tubing.

K. Mounting fasteners:
   1. Minimum size for panel fastening anchors shall be 9/16" for floor anchors and 3/8" bolt for wall anchors. Increase anchor sizes as required for heavy panels.

L. Floor Mounted Panels:
   1. Unless otherwise specified, install floor mounted control panel(s) on four 4" concrete equipment pad(s) with grout as required.
   2. Install two (2) anchors for each four (4) feet of equipment length or minimum of four (4) anchors. Decrease anchor spacing for heavy panels as required. Bolt equipment to pad using cap screws and washers.
   3. Do necessary grouting after equipment is installed and leveled. Grouting material shall be Owner approved cement grout; mixed and placed in accordance with manufacturer's recommendations. Remove leveling shims and wedges after grout has hardened. Re-grout Shim and wedge areas after shims or wedges are removed.

M. Wall Mounted Panels:
   1. Provide one anchor for every 4'-0" of outside perimeter for wall mounted panels; minimum anchors for wall mounted panels shall be 4. Decrease anchor spacing for heavy panels as required.
2. Provide clear space for dressing out wiring, cables and tubing entering panel. Provide 4”x2
unrestricted clear space for each inch of conduit size or each square inch of wiring duct size,
with 4” x 4” being minimum area, in alignment with entering conduit or wiring duct, for bringing
wiring into panel and routing to other locations. This space shall be sufficiently accessible to
enable pulling wiring, cables, or tubing into panel for termination with initially installed
equipment in place.

N. Lifting Lugs:
1. Remove lifting lugs after panels are set and use short, full-thread, hex-head machine screws
to fill lug holes.

O. Pneumatic Tubing
1. Do not splice tubing within panel. Use bulkhead bars for circuit extensions.
2. Mount tubing so that tubing run(s) do not interfere with removal of components.
3. Terminate interior pneumatic components to bulkhead bars. Terminate incoming tubing to
these bulkheads.
4. Install tubing along vertical or horizontal runs to present neat appearance. Angled runs are
not allowed.
5. Label pneumatic tubing.

3.2 WIRING DUCT
A. Install wiring duct along vertical or horizontal runs to present neat appearance.
B. Permanently fasten wire duct into sub-panels using 10/32 screws.
C. Support lower sidewall on horizontal runs of plastic wiring duct with bracing to avoid sagging.
D. Install wiring between devices and terminal blocks in wiring duct except for dressing out to make
terminations.
E. Wiring duct fill shall not exceed 40% of wiring duct volume.
F. Provide labels on wiring duct designating AC and DC wiring.

3.3 WIRING TROUGH
A. Provide wiring trough above or parallel to field control panels.
B. Route wiring through wire trough to minimize wire tension and allow re-routing of wire when
necessary.

3.4 AC POWER SUPPLIES
A. Provide transformer with a means of disconnect.
B. Locate transformer in panel to minimize 120V power wiring inside panel (upper left or upper right
side of panel).

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes software requirements for the following:
   1. Operator Workstation
   2. Network or Building level controllers
   3. Application Specific or Terminal level controllers
   4. Communication analyzer

B. Related Work
   1. 25 1300 Control and Monitoring Network
   2. 25 1400 Local Control Units

1.2 REFERENCES


1.3 DEFINITIONS

A. Access          Process or effort to communicate to system
B. AutoCAD         Computer Aided Design software
C. Communication Analyzer Software tool used to troubleshoot communication problems
D. Firmware        Hardware imbedded with software
E. Hardware        Physical components of a system
F. License         Permit, rights and restrictions for legal use and access of software and applications
G. Patch           Software upgrade typically to correct known problems
H. Software        Program
I. Stand Alone     Control without the need for communications

1.4 SYSTEM DESCRIPTION

A. Provide all required system software to support an existing server/client architecture, designed around the open standards of web services.

B. Software
   1. Software shall be compatible and integrate with Building Management System.
   2. Includes project specific programming such that any of the following may be performed simultaneously on-line, and in any combination, via the browser interface:
C. Licenses
   1. Complete set of product licenses for systems and third-party software used in system
development, including documentation for all applications, databases, browsers,
communications software etc.
   2. Owner shall be the named license holder of all software.

D. Alarms
   1. Coordinate with Owner all alarm message requirements and guidelines.

E. Security Access
   1. Access control via user defined passwords for system operation.
   2. Minimum of 3 access levels.
   3. Campus Access Security: Communications between any campus Web browser and the BAS
server shall be encrypted using 128-bit encryption technology within Secure Socket Layers
2 (SSL 2).
   4. Allow authorized users complete access to the system via a web browser.
   5. User security access from any web browser PC/PDA to the BAS controllers or server shall
require both a Login Name and password.

F. Communication Analyzer for network troubleshooting.

1.5 SUBMITTALS

A. Software Manual including:
   1. System overview
   2. Describe operating procedures
   3. Software command descriptions
   4. Password management
   5. Control program functions

B. Data sheet for each software program used.

C. Provide all product licenses including:
   1. System software
   2. Documentation for all third-party software

1.6 QUALITY ASSURANCE

A. Provide most current revision of software.

B. Operator workstation software, project-specific software, graphic software, database software,
and firmware updates which resolve known software deficiencies as identified by this Contractor
shall be provided at no additional charge during the 2-year warranty period.

C. Static IP addresses shall be provided by the Project Owner and not assigned by the Contractor.

D. All BACnet Network/Instance Numbers shall be provided by the Project Owner and not assigned
by the contractor unless approved by the Project Owner.

E. JACE units shall be open license type and the license shall never expire.

F. Network controls shall include a lifetime license for free software updates/upgrades.
G. Software licensing shall have no restrictions on which brand of server software or programming tools that can interact with the system. Station and tool compatibility must be universal with connectivity restrictions.

H. When suitable, BACnet standard network communications shall be configured for COV reporting to minimize network traffic.

I. Obtain Project Owner approval before connecting new networks with existing networks.

J. Coordinate other system requirements with Project Owner.

1.7 WARRANTY

A. Install software upgrades, patches, and protocol fixes. Contractor shall provide verification to Project Owner that all updates/upgrades have been installed and tested in accordance with site testing and deployment procedures.

1. If the firmware version for a new project or firmware upgrade for an existing building BAS causes the need to upgrade or reconfigure/reprogram existing systems, controllers or software. Contractor shall notify the Project Owner prior to upgrade and provide additional work scope requirements in coordination with other Contractors, as required, at no cost to the Project Owner.

B. During the warranty period, the Contractor shall maintain a backup of all software installed in the system. The backup shall be updated monthly or whenever the Contractor makes a change to the software. A reload of backup software into the system shall be performed by the Contractor immediately upon notification by the Project Owner. The reload shall be free of charge.

1.8 OWNER’S INSTRUCTIONS

A. Provide 32 hours of off-site training by factory trained instructor for 4 people. Include travel and hotel accommodations.

B. Provide an additional 24 hours of on-site training by factory trained instructor of owner specific subject, after 6 months of occupation and prior to end of warranty.

C. Coordinate and schedule training with Owner.

PART 2 - PRODUCTS

2.1 PLATFORM (TRIDIUM NIAGARA N4)

A. Provide access and control to Integrated Automation System.

B. Allow standard web-browsers for access to Integrated Automation Systems.

C. Include real time control of system interactions.

D. Provide database information requests/transfers by system hardware or by operators.

E. Include uninterrupted real time clocks capable of time of day, week, and year information to the system as needed to perform software functions.

F. Allow for Daylight Savings Time.

G. Synchronize with BAS network.

H. Contain a HELP function key.
I. Database management.
   a. Point values
   b. Controlled variables
   c. Setpoints
   d. Tuning parameters
   e. New hardware and software points.
   f. Online modifications
   g. Error detection, correction, re-transmission of database values, arithmetic or logical faults

J. Alarm management.
   a. Perform enhanced alarm analysis
   b. Buffering alarms in order of importance
   c. Filtering to minimize operator interruptions
   d. Messages
   e. Routing
   f. Parameter modification

K. Trending management.
   a. Creating
   b. Modifying
   c. Deleting

L. Field controller loop tuning.

M. Enable and Disable control loops.

N. Integration Capabilities multiple building functions including:
   a. Equipment supervision and control
   b. Alarm management
   c. Energy management
   d. Access control
   e. Information management
   f. Historical data collection and archiving

O. Simulation software
   a. Ability to view the logic execution in a step approach
   b. Ability to view the logic in real time for easy diagnosis of the logic execution
   c. Imbedded comment section
   d. Boolean Logic
   e. Ability to view the logic in a monitor mode
   f. Modular custom and standard applications

2.2 CONTROLLER CONFIGURATION TOOLS

A. Software used to configure and commission controllers.

B. Compatible with operating system.

C. Capable of communication via Ethernet network.
D. Communication Analyzer.

2.3 BUILDING LEVEL CONTROLLERS

A. Appropriate functionality to accomplish monitoring and control of system.
B. Provide security by allowing assignment of a minimum of 50 passwords for access and control priorities to each controller point individually.
C. Capable of monitoring the status of all overrides and inform the operator that automatic control has been inhibited.
D. Alarm or point change reports shall include the point’s English language description and the time and date of occurrence.
E. Contain self diagnostics that monitor panel operation.
F. Store trend and history data until uploaded to hard disk storage archival volume as required ensuring no data is lost.
G. Perform the following energy management routines
   1. Automatic Daylight Savings Time Switch-over
   2. Night setback control
   3. Enthalpy switch-over (economizer)
   4. Peak demand limiting
   5. Temperature-compensated duty cycling
   6. Runtime accumulation
   7. Allow for comment lines for sequence of operation explanation

2.4 APPLICATION SPECIFIC AND MULTI-EQUIPMENT APPLICATION CONTROLLER

A. Stand alone control capability.
B. Allow access to the controller's application parameters via standard Microsoft compatible laptop computer plugged in to the room temperature sensor.
C. Includes a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
D. Include time delays between successive start commands to heavy electrical loads (user selectable).
E. Returns equipment to normal operation upon power restoration.
F. Perform the following algorithms:
   1. Two-position control
   2. Proportional, integral, plus derivative control
   3. Automatic tuning of control loops
   4. Floating control

PART 3 - EXECUTION

3.1 GENERAL

A. Provide latest software compatible with automation system.
B. Provide available upgrades, patches, etc. up to substantial completion date.
C. Coordinate system requirements with owner.

3.2 CONTROLLER CONFIGURATION TOOLS
A. Provide software for configuration of controllers.
B. Provide network cards, cables and other accessories necessary for operation.
C. Simulation software
   1. Provide programming for the system and adhere to the sequences of operation provided.
   2. Imbed into the control program sufficient comment statements to clearly describe each section of the program.
   3. Document all programming in the form of a logic flowchart.
   4. Provide actions for all possible situations.
   5. Programming shall be modular and structured.

