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Construction Specification Manual

Salt River Project

Technical Specification Index – September 2021

Division 25

Division	Title	Updated
DIVISION 25:	**INTEGRATED AUTOMATION**	
250000	Requirements for Integrated Automation	New 04/21
251100	Network Devices	New 04/21
251200	Network Configuration	New 04/21
251400	Field Devices	New 04/21
251500	Software	New 04/21

SECTION 25 00 00

INTEGRATED AUTOMATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general requirements for the SRP building automation system.

B. Related Sections:
1. 01 91 00 Commissioning Program
2. 01 91 13 General Commissioning Requirements
3. 23 09 23 Instrumentation and Controls for HVAC
4. 23 09 93 Sequences of Operations for HVAC Controls
5. 25 11 00 Integrated Automation Network Devices
6. 25 12 00 Integrated Automation Network Configuration
7. 25 14 00 Integrated Automation Field Devices
8. 25 15 00 Integrated Automation Software

C. Coordination with other trades is required wherever architectural features govern the location of work.

1.2 REFERENCES

A. Any rules and regulations of Federal, State, local authorities, and utility companies in force throughout the contract duration.

B. Appendix A Object Naming Standard

C. Appendix B Graphic Standard for Niagara N4

D. Appendix C Device Data Spreadsheet

E. Appendix D Object Naming Spreadsheet

F. Agencies relevant to this specification:

1.	ANSI	American National Standards Institute
2.	ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
3.	BTL	BACnet Testing Laboratories
4.	FCC	Federal Communications Commission
5.	IEC	International Electrotechnical Commission
6.	ISO	International Organization for Standardization

7.	NEC	National Electrical Code
8.	NEMA	National Electrical Manufacturers Association
9.	OSHA	Occupational Safety and Health Administration
10.	UL	Underwriters Laboratories

G. Publications relevant to this specification:

1. ANSI/ASHRAE Standard 135-2016, A Data Communication Protocol for Building Automation and Control Networks
2. ASHRAE 223P (expected 2019) - Designation and Classification of Semantic Tags for Building Data
3. ISO 16484-5:2017 - Building Automation and Control Systems (BACS) -- Part 5: Data communication protocol

1.3 ACRONYMS

A.	B-AAC	BACnet Advanced Application Controller - Profile with criteria defined by BACnet International
B.	B-ASC	BACnet Application Specific Controller - Profile with criteria defined by BACnet International
C.	B-BC	BACnet Building Controller - Profile with criteria defined by BACnet International
D.	BAS	Building Automation System – The primary software used to read and/or write data to any building system.
E.	BBMD	BACnet Broadcast Management Device capable of forwarding BACnet broadcast messages across subnetworks.
F.	BIBB	BACnet Interoperability Building Blocks – Standardized documentation of a devices BACnet functionality across the network.
G.	BTL	BACnet Testing Laboratories supports interoperability testing for BACnet device
H.	EMS	Energy Management System
I.	COV	Change of Value - Trending increment that records data every time a value changes a pre-specified amount.
J.	DDC	Direct Digital Controller containing internal programming logic and input/output capabilities and is typically directly associated with equipment
K.	PID	Proportional, Integral, Derivative - Control algorithm used to adjust an output based upon the difference between a process variable and setpoint variable
L.	INT	Interval - Trending increment that records data on a pre-defined time interval.
M.	IP	Internet Protocol - Set of rules governing the format of data

		sent over the internet or other networks
N.	GUI	Graphical User Interface – Term for any graphical pictation allowing user to read/write data
O.	LAN	Local Area Network – A collection of devices interconnected in one physical location
P.	O&M	Operations and Maintenance – Term to define documentation that illustrates both the operation and maintenance of a product.
Q.	PICS	Protocol Implementation Conformance Statement used to describe the BACnet capabilities of a device
R.	SaaS	Subscription as a Service – Service or application subscribed for use on while on a re-occurring payment.
S.	SLA	Service Level Agreement - A commitment between a service provider and a client.
T.	UDP	User Datagram Protocol
U.	XML	Extensible Markup Language - A markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