3.3 BUILDING LEVEL CONTROLLERS
A. Provide software as utilized for complete operating system.
   1. Include building level controller software for engineering and application modifications.
   2. Include software data/configuration files for each separate controller, programming code and documentation.
B. Provide a software data/configuration files for each separate controller.

3.4 APPLICATION SPECIFIC AND MULTI-EQUIPMENT APPLICATION CONTROLLER
A. Provide software as utilized for complete operating system.
   1. Include software for engineering and application modifications.
   2. Include software data/configuration files for each separate controller, programming code and documentation.
B. Provide a software data/configuration files for each separate controller.

END OF SECTION
SECTION 25 1523
GRAPHICS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes the graphic requirements for Integrated Automation System
B. Related Work
   1. 25 1500 Software

1.2 SYSTEM DESCRIPTION
A. Provide software and labor for graphical representation of all systems connected to the Integrated Automation System.
B. Show all hardware points, setpoints, integrated points as shown in drawings and as need to proper control and monitor systems.
C. Include floor plans showing locations of sensors, equipment, panels, etc. Point descriptions and units shall be as defined in documents.
D. Optimize graphical representations to maximize information such as descriptions, points, units, etc.
E. Graphics shall be compatible with manufactures software platform and Engineer's AutoCAD software and existing site map.
F. Coordinate additional graphics requirements with Owner.
G. Provide 2D color graphics. Graphics to have consistent use of colors, units, symbols and descriptions. Include the following:
   1. Text description
   2. Calculated and shared points
   3. Integrated points
   4. Associated points, including dynamic input values, output values, set points, gains, time schedules, etc.
   5. System schematic or picture
   6. Alarm fields
H. Minimum Performance:
   1. Display all points within 10 seconds.
   2. Refresh all points every 15 seconds.
I. Include the following:
   1. Integrated systems
      a. Legend page
      b. Communication risers
      c. Communication status of systems
2. Provide system graphics such as:
   a. AHU, FCU, and ATU
   b. Exhaust
   c. Chilled Water system
   d. Heating Hot Water system
   e. Utilities
   f. Plumbing
   g. Power Monitoring
3. Site Plan
   a. Utilities
   b. Lighting
   c. Weather conditions
   d. Allow penetration to floor plans graphics
4. Floor Plans
   a. Coordinate with as-built drawings to include
      1) Room name and numbers
      2) Column numbers
   b. Identify
      1) HVAC zones by AHU
      2) HVAC rooms served by single space sensor
      3) Fire Zones
   c. Allow penetration to associated system graphic
5. Additional floor plan requirements include
   a. Automated Temperature Controls system
   b. Fire Alarm system
   c. Security system
   d. Lighting system
   e. Plumbing system
   f. Color coded temperature and/or pressure zones
   g. Color coded alarms
   h. Small key plan for partial floor plans
6. Dashboards
   a. Facility weather
   b. Facility cost per hour
   c. Facility alarms
   d. Facility utility usage
7. Dynamic Risers
   a. System service and status
   b. Hardware service and status
8. Summaries:
   a. Alarms
   b. Overrides
   c. Transactions
   d. AHUs
e. Terminal Units
f. Exhaust

J. Coordinate with Owner prior to installation of graphics.

K. Provide organized hierarchy
   1. Provide penetration from main page down to instrument level using mouse point and click feature.
   2. Provide penetration from instrument level back up to main page level using mouse point and click feature.
   3. Provide links from sub-systems to main systems such as
      a. Air terminal shall have a link to associated AHU, lighting, etc.
      b. AHU shall have a link to cooling, heating, exhaust, energy recovery, etc.
      c. Labs shall have a link to supply and exhaust systems.
      d. Rooms shall have a link to floor plan.
   4. Provide links to the following:
      a. Vendor control as-builts
      b. Equipment schedules
      c. Mechanical plans
      d. Network layout

L. Organize system data such that:
   1. Inputs and outputs points on graphics are relative to actual field locations.
   2. Locate control loop setpoints close to controlled loop variable.
   3. Locate commanded points close to feedback.
   4. Locate global information in upper left corner of the screen.

1.3 SUBMITTALS

A. Provide submittals for each unique graphic.

B. Sample proposed Graphics systems including:
   1. Air Handling system
   2. Air terminal unit
   3. Floor plan
   4. Hydronic System
   5. Energy Wheel

C. Sample proposed Graphics status pages including:
   1. Area status pages
   2. Group status pages
   3. Overview pages

1.4 OWNER’S INSTRUCTIONS

A. Provide an additional 8 hours of on-site training by factory trained instructor after 6 months of occupation and prior to end of warranty.

B. Coordinate and schedule training with Owner.
PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 GENERAL

A. Every graphic screen to show current outdoor air conditions, date and time information at bottom of the page.
B. All control points shown on as-built control drawings will be indicated on equipment graphics.
C. For all equipment graphics, provide free text space (chalk board) for operator to document notes.
D. All analog inputs will have their corresponding setpoints displayed on the equipment graphic.
E. When the input values are outside their respective setpoints their indicator cells will turn red to show the user that the reading is in alarm mode.
F. The user will be allowed to override all setpoints and settings.
G. Link database graphic objects with associated product specification data sheet.

3.2 LEGEND PAGE

A. Include color coding intent of the graphics and instructions to help the operator with various viewing commands.
B. Include links to home screen, previous screen and site map in the top left corner.

3.3 DASHBOARD

A. Provide overview of the building energy consumption and building pressurization.
B. A picture of the building will appear in the left-hand corner of the screen. The picture will not act as an active link. Under the building picture, provide links to floor plans, building systems and performance graphics as below:
   1. Floor plans
   2. Air Systems
   3. Water Systems
   4. Miscellaneous Systems
   5. Key Performance Indicators
   6. Measurement and Verification
C. Provide an alarm bell as an indicator and an active link. Bell will have one of two colors – green or red. Green color will inform the user that all building systems are operating normally, while red color will notify the user that there are systems within the building which are in alarm mode. The alarm bell red color activation will be adjustable per user preference to trigger only if high priority alarms exist in the building. Provide a direct link to alarm management screen.
D. Provide building pressurization indicator to show the building pressure with respect to outdoor. The bar indicator will be divided into green and red area, with green representing positive building pressure and red as negative pressure. The numerical indicator cell below the bar will display
current building pressure as reported by the building differential pressure sensor. If more than one DP sensor serves the building, the cell will display the worst case differential pressure.

E. Show energy consumption gauges and indicator to display current energy consumption for each measured utility. The gauges scale and resolution will be adjusted to correspond to peak design conditions. The indicator arrows will show the same value as displayed in a cell below the gauge.

F. Top left-hand corner of the screen will have two links to previous screen and site map.

3.4 FLOORPLANS

A. When a link to a particular floor is selected, the screen will show an overall floor plan view divided into sections, where necessary, to view room numbers and sensors. The floor plan will accurately represent the as-built layout of rooms in the building.
   1. If partial floor plan sections should require, they shall be based on the zoning relative to the system serving the area being viewed where possible or the floor plan to be divided in equal parts.
   2. Each section to actively inform user of any alarm conditions within the section by changing from green to red background color.

B. Each section shall have a link to take the user to a more detailed floor plan screen. In the bottom left hand corner of the screen are links to other floors arranged in a tree. The links to indicate alarm conditions present on each floor.

C. The floor plan section screen to show layout in more detail with room numbers and sensors displaying room environmental conditions.
   1. Each sensor acts as a link to the corresponding room. Room background color to be green under normal operation and red when any of the analog or binary inputs are outside their alarm limits.
   2. The bottom left hand corner of the screen to feature links to different floors described previously as well as a picture of the sectioned view of the overall floor plan.
   3. Each section acts as an indicator and a link. When any room is in alarm mode in, that section turns red, otherwise it remains green. The user can move between section screens by selecting the appropriate link. Room thermostat graphic shall be provided with link to the associated system.

3.5 AIR SYSTEMS

A. AIR HANDLING UNITS
   1. AHU screen will show equipment tag and overview of the system.
   2. Following additional information will be included as applicable:
      a. Cooling and economizer mode setpoints
      b. Mode of Operation including dehumidification mode, economizer mode
      c. Economizer run time (reset per day)
      d. Average ATU damper position served by AHU
      e. ATU driving AHU's Static Pressure Reset Setpoint
      f. Total airflow CFM derived by adding airflows associated with all ATUs served by AHU
   3. Damper statuses will be indicated by indicator cell and dynamically by making the damper blades move close when damper is closed and open when damper is open.
   4. Fan status will be shown by dynamically spinning the fan wheel when the fan is ON, when fan is OFF the fan wheel will not spin. When fan is in alarm, the fan wheel color will be red.
   5. Fan operating kW will be indicated next to fan icon.
6. When AHU is equipped with fan array, the number of fans will be shown next to the fan icon. An alarm point shall be added to indicate alarm condition when fans are commanded ON but indicate an OFF condition.

7. VFD box above the fan will provide the user with active links to variable frequency drive integrated points.

8. Fan VFD command cell will display the speed of the drive in 0-100%. If the VFDs are allowed to exceed 60Hz during normal operation, 100% will correspond to the maximum speed the VFD is allowed to go to.

9. Cooling and heating coil valve command indicator cells will display the % open amount of valve full span. Chilled water returning from the cooling coil will have its temperature displayed in the indicator cell.

10. Filter status will be indicated in the cell and shall flash red when in an alarm state.

11. Low temperature alarm, high static alarm and smoke alarm indicator cells will have a green background and display “Normal” when in normal mode. During alarm mode, the cell background color will change to red and display will read “Alarm”.

12. UV lights status indicator cell will indicate “On” or “Off” according to the status of the lights.

B. AIR TERMINAL UNITS

1. Air terminal unit graphic will indicate equipment tag along with room number in parentheses.

2. Supply airflow sensor will have the airflow and min/max airflow setpoints listed.

3. Zone temperature will be listed with associated heating and cooling setpoints. If the temperature deviates outside those setpoints, the point will go into alarm mode.

4. Show a setpoint list block that will act as a link to all settings not displayed on the screen.

5. Provide links to associated as-built reference information at the bottom of the page.

6. For laboratory air terminal equipment such as air valves, graphics shall include all valves (with their respective tags displayed on their icons), per as-built drawings.

C. EXHAUST SYSTEM

1. Exhaust fan screen title will show the equipment tag.

2. Following additional information will be included as applicable:
   a. Average ATU position served by EF system
   b. ATU driving EF’s Static Pressure Reset Setpoint
   c. Total airflow CFM derived by adding airflows associated with all ATUs served by EF

3. Fan status will be shown by dynamically spinning the fan wheel when the fan is ON, when fan is OFF the fan wheel will not spin. When fan is in alarm, the fan wheel color will be red.

4. Indicator cell displaying fans lead-lag listing will be shown below each fan, as the fan rotation occurs, the indicator cells will display updated lead lag status in each cell.

5. Fan operating kW will be indicated next to fan icon.

6. Where bypass dampers are present, damper status will be indicated by indicator cell and dynamically by making the damper blades move close when damper is closed and open when damper is open.

7. Where fan is provided with a VFD, command cell will display the speed of the drive in 0-100%. If the VFD is allowed to exceed 60HZ during normal operation, 100% will correspond to the maximum speed the VFD is allowed to go to.

8. Low static alarm indicator cells will have a green background and display “Normal” when in normal mode, during alarm mode the cell background color will change to red and display will read “Alarm”.

D. LAB SYSTEM
1. When user selects a link to a lab space, the graphic link will bring up a room showing fume hoods and relevant air valves depending upon the lab layout.

2. The screen title block will list all the room number with the air valves listed in parentheses.

3. The air change rate information shall be calculated and based on the room volume and the air flowing in or out of the room. Positive rooms shall use the total supply and negative rooms shall use the total exhaust.

4. Zone temperature will be listed with associated heating and cooling setpoints. If the temperature deviates outside those values the point will go into alarm mode.

5. Graphics will show sash positions, alarms and hibernate mode status.

6. Provide a floor-based summary of all fume hoods with their sash position, alarm and hibernate mode status.

3.6 WATER SYSTEMS

A. CHILLED WATER SYSTEM

1. Chilled water system screen title will show the system name.

2. Chiller water system graphic will include all relevant components such as chillers, primary/secondary pumps, cooling towers etc.
   a. Picture of each equipment to closely resemble actual piece of equipment in the field.
   b. Chiller picture or tag shall be provided with an active link to take the user to a more detailed interface showing internal chiller control points.

3. Provide indicator cells to display status and position of relevant valves in the system such as isolation valves, bypass valves etc.

4. Where applicable, provide dynamic representation of equipment statuses such as chillers, towers, pumps etc. to indicate whether a particular piece of equipment is ON or OFF.
   a. Pump status will be shown by dynamically spinning the impeller wheel when the pump is ON, when pump is OFF the impeller wheel will not spin. When pump is in alarm mode, the impeller wheel color will turn red.
   b. Pump operating kW will be indicated next to the pump icon.
   c. Where pump is provided with a VFD, VFD box above the pump will provide the user with active links to variable frequency drive.
   d. Indicator cell displaying pumps lead-lag listing will be shown below each pump, as the pump rotation occurs, the indicator cells will display updated lead lag status in each cell.

B. HEATING HOT WATER SYSTEM

1. Heating hot water system screen title will show the system name.

2. Heating hot water system graphic will include all relevant components such as boilers, primary/secondary pumps etc.

3. Picture of each equipment to closely resemble actual piece of equipment in the field.

4. Provide indicator cells to display status and position of relevant valves in the system such as isolation valves.

5. Where applicable, provide dynamic representation of equipment statuses such as boilers, heat exchangers, pumps etc. to indicate whether a particular piece of equipment is ON or OFF.
   a. Pump status will be shown by dynamically spinning the impeller wheel when the pump is ON, when pump is OFF the impeller wheel will not spin. When pump is in alarm mode, the impeller wheel color will be red.
   b. Pump operating kW will be indicated next to the pump icon.
   c. Where pump is provided with a VFD, VFD box above the pump will provide the user with active links to variable frequency drive.
d. Indicator cell displaying pumps lead-lag listing will be shown below each pump, as the pump rotation occurs, the indicator cells will display updated lead lag status in each cell.

3.7 MISCELLANEOUS SYSTEMS

A. VARIABLE FREQUENCY DRIVE
1. Upon activation of a VFD link on any of the equipment screens the user will be directed to the VFD display screen. The name of the equipment will be displayed in the title block of the screen. If the piece of equipment has backup VFD, the name will appear in the title block.
2. The picture of the VFD will show the actual piece of equipment installed in field.
3. All available analog and binary inputs will be shown with appropriate names and units. When VFD is offline all the indicator cells will turn black.
4. Fan or pump status will be derived from the output power reading.

3.8 KEY PERFORMANCE INDICATORS

A. Key Performance Indicators (KPI) will be configured and trended at Building Automation System at 15 min intervals.

B. Provide the following data points for each of the KPIs shown below, Current Value, Previous Month Value, Previous Year Value (Current Month), and Benchmark Data.

C. The KPI Graphics shall include the following:

<table>
<thead>
<tr>
<th>Key Performance Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPI</td>
</tr>
<tr>
<td>TOTAL BUILDING ENERGY AND WATER</td>
</tr>
<tr>
<td>MEASURED ENERGY USE INTENSITY (EUI)</td>
</tr>
<tr>
<td>MEASURED WATER USE INTENSITY (WUI)</td>
</tr>
<tr>
<td>PRIMARY UTILITY METRICS</td>
</tr>
<tr>
<td>ELECTRICITY TOTALIZED</td>
</tr>
<tr>
<td>ELECTRICITY PEAK</td>
</tr>
<tr>
<td>NATURAL GAS TOTALIZED</td>
</tr>
<tr>
<td>NATURAL GAS PEAK</td>
</tr>
<tr>
<td>DISTRICT HEATING TOTALIZED</td>
</tr>
<tr>
<td>DISTRICT HEATING PEAK</td>
</tr>
<tr>
<td>DOMESTIC COLD WATER TOTALIZED</td>
</tr>
<tr>
<td>PRIMARY END USE METERS</td>
</tr>
<tr>
<td>HVAC COOLING</td>
</tr>
<tr>
<td>HVAC STEAM</td>
</tr>
<tr>
<td>HVAC HEATING HOT WATER</td>
</tr>
<tr>
<td>HVAC PUMPS</td>
</tr>
<tr>
<td>DCW PUMPS</td>
</tr>
<tr>
<td>PROCESS COOLING</td>
</tr>
<tr>
<td>PROCESS HEATING</td>
</tr>
</tbody>
</table>
### PROCESS ELECTRICITY

<table>
<thead>
<tr>
<th>KWH</th>
<th>TOTAL</th>
<th>1</th>
<th>5</th>
</tr>
</thead>
</table>

### PRIMARY EQUIPMENT/SYSTEM METRICS

<table>
<thead>
<tr>
<th>COOLING PLANT</th>
<th>KW/TON</th>
<th>15 Minutes</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOILER/STEAM METER</td>
<td>MMBTU/HR</td>
<td>1 hour</td>
<td>5</td>
</tr>
<tr>
<td>BOILER</td>
<td>% EFF</td>
<td>1 hour</td>
<td>5</td>
</tr>
<tr>
<td>AIR HANDLING UNITS</td>
<td>KW/CFM</td>
<td>15 Minutes</td>
<td>5</td>
</tr>
<tr>
<td>RETURN FANS</td>
<td>KW/CFM</td>
<td>15 Minutes</td>
<td>5</td>
</tr>
<tr>
<td>EXHAUST FANS</td>
<td>KW/CFM</td>
<td>15 Minutes</td>
<td>5</td>
</tr>
<tr>
<td>AIR CHANGE RATES</td>
<td>ACH</td>
<td>1 hour</td>
<td>5</td>
</tr>
<tr>
<td>ECONOMIZER MODE OPERATING HOURS</td>
<td>HOURS</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>AVERAGE FACE VELOCITY OF HOOD AIR FLOW</td>
<td>FPM</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>AVERAGE SASH POSITION</td>
<td>INCHES</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

3.9 **MEASUREMENT AND VERIFICATION**

Provide building performance graphics reports for the following utilities. Reports should include 5 years of historical data. X-axis to be time in months, Y-axis to be utility consumption totalized for per month.

A. Mechanical
   1. Chilled water consumption (kTons)
   2. Steam Consumption (#/Hr)
   3. Steam Condensate Return (Gal)

B. Electrical
   1. Electrical Consumption Building (kW-Hr)
   2. Electrical Consumption Mechanical Equipment (kW-Hr)

C. Plumbing
   1. Domestic Water Usage (Gal)
   2. Irrigation Water Usage (Gal)
   3. Process Water Usage (Gal)
   4. Non-Potable Water Usage (Gal)
   5. Nature Gas Consumption (CuFt)

**END OF SECTION**
SECTION 25 3513
ACTUATORS AND OPERATORS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes control valve actuators, damper actuators, and positioners for systems as shown in Contract Documents and where provided by equipment manufacturer.

B. Related Sections
   1. 25 0513 Conductors and Cables
   2. 25 0528 Pathways
   3. 25 3519 Control Valves
   4. 25 3523 Control Dampers

1.2 REFERENCES
A. ISO 9001 Quality Management
B. UL 873 Temperature-Indicating and -Regulating Equipment

1.3 DEFINITIONS
A. Sub-circuit - Branch supply and return piping to terminal device, including valve, coil, control valve, and balancing valve.

1.4 SYSTEM DESCRIPTION
A. Actuators, operators and positioners for control valves and control dampers, etc.

1.5 SUBMITTALS
A. Product data sheets shall include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke.

B. Identify actuator torque capacities, control signal, power requirements.

C. Include other options such as linkage kits, weather shields, manual cranks, etc.

1.6 QUALITY ASSURANCE
A. Manufacturer shall be ISO 9001 certified.

B. UL listed under standard 873 for Temperature-Indicating and Regulating Equipment.

C. Obtain adequate system information necessary for sizing.

D. Refer to section 25 0513 for power connections and other cable requirements.

E. Refer to section 25 0528 for pathway requirements.
PART 2 - PRODUCTS

2.1 ANALOG ELECTRONIC ACTUATORS

A. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or or approved equal.

B. Modulating actuator input signals shall be, 0-5VDC, 2-10VDC, or 0-10VDC. Floating or pulsing signals are not allowed.

C. Provide spring return feature for fail open or closed positions as required by control sequence or control drawings.

D. Provide actuator with a conduit fitting.

E. Non-spring return actuators and spring return actuators with more than 60lbs torque, shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.

F. Provide local service switch for large valves powered by 120VAC.

G. Spring return not required for terminal equipment.

H. Provide analog feedback as required by control sequence or control drawings.

2.2 DISCRETE TWO-POSITION ELECTRIC ACTUATORS

A. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or approved equal.

B. Provide spring return feature for fail open or closed positions as required by control sequence or control drawings.

C. Non-spring return actuators and spring return actuators with more than 60lbs torque, shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.

D. Provide local service switch for large valves powered independent of control signal or powered by 120VAC.

E. Provide discrete feedback as required by control sequence or control drawings.

2.3 PNEUMATIC ACTUATORS

A. Pneumatic Diaphragm with Spring Return

1. Actuators shall be by selected to match maximum diaphragm air pressure, fail position, stroke, shut-off pressure, temperature, torque, etc., required for intended service. Unless otherwise scheduled, diaphragm air pressure shall be sufficient to provide 100% valve shut-off at least equal to pump shut-off head or 125% of rated flow head for water systems, or full rated pressure for steam systems.

2. Select spring ranges to match intended service. If valves or dampers are sequenced, spring ranges shall not overlap.

3. Provide spring return feature for fail open or closed positions, as required by control sequence, for critical applications such as outside, return, or exhaust dampers, heating and cooling coils on major air handling units, humidifiers, heat exchangers, flow control for major equipment items such as chillers, cooling towers, boilers, etc.
PART 3 - EXECUTION

3.1 ANALOG ELECTRONIC ACTUATORS

A. Provide actuator for dampers and valves with sufficient capacity to operate under all conditions.
B. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
C. Each actuator shall be full-modulating as required or specified and shall be provided with spring-return for fail open or fail closed position for, heating or cooling protection on power interruption as indicated and/or as required.
D. Fail steam valves serving pressure rated heat exchangers or converters closed unless otherwise shown.
E. Valve and damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.
F. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.
G. Coordinate the factory installation of control valve actuators and operators where possible.
H. Mount actuators and operators outside the airstreams.

3.2 DISCRETE TWO POSITION ELECTRIC ACTUATORS

A. Provide actuators for dampers and valves with sufficient capacity to operate under all conditions.
B. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
C. Each actuator shall be two-position as specified and shall be provided with spring-return for fail open or fail closed position for, heating or cooling isolation or protection on power interruption as indicated and/or as required.
D. Valve and damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.
E. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.

3.3 PNEUMATIC ACTUATORS

A. Provide actuators for major systems such as Air Handlers, Exhaust Fans, Hydronic systems, steam, etc.
B. Provide actuator for each automatic damper or valve with sufficient capacity to operate damper or valve under all conditions.
C. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.

D. Each actuator shall be full-modulating, or two-position type as required or specified, and shall be provided with spring-return for fail open or fail closed position for fire, freeze, occupant safety, equipment protection, heating or cooling protection on power interruption as indicated and/or as required.

E. Valve and damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.

F. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.

G. Coordinate the factory installation of control valve actuators and operators.

H. Mount actuators and operators outside the airstreams of unit.

END OF SECTION
SECTION 25 3516
SENSORS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Instrumentation for the following Sensors and Transmitters for HVAC

B. Products Supplied but Not Installed Under This Section
   1. Sensor wells

C. Related Sections:
   1. 25 0000 Integrated Automation

1.2 REFERENCES

A. DIN-IEC -751 Standard for platinum sensor.

B. Refer to section 25 0000 for additional references.

1.3 SYSTEM DESCRIPTION

A. Provide supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable installation.

B. Wiring shall be done in accordance with all local and national codes.

C. Coordinate installation of instrumentation, including but not limited to:
   1. Power requirements
   2. Panel locations
   3. Commissioning
   4. Test and Balance
   5. Equipment start-up
   6. User access

1.4 SUBMITTALS

A. Refer to section 25 0000.

1.5 QUALITY ASSURANCE

A. Coordinate timely delivery of materials.

B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping’s, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.

C. Install control devices in appropriate enclosure and in an accessible location.

D. Provide shielding per manufactures recommendation.
E. Provide junction box or enclosure to protect wiring and allow conduit connection for all sensors.
F. Refer to section 25 0000 for additional requirements.

1.6 WARRANTY
A. Refer to section 25 0000.

PART 2 - PRODUCTS

2.1 AVERAGING TEMPERATURE SENSORS
A. Platinum RTD type, with the following minimum performance
   1. Accuracy: ± 1.0% at 32°F (Class B)
   2. Operating Range: -50 to 170°F
      0 to 99% RH
   3. Conformance: DIN-IEC 751

2.2 SINGLE POINT TEMPERATURE SENSORS
A. Platinum RTD type, with the following minimum performance
   1. Accuracy: ± 0.1% at 32°F (Class B)
   2. Operating Range: -50 to 170°F
      0 to 99% RH
   3. Conformance: DIN-IEC 751

B. Thermistors type, with the following minimum performance
   1. 5 yr guarantee that device will maintain its accuracy within tolerance of ± 0.36°F between
      32°F and 150°F, and 0.5°F between -20°F and 212°F.
   2. Accuracy: ± 0.1% at 32°F (Class B)
   3. Operating Range: -50 to 170°F
      0 to 99% RH

2.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS
A. Thermister or RTD type, with the following minimum performance
   1. Accuracy: ± 1.0 Deg F at 70°F (Class B)
   2. Operating Range: -50 to 170°F
      0 to 99% RH

2.4 RTD TEMPERATURE SENSOR/TRANSMITTERS:
A. Manufacturers: Rosemount, Burns, Minco Products, Weed or Pyromation or Equal.
B. Transmitters shall provide 2 wires, 4-20 mA current output signal proportional to specified
   temperature span of transmitter and compatible with DDC equipment.
   1. These shall be 1000 platinum RTD type temperature instruments for process immersion or
      air duct mounting
   2. Operating Temperature: -20 to +180°F
   3. Power Supply Voltage: 13 to 35 VDC unregulated
   4. Accuracy or Output Error: 0.1% of span of sensor and transmitter combination
   5. Temperature Coefficient: 0.00385 O/O°C
6. Thermowells: By same manufacturer as Sensor/Transmitter or approved alternate.

C. Provide local temperature indicator with 3 LCD digital readout.

2.5 SENSOR WELLS

A. Compatible with sensor and application.

B. Include thermal compound.

2.6 SPACE TEMPERATURE SENSORS

A. Adjustable setpoint, with programmable minimum/maximum setpoints (default to disable).

B. Pushbutton override for temporary occupancy default to disable.

C. Compatible with the intended service (VAV, VAV Reheat, Dual-duct, unoccupied setback, etc.), and associated controlled devices (DDC air terminal controller, damper, valve, etc.).

D. RTD type, with the following minimum performance:
   1. Accuracy: ± 0.1% at 32°F (Class B)
   2. Temperature Operating Range: -50 to 500°F
   3. Humidity Operating Range: 0 to 99% RH

E. Thermistors will be acceptable in lieu of RTD provided that device will maintain its accuracy within tolerance of ± 0.36°F between 32°F and 150°F, and 0.5°F between -20°F and 212°F.

2.7 SPACE HUMIDITY SENSORS/TRANSMITTERS

A. Manufactures: Viasala, General Easter, or Automation Components or Equal.

B. Space humidity sensors shall be wall mount type to match room thermostats and/or temperature sensors.

C. Sensing element shall be resistive bulk polymer, or thin film capacitive type. Sensor/transmitter shall have the following minimum performance:
   1. Accuracy: ± 2% RH at 25°C over range of 20-95% RH including hysteresis, linearity and repeatability
   2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F
   3. Sensitivity: 0.1% RH
   4. Repeatability: 0.5% RH
   5. Hysteresis: Less than 1%
   6. Long Term Stability: Less than 1% RH drift per year
   7. Adjustment: ± 20% RH zero, non-interactive
      ± 10% RH span, non-interactive
   8. Operating Range: 0-99% RH, non-condensing, sensor
      -95% RH, non-condensing, electronics
   9. Output: 0-10VDC 0-100% linear, proportional
   10. Power: 12-36 VDC or 24VAC

2.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

A. Manufactures: Viasala, General Easter, or Automation Components or Equal.
B. Probe type, temperature compensated, resistive bulk polymer or thin film capacitive type.

C. Sensor/transmitter shall have the following minimum performance.
   1. Accuracy: ± 2% RH at 25°C over 20-95% RH including hysteresis linearity and repeatability
   2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F.
   3. Sensitivity: 0.1% RH
   4. Repeatability: 0.5% RH
   5. Hysteresis: Less than 1%
   6. Long Term Stability: Less than 1% drift per year
   7. Adjustment: ± 20% RH zero, non-interactive
                  ± 10% RH span, non-interactive
   8. Operating Range: 0-99% RH, non-condensing, sensor
                      0-95% RH, non-condensing, electronics
   9. Output: 0-10VDC 0-100% linear, proportional
   10. Power: 12-36 VDC or 24VAC

2.9 VIBRATION SENSOR
A. Performance Requirements:
   1. Power 12VDC – 36VDC loop power
   2. Output 4-20mA
   3. Frequency Range 2-1000 HZ
   4. Accuracy +/- 5%

B. Enclosure shall be NEMA rated for application.

PART 3 - EXECUTION
3.1 AVERAGING TEMPERATURE SENSORS
A. Provide flexible averaging element for air ducts where prone to temperature stratification or where ducts are larger than 9 square feet.
B. Provide rigid averaging probe for air ducts smaller than 9 square feet.
C. Provide multiple averaging type sensors as required for sufficient duct or coil coverage. For coils, at minimum provide appropriate number of sensors as necessary for 1 linear foot of sensing for every 1 sq. ft of coil.

3.2 SINGLE POINT TEMPERATURE SENSORS
A. Provide single point duct mounted probes where ducts are too small for averaging elements.
B. Mount in center of air flow or where most accurate reading will result.
C. Install as far from fan as possible, but within mechanical space.

3.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS
A. Provide single point duct mounted sensors at air terminal coils or fan coil units
3.4 SPACE TEMPERATURE SENSORS
A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
B. Coordinate mounting height prior to installation. Unless otherwise noted, mount sensors at 48” above finished floor.
C. Recess mounting box unless otherwise indicated or required by the building construction materials.
D. Unless otherwise noted provide at minimum, 1/2” conduit from room sensors to corresponding controller.
E. Mounted space thermostats/sensors, located on exterior walls, on thermally insulated sub-base.
F. Relocate space thermostats/sensors if required due to draft, interferences with cabinets, chalkboards, etc., or improper sensing.

3.5 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS
A. Provide sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions. At minimum, provide at discharge of fan coil units and terminal reheat.

3.6 SPACE HUMIDITY SENSORS/TRANSMITTERS
A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
B. Mount sensors at 48” above finished floor.
C. Recess mounting box unless otherwise indicated or required by the building construction materials.

3.7 SENSOR WELLS
A. Furnish wells for installation.
B. Coordinate with Division 23 Specifications for location placement.
   1. Wells mounted in pipe 3” and larger may be installed in horizontal or vertical lines provided that element is always in the flow, (for condensate and other gravity return lines, install in bottom of pipe).
   2. Wells mounted in pipe 2-1/2” and smaller shall be installed at elbow tee fittings with well pointed upstream. Minimum of 2” pipe size for elbow tee installation.

3.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS
A. Provide duct humidity sensors and transmitters where indicated, and as required to perform specified control sequences, and as directed to meet job site conditions.

3.9 VIBRATION SENSOR
A. Provide vibration transmitter for well pumps, and motors and equipment where shown.
B. Coordinate installation/mounting requirements with motor and equipment manufacture.
END OF SECTION
SECTION 25 3516
SENSORS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Instrumentation for the following Sensors and Transmitters for HVAC

B. Products Supplied but Not Installed Under This Section
   1. Sensor wells

C. Related Sections:
   1. 25 0000 Integrated Automation

1.2 REFERENCES

A. DIN-IEC -751 Standard for platinum sensor.

B. Refer to section 25 0000 for additional references.

1.3 SYSTEM DESCRIPTION

A. Provide supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable installation.

B. Wiring shall be done in accordance with all local and national codes.

C. Coordinate installation of instrumentation, including but not limited to:
   1. Power requirements
   2. Panel locations
   3. Commissioning
   4. Test and Balance
   5. Equipment start-up
   6. User access

1.4 SUBMITTALS

A. Refer to section 25 0000.

1.5 QUALITY ASSURANCE

A. Coordinate timely delivery of materials.

B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.

C. Install control devices in appropriate enclosure and in an accessible location.

D. Provide shielding per manufactures recommendation.
E. Provide junction box or enclosure to protect wiring and allow conduit connection for all sensors.

F. Refer to section 25 0000 for additional requirements.

1.6 WARRANTY

A. Refer to section 25 0000.

PART 2 - PRODUCTS

2.1 AVERAGING TEMPERATURE SENSORS

A. Platinum RTD type, with the following minimum performance
   1. Accuracy: ± 1.0% at 32°F (Class B)
   2. Operating Range: -50 to 170°F
      0 to 99% RH
   3. Conformance: DIN-IEC 751

2.2 SINGLE POINT TEMPERATURE SENSORS

A. Platinum RTD type, with the following minimum performance
   1. Accuracy: ± 0.1% at 32°F (Class B)
   2. Operating Range: -50 to 170°F
      0 to 99% RH
   3. Conformance: DIN-IEC 751

B. Thermistors type, with the following minimum performance
   1. 5 yr guarantee that device will maintain its accuracy within tolerance of ± 0.36°F between 32°F and 150°F, and ±0.5°F between -20°F and 212°F.
   2. Accuracy: ± 0.1% at 32°F (Class B)
   3. Operating Range: -50 to 170°F
      0 to 99% RH

2.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

A. Thermister or RTD type, with the following minimum performance
   1. Accuracy: ± 1.0 Deg F at 70°F (Class B)
   2. Operating Range: -50 to 170°F
      0 to 99% RH

2.4 RTD TEMPERATURE SENSOR/TRANSMITTERS:

A. Manufacturers: Rosemount, Burns, Minco Products, Weed or Pyromation or Equal.

B. Transmitters shall provide 2 wires, 4-20 mA current output signal proportional to specified temperature span of transmitter and compatible with DDC equipment.
   1. These shall be 1000 platinum RTD type temperature instruments for process immersion or air duct mounting
   2. Operating Temperature: -20 to +180°F
   3. Power Supply Voltage: 13 to 35 VDC unregulated
   4. Accuracy or Output Error: 0.1% of span of sensor and transmitter combination
   5. Temperature Coefficient: 0.00385 O/O°C
6. Thermowells: By same manufacturer as Sensor/Transmitter or approved alternate.

C. Provide local temperature indicator with 3 LCD digital readout.

2.5 SENSOR WELLS

A. Compatible with sensor and application.

B. Include thermal compound.

2.6 SPACE TEMPERATURE SENSORS

A. Adjustable setpoint, with programmable minimum/maximum setpoints (default to disable).

B. Pushbutton override for temporary occupancy default to disable.

C. Compatible with the intended service (VAV, VAV Reheat, Dual-duct, unoccupied setback, etc.), and associated controlled devices (DDC air terminal controller, damper, valve, etc.).

D. RTD type, with the following minimum performance:
   1. Accuracy: ± 0.1% at 32°F (Class B)
   2. Temperature Operating Range: -50 to 500°F
   3. Humidity Operating Range: 0 to 99% RH

E. Thermistors will be acceptable in lieu of RTD provided that device will maintain its accuracy within tolerance of ± 0.36°F between 32°F and 150°F, and 0.5°F between -20°F and 212°F.

2.7 SPACE HUMIDITY SENSORS/TRANSMITTERS

A. Manufactures: Viasala, General Easter, or Automation Components or Equal.

B. Space humidity sensors shall be wall mount type to match room thermostats and/or temperature sensors.

C. Sensing element shall be resistive bulk polymer, or thin film capacitive type. Sensor/transmitter shall have the following minimum performance:
   1. Accuracy: ± 2% RH at 25°C over range of 20-95% RH including hysteresis, linearity and repeatability
   2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F
   3. Sensitivity: 0.1% RH
   4. Repeatability: 0.5% RH
   5. Hysteresis: Less than 1%
   6. Long Term Stability: Less than 1% RH drift per year
   7. Adjustment: ± 20% RH zero, non-interactive
     ± 10% RH span, non-interactive
   8. Operating Range: 0-99% RH, non-condensing, sensor
     -95% RH, non-condensing, electronics
   9. Output: 0-10VDC 0-100% linear, proportional
   10. Power: 12-36 VDC or 24VAC

2.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

A. Manufactures: Viasala, General Easter, or Automation Components or Equal.
B. Probe type, temperature compensated, resistive bulk polymer or thin film capacitive type.

C. Sensor/transmitter shall have the following minimum performance.
   1. Accuracy: ± 2% RH at 25°C over 20-95% RH including hysteresis linearity and repeatability
   2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F.
   3. Sensitivity: 0.1% RH
   4. Repeatability: 0.5% RH
   5. Hysteresis: Less than 1%
   6. Long Term Stability: Less than 1% drift per year
   7. Adjustment: ± 20% RH zero, non-interactive ± 10% RH span, non-interactive
   8. Operating Range: 0-99% RH, non-condensing, sensor 0-95% RH, non-condensing, electronics
   9. Output: 0-10VDC 0-100% linear, proportional
   10. Power: 12-36 VDC or 24VAC

2.9 VIBRATION SENSOR

A. Performance Requirements:
   1. Power 12VDC – 36VDC loop power
   2. Output 4-20mA
   3. Frequency Range 2-1000 HZ
   4. Accuracy +/- 5%

B. Enclosure shall be NEMA rated for application.

PART 3 - EXECUTION

3.1 AVERAGING TEMPERATURE SENSORS

A. Provide flexible averaging element for air ducts where prone to temperature stratification or where ducts are larger than 9 square feet.

B. Provide rigid averaging probe for air ducts smaller than 9 square feet.

C. Provide multiple averaging type sensors as required for sufficient duct or coil coverage. For coils, at minimum provide appropriate number of sensors as necessary for 1 linear foot of sensing for every 1 sq. ft of coil.

3.2 SINGLE POINT TEMPERATURE SENSORS

A. Provide single point duct mounted probes where ducts are too small for averaging elements.

B. Mount in center of air flow or where most accurate reading will result.

C. Install as far from fan as possible, but within mechanical space.

3.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

A. Provide single point duct mounted sensors at air terminal coils or fan coil units
3.4 SPACE TEMPERATURE SENSORS

A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.

B. Coordinate mounting height prior to installation. Unless otherwise noted, mount sensors at 48” above finished floor.

C. Recess mounting box unless otherwise indicated or required by the building construction materials.

D. Unless otherwise noted provide at minimum, 1/2” conduit from room sensors to corresponding controller.

E. Mounted space thermostats/sensors, located on exterior walls, on thermally insulated sub-base.

F. Relocate space thermostats/sensors if required due to draft, interferences with cabinets, chalkboards, etc., or improper sensing.

3.5 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

A. Provide sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions. At minimum, provide at discharge of fan coil units and terminal reheat.

3.6 SPACE HUMIDITY SENSORS/TRANSMITTERS

A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.

B. Mount sensors at 48” above finished floor.

C. Recess mounting box unless otherwise indicated or required by the building construction materials.

3.7 SENSOR WELLS

A. Furnish wells for installation.

B. Coordinate with Division 23 Specifications for location placement.
   1. Wells mounted in pipe 3” and larger may be installed in horizontal or vertical lines provided that element is always in the flow, (for condensate and other gravity return lines, install in bottom of pipe).
   2. Wells mounted in pipe 2-1/2” and smaller shall be installed at elbow tee fittings with well pointed upstream. Minimum of 2” pipe size for elbow tee installation.

3.8 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

A. Provide duct humidity sensors and transmitters where indicated, and as required to perform specified control sequences, and as directed to meet job site conditions.

3.9 VIBRATION SENSOR

A. Provide vibration transmitter for well pumps, and motors and equipment where shown.

B. Coordinate installation/mounting requirements with motor and equipment manufacture.
END OF SECTION
SECTION 25 3517
AIR AND GAS MEASUREMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Systems include air flow measurement, static pressure measurement, and differential pressure measurement.

B. Products Supplied but Not Installed Under This Section:
   1. Duct mounted Air Flow measuring stations
   2. Inlet fan mounted Air Flow measuring stations

1.2 SYSTEM DESCRIPTION

A. Provide supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable installation.

B. Coordinate installation of instrumentation, including but not limited to:
   1. Power requirements
   2. Panel locations
   3. Communication requirements (if applicable).
   4. Commissioning
   5. Test and Balance
   6. Equipment start-up
   7. User access

1.3 SUBMITTALS

A. Include recommended probe quantities to meet specified accuracies for air flow devices.

B. Identify locations where measurement accuracy may be negatively affected and demonstrate solution to maintain specified accuracy.

1.4 QUALITY ASSURANCE

A. Coordinate timely delivery of materials.

B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping’s, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.

C. Install control devices in appropriate enclosure and in an accessible location.

D. Provide access doors where removal of instrument is not possible or practical for maintenance.

PART 2 - PRODUCTS

2.1 DUCT MOUNTED AIR FLOW MEASURING STATION

A. Manufacturers: Tek-Air, Ebtron or Equal
1. Transmitter and/or systems, which require periodic calibration to maintain accuracy specified, shall not be acceptable.

2. Minimum Requirements:
   a. Accuracy: ± 2.0% of Reading
   b. Span: Less than twice maximum flow
   c. Temperature Range: -20 Deg F to 140 Deg F.
   d. Humidity Range: 10-95% RH (non-condensing)
   e. Power: 24 VAC
   f. Output Signal: 4-20 mA or 0-10VDC

B. Velocity measured by each sensor shall be linearized, summed, averaged, and an output signal proportional to air-flow rate (cfm) or velocity (fpm) by transmitter electronics.

2.2 INLET FAN MOUNTED AIR FLOW MEASURING STATION

A. Transmitter and/or systems, which require periodic calibration to maintain accuracy specified, shall not be acceptable.

B. Requirements:
   1. Accuracy: ± 3.0% of Reading
   2. Span: Less than twice maximum flow
   3. Temperature Range: -20 Deg F to 140 Deg F.
   4. Humidity Range: 10-95% RH (non-condensing)
   5. Power: 12-30VDC or 24 VAC
   6. Output Signal: 0-5VDC, 2-10VDC or 0-10VDC

C. Velocity measured by each sensor shall be linearized, summed, averaged, and an output signal proportional to air-flow rate (cfm) or velocity (fpm) by transmitter electronics.

2.3 DIFFERENTIAL PRESSURE TRANSMITTERS

A. Manufacturers: GE Modus, Setra, Ashcroft XLDP or approved equal.

B. Sensors shall convert velocity pressure differential or static duct pressure relative to sensor location into electronic signal.

C. Unit shall be capable of transmitting linear signal proportional to differential (total minus static or static minus ambient) pressure input signals with the following minimum performance and application criteria:
   1. Span: Less than twice maximum reading.
   2. Accuracy: ± 1.0% of span or ± 1.0% of full scale
   3. Dead Band: Less than 0.5% of output
   4. Hysteresis: Within 0.5% of span or within 0.5% of full scale
   5. Linearity: Within 1.0% of span or within 0.5% of full scale
   6. Repeatability: Within 0.5% of output
   7. Response: Less than 1 second for full span input
   8. Output Signal: 0-5VDC, 2-10VDC or 0-10VDC

2.4 CO2 SENSORS

A. Manufacturers: Veris, Telaire, Vaisala, or approved equal.
B. Units shall have following minimum characteristics:
   1. Range 0-2000ppm
   2. Power Supply 15-30 VDC/VAC
   3. Output 0-5VDC, 2-10VDC or 0-10VDC
   4. Operating Temperature 0 – 120 Deg F
   5. Operating Humidity 0 to 90% RH non-condensing
   6. Accuracy 5.0% or 30ppm

2.5 CO SENSORS

A. Manufacturers: Veris, Telaire, Vaisala, or approved equal.

B. Units shall have following minimum characteristics:
   1. Range 0-2000ppm
   2. Power Supply 15-30 VDC/VAC
   3. Output 0-10VDC
   4. Operating Temperature 40 – 100 Deg F
   5. Operating Humidity 0 to 85% RH non-condensing

PART 3 - EXECUTION

3.1 DUCT MOUNTED AIR FLOW MEASURING STATION

A. Furnish and coordinate the installation of Air Flow Measuring Stations according to contract documents, control sequences or to achieve LEED credit.

B. Include manufacturer’s recommended number of probes for the proper traverse of the air duct, and required mounting hardware.

C. Provide transmitter as part of air flow sensor, and shall include integral diagnostics with on-line zeroing and sensor operation verification

D. Provide all cabling required for connection to probe assemblies and transmitter electronics.

3.2 INLET FAN MOUNTED AIR FLOW MEASURING STATION

A. Provide Inlet Fan Mounted Air Flow Measuring Stations (where not provided by Division 23) on Supply and Return Fans and according to contract documents control sequences or to achieve LEED credit.

B. Include manufacturer’s recommended number of probes for the proper traverse of the air duct and required mounting hardware.

C. Provide transmitter (where not provided by Division 23) as part of air flow sensor, and shall include integral diagnostics with on-line zeroing and sensor operation verification

D. Provide all cabling required for connection to probe assemblies and transmitter electronics.

E. Coordinate signal requirements and monitor air flow stations provided.

3.3 DIFFERENTIAL PRESSURE TRANSMITTERS

A. Provide Differential Pressure Transmitters according to contract documents or to accomplish sequences.
B. Locate static pressure transmitters and transducers in control panel where possible.

C. Select instrument for intended usage range, maximum pressure/temperature.

D. For indicating type instruments, locate indicating element with 6 ft of floor with readout easily visible from floor level.

3.4 CO2 SENSORS

A. Provide CO2 sensors according to contract documents, control sequences or to achieve LEED credit.

3.5 CO SENSORS

A. Provide CO sensors according to contract documents or to accomplish sequences.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Systems include instrumentation for the following water systems pressure and flow measurement for Integration and Automation.
B. Products furnished but not installed under this section:
   1. Pressure transmitters
   2. Domestic water flow meter
   3. Heating hot water flow meter.
   4. Reverse osmosis
C. Related Sections:
   1. 25 0000 Integrated Automation
   2. 25 1219 Integration Protocols

1.2 SUBMITTALS
A. Refer to section 25 0000.

1.3 QUALITY ASSURANCE
A. Coordinate timely delivery of materials.
B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.

1.4 WARRANTY
A. Refer to section 25 0000.

PART 2 - PRODUCTS

2.1 DIFFERENTIAL PRESSURE TRANSMITTER
A. Manufacturers: Ashcroft, BAPI, Setra, Veris or approved equal.
B. Pressure sensor and integral transmitter. Select instrument for intended usage (differential pressure, gauge pressure, level, etc.), range, maximum pressure/temperature. Enclosure to be NEMA 4.
C. Include LCD display.
D. Differential pressure transmitters shall have 3-valve manifold for servicing.
E. Performance:
   1. Power 12 - 30 VDC or 24VAC
2. Output 0-5 VDC, 2-10 VDC or 0-10VDC  
3. Accuracy (PSIG) + 1 percent of full scale  
4. Stability + 0.25 percent per year  
5. Hysteresis ± 0.05 percent of calibrated span  

F. Operating Range -140 Deg F to 130 Deg F  
G. Over Pressure: 2 times maximum operating pressure whichever is greater.  
H. Accuracy: ± 1% of full scale  
I. Zero adjust pushbutton.

2.2 PRESSURE TRANSMITTERS  
A. Manufacturers: Setra, Ashcroft, Dwyer or approved equal  
B. Include pressure sensor and integral transmitter. Transmitters shall use capacitance sensing element.  
C. Performance:  
   1. Power 12 - 30 VDC or 24VAC  
   2. Output 0-5 VDC, 2-10 VDC or 0-10VDC  
   3. Accuracy (PSIG) + 0.5 percent of calibrated span  
   4. Stability ± 0.25 percent per year  

2.3 WATER FLOW TRANSMITTER  
A. Manufacturers: Onicon, Badger, Neptune or approved equal  
B. Type: Electromagnetic insertion  
C. Include flow meter and transmitter.  
D. Include certificate of calibration  
E. Direction of flow indication (for bi-direction flow meters)  
F. Performance:  
   1. Output 0-5 VDC, 2-10 VDC or 0-10VDC  
   2. Accuracy ± 1 percent of rate from 2-20ft/s  

2.4 BTU SUB-METER  
A. Manufacturer: Onicon (System 10), or approved equal  
B. Include flow meter and remote transmitter with NIST Traceable Calibration with Certifications.  
C. Include BACnet communications card to integrate to building automation systems. Refer to section 12 1219.  
D. Minimum Performance:  
   1. Output 0-5 VDC, 2-10 VDC or 0-10VDC  
   2. Temperature Accuracy + .15 percent from 32-200 Deg F.  
   3. Water Flow Accuracy ± 1.0 percent of reading.
PART 3 - EXECUTION

3.1 DIFFERENTIAL PRESSURE TRANSMITTER


B. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device. Transmitter range shall be selected for mid-range values while operating under normal operating range.

C. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines. Test ports shall be included for 3rd party verification.

D. Differential pressure transmitter shall include a separate pressure gage scaled to indicate normal operating range of device. This pressure gage shall be installed in parallel with sensing lines.

E. The transmitters shall be installed in an accessible location whenever possible.

3.2 PRESSURE TRANSMITTER

A. Furnish differential pressure transmitters as shown in construction documents or as required to implement sequences.

   1. Span flow transmitter for 130% of design pressure.

B. Transmitter shall be mounted in accessible location and in mechanical rooms shall be installed 4' to 5' above floor level. Include isolation valve for servicing at transmitter location.

3.3 WATER FLOW TRANSMITTER


   1. Span flow meter for 130% of design flow.

B. Remote Transmitter shall be mounted in accessible location and in mechanical rooms shall be installed 4’ to 5’ above floor level.

3.4 BTU SUB-METER

A. Furnish BTU Sub-Meter for Water Systems.

   1. Span flow meter for 130% of design flow.

B. Display shall be mounted in accessible location and in mechanical rooms shall be installed 4’ to 5’ above floor level.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes:
   1. Control valves for HVAC systems as shown in Contract Documents, except where provide
      by equipment manufacturer.
B. Products Supplied, But Not Installed Under This Section:
   1. Actuated Control Valves for Integrated Automation and HVAC applications.
C. Related Sections:
   1. 25 0553 Identification
   2. 25 3513 Actuators and Operators

1.2 REFERENCES
A. UL-873 Temperature-Indicating and Regulating Equipment
B. ANSI American National Standards Institute

1.3 DEFINITIONS
A. HVAC – Heating Ventilation and Air Conditioning.
B. Sub-circuit - Branch supply and return piping to terminal device, including valve, coil, control
   valve, and balancing valve.

1.4 SYSTEM DESCRIPTION
A. Control valves for HVAC systems.
B. Control valves types shall be from the same manufacture.

1.5 SUBMITTALS
A. Product data sheets shall include construction materials and assembly methods, maximum
   design parameters (temperature, pressure, velocity, etc.), and performance data for full range of
   actuator stroke. Product data sheets shall include charts, graphics or similar items used in
   making selections.
B. Valve Schedule:
   1. Indicate size, location and model of each control valve, CV, flow, type, actuation, etc.
   2. Indicate unique tag numbers for each device, equipment item or system served, d
   3. Include sizes, shut-off head required, actuator air pressure or force required to meet shut-off
      head, torque requirements for rotary valves, actual flow requirements based on equipment
      shop drawings, and calculation of actual pressure drops.
C. Include construction materials and assembly methods, maximum design parameters
   (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke.
1.6 QUALITY ASSURANCE

A. UL listed under standard 873 for Temperature-Indicating and Regulating Equipment.

B. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Obtain adequate system information necessary for valve sizing.

D. Water Valves:
   1. Pressure independent control valves shall be factory calibrated and tested.

E. Tag control valves appropriately. Refer to 25 0553.

F. Valve body ratings indicated in Part 2 are minimum required. Valves selected shall be designed to withstand maximum pressure and temperature encountered in the systems, for proper control and without cavitation.

G. Calculations for sizing modulating valves shall be based on actual characteristics of equipment and system being installed. Valve calculations shall include information such as pump head or available pressure; branch piping circuit losses including all pipe, fittings, valves, and coils; flow rates; and pressure losses of other in-line devices.

H. Obtain adequate system information necessary for sizing.

PART 2 - PRODUCTS

2.1 WATER CONTROL VALVES (3’ OR SMALLER):

A. Valves shall be pressure independent.

B. Actuator stem shall be removable/replaceable without removing valve from line.

C. Control flow from 0 to 100%

D. Include pressure/temperature ports

E. Minimum Characteristics:
   1. Valve Body: Brass
   2. Max Operating Temperature: 212°F
   3. Close off Pressure: 90 PSI
   4. Accuracy +/- 5%
   5. Rated Pressure: 150 PSI

2.2 WATER CONTROL VALVES (LARGER THAN 3”):

A. Valves shall be pressure independent.

B. Control flow from 0 to 100%.

C. Include pressure/temperature ports.

D. Minimum Characteristics:
   1. Valve Body: Iron, Bronze, or Steel
2. Max Operating Temperature: 240°F
3. Close off Pressure: 90 PSI
4. Rated Pressure: 150 PSI
5. Accuracy +/- 5%

2.3 TWO POSITION CONTROL VALVES

A. Meet ANSI Class 150 rating design.
B. Provide bubble-tight shut off with pressures in either direction to 275 psi suitable for 150 psi steam.
C. External disc position indication.
D. Valve neck extensions with sufficient length to allow for insulation.
E. Provide threaded lug type valves for equipment isolation, permitting removal of downstream piping without removing valve. Dead end pressure rating of lug type valves shall be 275 psi.
F. Characteristics:
   1. Valve Body: Carbon or Cast steel, Cast Iron
   2. Valve Type Butterfly
   3. Max Operating Temperature: 250°F (minimum)
   4. Min Rated Pressure 150 PSI
   5. Shaft Stainless steel
   6. Disc Stainless steel
   7. Seat Reinforced PTFE
   8. Packing graphite

PART 3 - EXECUTION

3.1 WATER CONTROL VALVES (3" OR SMALLER):

A. Furnish pressure independent control valves for terminal units.
B. Factory mount actuator.
C. Select valves to provide tight shut-off against maximum system temperatures and pressure encountered.

3.2 WATER CONTROL VALVES (LARGER THAN 3"):

A. Furnish pressure independent control valves for larger equipment.
B. Factory mount actuator where possible
C. Shut-off against maximum system temperatures and pressure encountered.
D. Select valve components to withstand maximum pressure and temperature encountered in system.

3.3 TWO POSITION CONTROL VALVES (2" and Larger)

A. Furnish two position control valves for equipment isolation.
B. Factory mount actuator.

C. Select valves to provide tight shut-off against maximum system temperatures and pressure encountered.

D. Size valve to full pipe size for shut off applications.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This section includes HVAC control dampers for systems shown in Contract Documents and except where provide by equipment manufacturer.

B. Products Supplied but Not Installed Under This Section:
   1. Control dampers.
   2. Optional factory mounted actuators.

C. Related Sections:
   1. 25 3513 Actuators and Operators
   2. 25 0553 Identification

1.2 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. AMCA 511 - Certified Ratings Program for Air Control Devices.

C. UL-873 - Temperature-Indicating and -Regulating Equipment.

1.3 DEFINITIONS

A. AMCA – Air Movement and Controls Association

B. Duct Section- Ductwork containing flow control damper starting with inlet or branch tee and ending with outlet or branch tee.

1.4 SYSTEM DESCRIPTION

A. High performance low leakage Class I control dampers suitable for HVAC applications such as control or isolation of outside, exhaust, or supply air and other non-smoke or fire rated applications.

1.5 SUBMITTALS

A. Damper Schedule:
   1. Indicate size, location and model of each damper

B. Product Data Shall Include:
   1. Construction materials and assembly methods
   2. Maximum design parameters (temperature, pressure, velocity, etc.)
   3. Performance data for full range of actuator stroke and installation details.
   4. Graphics or similar items used in making selections, including damper to duct area ratio and free area ratio.
   5. Sizing calculations
C. Indicate AMCA certified leakage rates for given pressure differentials.
D. Indicate pressure drop ratings based on AMCA tests and procedures.

1.6 QUALITY ASSURANCE
A. UL listed under standard 873 for Temperature-Indicating and Regulating Equipment.
B. Meet certified leakage rates and pressure drop ratings in accordance with AMCA. Leakage ratings shall be based on AMCA Standard 500 and dampers shall bear AMCA Air Leakage Seals.
C. Base sizing calculations on actual characteristics of ductwork system being installed.
D. Size dampers as close as possible to duct size, but in no case is damper size to be less than duct size.
E. Size opposed blade dampers shall for minimum of 10% of duct system pressure drop.
F. Size parallel blade dampers for minimum of 30% of duct system pressure drop.
G. Calculate actual duct pressure drops for each duct section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals.
H. Obtain adequate system information necessary for damper sizing.
I. Two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than duct area.
J. Select dampers to meet their intended service with respect to maximum approach velocities and maximum pressure differential.
K. Damper materials shall meet intended service for which they are installed (galvanized steel, aluminum, 304 or 316 stainless steel, etc. unless otherwise noted).
L. Dampers shall be tested, rated and labeled in accordance with the latest UL requirements.
M. Tag control dampers appropriately. Refer to 25 0553.

1.7 WARRANTY
A. Include two-year warranty for parts replacement.
B. Include registration and warranty documents and warranty rights to the Owner.

PART 2 - PRODUCTS
2.1 STANDARD CONTROL DAMPERS
A. Manufacturers: Ruskin, Tamco, Johnson Controls, Siemens, Honeywell or approved equal.
B. Opposed or parallel blades for modulating dampers and opposed blade only for 2 position dampers.
C. Blade linkage hardware shall have corrosion-resistant finish.
D. Requirements:
   1. Frame 16 ga galvanized steel or 14 ga extruded aluminum hat-shaped channel.
2. Blades 16 ga galvanized steel or 14 ga aluminum airfoil shaped
3. Max Blade Width  8 inches
4. Bearings  Molded synthetic, nylon, bronze, or ball
5. Max Leakage  Less than 3 cfm per square foot at 1 inch of static pressure.
6. Temp. Range  -40 to 250 Deg F.
7. Diff. Pressure  6.0 INWG
8. Approach Velocity  6000 fpm

2.2 EXHAUST FAN SHUT-OFF DAMPERS:
A. Manufacturers: Swartwout 902, Ruskin CDR92 or approved equal.
B. 304 stainless steel constructions, flanged connection, grease lubricated ball bearings, continuous shaft with seal, suitable for maximum temperature 250°F, approach velocity 6000 fpm, and differential pressure of 13" WG.
C. Furnish dampers with neoprene blade seals.

2.3 OUTSIDE AIR DAMPERS:
A. Manufacturers: Ruskin, Tamco, Johnson Controls, Siemens, Honeywell, or approved equal.
B. Opposed or parallel blades for modulating dampers and opposed blade only for 2 position dampers.
C. Requirements:
   1. Frame Extruded aluminum.
   2. Blades Extruded aluminum
   3. Linkage Corrosion resistant and concealed
   4. Max Blade Width  8 inches
   5. Max Leakage Leakage Class 1A at 1 in. w.g.
   6. Temp. Range  -40 to 250 Deg F.

PART 3 - EXECUTION

3.1 STANDARD CONTROL DAMPERS
A. Furnish control dampers as shown on drawings or as required to perform control sequences specified, except those furnished with other equipment.
B. Coordinate delivery, storage and installation with Division 23 Specifications.
C. Mount blade linkage hardware to be readily accessible for maintenance.
D. Mount actuator to achieve fail safe condition as shown on drawings or as needed to accomplish sequences.

3.2 EXHAUST FAN SHUT-OFF DAMPERS
A. Furnish exhaust dampers as shown on drawings or as required to perform control sequences, or isolation as specified, except those furnished with other equipment.
B. Coordinate delivery, storage and installation with Division 23 Specifications.
C. Mount actuator to fail damper to the closed position, unless otherwise shown.

3.3 OUTSIDE AIR DAMPERS:

A. Furnish outside air dampers as shown on drawings or as required to perform control sequences, or isolation as specified, except those furnished with other equipment.

B. Provide cover or enclosures to protect actuators from weather.

C. Coordinate delivery, storage and installation with Division 23 Specifications.

END OF SECTION
SECTION 25 3524
SMOKE DAMPERS

PART 1 - GENERAL

1.1 SUMMARY
A. This section includes dampers systems as shown in Contract Documents and except where provide by equipment manufacturer.
B. Products Supplied but Not Installed Under This Section:
   1. Smoke rated dampers and combination fire/smoke dampers.
   2. Required factory mounted actuators.
C. Related Sections:
   1. 25 3523 Control Dampers
   2. 25 0553 Identification

1.2 REFERENCES
A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
B. NFPA 92A - Smoke-Control Systems
C. NFPA 92B - Smoke Control Systems in Atria, Covered Malls, and Large Areas
D. UL-864/UUKL - Smoke Control Listing
E. UL 555/555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems
F. Refer to section 25 0553 for additional references

1.3 DEFINITIONS
A. AMCA – Air Movement and Controls Association

1.4 SYSTEM DESCRIPTION
A. Class 1 rated Smoke Dampers and Combination Fire Smoke Dampers for HVAC systems.

1.5 SUBMITTALS
A. Damper Schedule:
   1. Indicate size, location and model of each damper
B. Include:
   1. Construction materials and assembly methods
   2. Maximum design parameters (temperature, pressure, velocity, etc.)
   3. Performance data for full range of actuator stroke and installation details
   4. Graphics or similar items used in making selections, including damper to duct area ratio and free area ratio
   5. Sizing calculations
C. Indicate AMCA certified leakage rates for given pressure differentials.
D. Indicate pressure drop ratings based on AMCA tests and procedures.

1.6 QUALITY ASSURANCE

A. Calculations for sizing dampers shall be based on actual characteristics of ductwork system being installed. Opposed blade dampers shall be sized for minimum of 10% of duct system pressure drop.

B. Meet certified leakage rates and pressure drop ratings in accordance with AMCA. Leakage ratings shall be based on AMCA Standard 500 and dampers shall bear AMCA Air Leakage Seals.

C. Base sizing calculations on actual characteristics of ductwork system being installed.

D. Size dampers as close as possible to duct size, but in no case is damper size to be less than duct size.

E. Size opposed blade dampers shall for minimum of 10% of duct system pressure drop.

F. Size parallel blade dampers for minimum of 30% of duct system pressure drop.

G. Calculate actual duct pressure drops for each duct section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals.

H. Obtain adequate system information necessary for sizing.

I. Two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than duct area.

J. Select dampers to meet their intended service with respect to maximum approach velocities and maximum pressure differential.

K. Damper materials shall meet intended service for which they are installed (galvanized steel, aluminum, 304 or 316 stainless steel, etc.).

L. Dampers shall be tested, rated and labeled in accordance with the latest UL requirements.

M. Tag smoke dampers appropriately. Refer to 25 0553.

1.7 WARRANTY

A. Include two-year warranty for parts replacement.

B. Include registration and warranty documents and warranty rights to the Owner.

PART 2 - PRODUCTS

2.1 SMOKE DAMPERS

A. Manufacturers: Air Balance, Johnson Controls, Ruskin, Greenheck, NCA Manufacturing, Cesco or Prefco.

B. Requirements:
   1. Leakage rated under UL 555S (less than 4 cfm per square foot at 1" of static pressure and 8 cfm at 4" static pressure) at temperature category 250°F.
   2. Maximum blade width of 8".
3. Minimum 16-gauge galvanized steel or aluminum airfoil shaped blades.
4. Stainless Steel or bronze bearings.
5. Dampers and seals shall be suitable for maximum system temperature, pressure differential and approach velocity, but not less than temperature category 250°F, pressure differential of 4" WG, and approach velocity of 2000 fpm.

C. Actuator mounting assemblies shall be outside airstreams.
D. Include damper position switch linked directly to damper blade to provide capability of remotely indicating damper blade open position and closed position.
E. Dampers shall fully open in 15 seconds or less and fully close in not more than 15 seconds and not less than 5 seconds when activated.
F. Electric actuators shall be 120-volt non-stall type unless otherwise stated, and shall be rated for energized hold open position period of 6 months or more.
G. Allow reset from fire alarm control panel.

2.2 COMBINATION FIRE AND SMOKE DAMPERS
A. Manufacturers: Ruskin, Air Balance, Prefco, Greenheck, Nailor, Cesco, equal to Ruskin FSD-60.
B. Requirements
1. Meet requirements of NFPA 90A.
2. 1-1/2 or 3 hr rated as shown on drawings,
3. Maximum blade width of 6”.
4. Minimum 14-gauge galvanized steel or aluminum airfoil shaped blades.
5. Leakage rated at no higher than leakage Class I (4 cfm/ft² at 1" WG and 8 cfm/ft² at 4" WG) under UL 555/555S at temperature category 350°F, and compatible with system static pressures.
6. Rated pressures to 4" WG and velocities to 3000 fpm.
C. Operators shall be electric, factory installed outside of air stream, linked to dampers for fail closed operation, and be UL listed and labeled for the application.
D. Include damper position switch linked directly to damper blade to provide capability of remotely indicating damper blade open position and closed position.
E. Operators to be capable of closing damper at pressures encountered in system. Electric operators shall be rated for energized hold open position period of 6 months or more.
F. Dampers shall fully open in 15 seconds or less and fully close in not more than 15 seconds and not less that 5 seconds when activated.
G. Firestat
1. Dampers shall be furnished with UL classified firestat, functioning to close dampers when duct temperatures exceed 165 deg. F while allowing reset capability from fire alarm system or building automation system.
2. Include damper position switch linked directly to damper blade to provide capability of remotely indicating damper blade position. Firestat and position indicator switches to be capable of interfacing electrically with building fire alarm system or automation system.
3. Firestats shall be equipped with high limit temperature sensors meeting requirements of NFPA 92A by returning damper to fire protection mode when temperature reaches 350°F.
H. Furnish EP switches where pneumatic operators are used.
I. Submit UL installation details showing mounting method and duct connection method.

2.3 FACTORY MOUNTED ACTUATORS
A. Pneumatic Diaphragm with Spring Return:
   1. Provide spring return feature for fail closed positions.
B. Discrete Two-Position Electric:
   1. Provide spring return feature for fail open or closed positions as required by control sequence.

PART 3 - EXECUTION
3.1 SMOKE DAMPERS
A. Furnish smoke dampers as shown on drawings or as required to perform control sequences specified.
B. Furnish factory mounted actuator mounted outside airstream.
C. Coordinate delivery, storage and installation.
D. Coordinate final power requirements and locations.

3.2 COMBINATION FIRE AND SMOKE DAMPERS
A. Furnish combination fire/smoke dampers as shown on drawings or as required to perform control sequences specified.
B. Furnish factory mounted actuator mounted outside airstream.
C. Coordinate delivery, storage and installation.
D. Coordinate final power requirements and locations.

3.3 FACTORY MOUNTED ACTUATORS
A. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
B. Fail smoke dampers serving pressure rated heat exchangers or converters closed unless otherwise shown.

END OF SECTION
SECTION 25 5400
MONITORING AND CONTROL OF PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
   A. Systems include monitoring for the following:
      1. Water Distribution Systems
      2. Water Heating Systems
      3. Fuel Tank Monitoring Systems
   B. Related Sections:

1.2 REFERENCES

1.3 SUBMITTALS
   A. Submit products not specified but required for integration of systems.

1.4 QUALITY ASSURANCE
   A. Install equipment according to manufacturers recommendations

1.5 WARRANTY
   A. Refer to section 25 0000.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 GENERAL
   A. Coordinate Water Distribution System with Division 22 specifications.
   B. Coordinate Fuel Tank integration and monitoring requirements with Division 22. Include the following list of points for monitoring from BAS.
      1. Communications Fault
      2. Leak Alarm
      3. Overfill Alarm
      4. Theft Alarm
      5. High Water Alarm

END OF SECTION
SECTION 25 5400
MONITORING AND CONTROL OF PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
   A. Systems include monitoring for the following:
      1. Water Distribution Systems
      2. Water Heating Systems
      3. Fuel Tank Monitoring Systems
   B. Related Sections:

1.2 REFERENCES

1.3 SUBMITTALS
   A. Submit products not specified but required for integration of systems.

1.4 QUALITY ASSURANCE
   A. Install equipment according to manufacturers recommendations

1.5 WARRANTY
   A. Refer to section 25 0000.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 GENERAL
   A. Coordinate Water Distribution System with Division 22 specifications.
   B. Coordinate Fuel Tank integration and monitoring requirements with Division 22. Include the following list of points for monitoring from BAS.
      1. Communications Fault
      2. Leak Alarm
      3. Overfill Alarm
      4. Theft Alarm
      5. High Water Alarm

END OF SECTION
SECTION 25 5500
INTEGRATED AUTOMATION CONTROL OF HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Equipment monitoring of HVAC equipment throughout the facility including but not limited to:
   1. Computer Room Air Conditioners
   2. VFD’s
   3. Chillers
   4. Boilers

B. Related Sections:
   1. 25 1300 Control and Monitoring Network
   2. 25 1219 Integration Protocols

1.2 DEFINITIONS

A. HOA Hand Off Auto (usually referring to equipment switch)

B. VFD Variable Frequency Drive

1.3 SYSTEM DESCRIPTION

A. Include all components not specifically indicated or specified, but necessary to make the system
   function within the intent of the specification

B. Coordinate installation of instrumentation, including but not limited to:
   1. Power requirements
   2. Panel locations
   3. Commissioning
   4. User access

C. Coordinate protocol requirements for integration to each piece of equipment. Refer to section 25
   1219 for protocol requirements.

D. Refer to Division 23 specifications for additional equipment information.

1.4 SUBMITTALS

A. Submit point-list and protocol information required for integration.

B. Submit products not specified but required for integration of systems.

1.5 QUALITY ASSURANCE

A. Install equipment according to manufacturers recommendations

B. Include auxiliary containers, immersion solutions/product, etc to minimize effects of routine
   operations, such as product inventory, product replacement, periodic door openings, compressor
   cycles, etc.
C. Safeties shall operate regardless of equipment HOA position or mode of operation, unless otherwise noted.

1.6 WARRANTY

A. Refer to section 25 0000.

PART 2 - PRODUCTS

2.1 NOT USED.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide Integrator/Driver to ensure seamless communications with HVAC equipment.

B. Integrate to HVAC equipment including VFD’s, Computer Room Air Conditioners, Chillers, Boilers, etc.

C. Coordinate network requirements with sections 25 1300.

D. Coordinate VFD monitor requirements with Division 23 specifications.

E. Coordinate Computer Room Air Conditioning monitor requirements with Division 23 specifications.

F. Coordinate Chillers, Boilers requirements with Division 23 design specification sections.

3.2 INTEGRATED HVAC EQUIPMENT POINTS

A. Include the following list of points for monitoring and control from the building automation system. Engineer to coordinate with Owner for points that are required to be controlled from BAS.

1. Computer Room Air Conditioners
   a. Unit Status
   b. Global Alarm
   c. Space Temperature Setpoint
   d. Space Humidity Setpoint
   e. Space Temperature
   f. Space Humidity
   g. Supply Air Temperature
   h. Fan Status
   i. Cooling Coil Control Valve Position
   j. Compressor Run Time

2. Variable Frequency Drives
   a. Speed Feedback
   b. Alarm
   c. Run time
   d. Power Consumption
   e. Power Consumption Totalized
   f. Setpoint
g. Drive Speed
h. Frequency
i. Current
j. Power
k. Last Fault Number
l. OK/Faulted Status
m. Stop/Run Status
n. Hand/Off/Auto Status

3. Chillers
   a. Chilled Water Flow Status
   b. Chilled Water Supply Setpoint
c. Chilled Water Totalization
d. Chiller Alarm Descriptor
e. Chiller Active Setpoint
f. Chiller Enable/Disable
g. Chiller Status
h. Communications Status
   i. Compressor Discharge Refrigerant Temp
   j. Compressor Run Time
   k. Compressor Running
   l. Condenser Refrigerant Pressure
   m. Condenser Refrigerant Temperature
   n. Current Demand Limit Setpoint
   o. Current Per Line
   p. Entering Chilled Water Temperature
   q. Entering Condenser Water Temperature
   r. Evaporator Refrigerant Pressure
   s. Evaporator Refrigerant Temperature
t. Leaving Chilled Water Temperature
   u. Leaving Condenser Water Temperature
   v. Refrigerant Monitor
   w. Voltage per Phase

4. Boilers
   a. Heating Hot Water Flow Status
   b. Heating Hot Water Supply Setpoint
c. Boiler Alarm Descriptor
d. Boiler Active Setpoint
e. Boiler Enable/Disable
f. Boiler Status
g. Communications Status
   h. Entering Heating Hot Water Temperature
   i. Leaving Heating Hot Water Temperature

END OF SECTION