1.4 DEFINITIONS

A.	Algorithm	A process or set of rules to be followed in calculations or other problem-solving operations.
B.	BACnet	Building Automation and Control Networks communication protocol developed by ASHRAE.
C.	BACnet Object	The concept of organizing BACnet information into standard components with various associated properties.
D.	Bridge	A repeater that connects two LANs on same network protocol across different data link layers
E.	Cloud	Referencing any data storage on an off-site location not maintained by the client
F.	Controls Contractors	The contractors installing and configuring the devices being installed on the SRP network
G.	Date of acceptance	The date determined between SRP and the contractor that the equipment is finalized and tested, and is turned over to SRP
H.	Device	Term for any type of DDC or network component used for monitoring or control
I.	Enterprise	Software used to satisfy the needs of an organization. Used as the interface for all integrated building management equipment.
J.	Ethernet	A computer networking architecture consisting of various

		local-area networking protocols and devices
K.	Equipment	Term referencing a controlled component
L.	FAULT	BACnet Notification state indicating that loss of communication or sensor
M.	Firmware	Permanent software programmed into read-only memory and provides low level hardware control
N.	Gateway	Connects two dissimilar protocols by translating the data from one system to another system.
O.	Integration Contractor	The contractors responsible for the integration of the devices being installed on the SRP network.
P.	Integration Project	Any project requiring data passing between installed controls any of SRP systems, including but not limited to the BAS Supervisor.
Q.	Hub	A common connection point for devices on a network
R.	Integrate	The act of connecting disparate BMS systems to a common platform
S.	Integrator	Integrates one system into another by acting as both a router and a gateway, and is capable of other functions including trending, scheduling, notifications, and other programming features.
T.	IP Address	A unique string of numbers separated by periods that identifies each computer using the internet protocol to communicate over a network.
U.	Loop	Synonymous with PID
V.	OFFNORMAL	BACnet Notification state indicating that a parameter is met to indicate an off normal event.
W.	Network	Multiple devices communicating with one another
X.	Non-Programmable	A device that has pre-programmed language or logic that cannot be re-written or only has pre-selectable options
Y.	Notification Object	A BACnet Object that is used to send event notifications, including alarms, within a BACnet System
Z.	Object	Data or packet or data on a network
AA.	SRP	Referring to Salt River Project or representative approved by SRP
BB.	Points	Software representation of virtual and physical inputs and outputs
CC.	Programmable	A device that does not have any pre-programmed language or logic.
DD.	Repeater	A device used to replicate signal data in order to increase transmission distance

EE.	Router	Routes data packets across IP addresses on different LANs/WANs with the ability to allow or deny
FF.	Subnet	Also knowns as a subnetwork, is a logical subdivision of a network
GG.	System	Term referencing multiple pieces of equipment acting in conjunction

1.5 SYSTEM DESCRIPTION

A. SRP has standardized an open system architecture for complete integration of new and existing components of the building automation system. This open system standardization will ensure continued building automation system interoperability between all sub-systems.

B. This standardized system must have the ability to allow for stand-alone operation of any sub system in the event of communication failure.

C. Project requirements are divided between responsibilities of Controls Contractor and Integration Contractor. If Controls Contractor and Integration Contractor are the same contractor, all approvals will still have to be completed by SRP as outlined in this division document.

1.6 SUBMITTAL REQUIREMENTS

A. All submittals must meet the requirements of Section 01 30 00.

B. All submittals listed in this division document are in addition to the respective division submittal requirements.

C. Submittals must be reviewed by SRP and/or a consultant for SRP for conformity with the design intent. Execution of work will not be performed until SRP has approved submittals.

D. Manufacturer datasheets that contain a series of components must clearly indicate the specific component that is applicable to this project. Each submitted piece of manufacturer literature will clearly reference the specification or drawing that the submittal is to cover. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

E. Contractor is required to provide their submittals in a timely manner to allow for timely review, resubmittal as needed, and final approval before proceeding with work. Failure to submit in timely manner does not alleviate Contractor from meeting the project schedule unless they receive approval of schedule change by SRP.

F. The following submittal documentation process is required to be completed throughout the life of the project. The basis of design for these submittals are defined as follows:

1. DEVICE CONFIGURATION – A template XLSX document provided to the Controls Contractor by SRP that contains a comprehensive list of required device information that the Controls Contractor must collect, as well as an SRP pre-

approved list of Device IDs pertaining to all integrated devices that the Controls Contractor must use. This document will be utilized by the Integration Contractor to ensure proper integration into the Building Management System and will be provided to SRP for filing at project completion.

2. DEVICE OBJECT IDENTIFICATION – A template XLSX document provided to the Controls Contractor by SRP to identify the objects that will be available on the network. This will include the object name matching the SRP standard, and identify the trending, notifications, and configuration for each individual object per device. For Programable devices, this includes every object. For Non-Programmable devices, this will include only the approved object to be proxied, and the additional information for configuration to be done by the Integration Contractor on the Niagara Supervisor.
3. DEVICE LAYOUT – A PDF document created by the Controls Contractor for each unique device indicating detailed wiring diagram for each of its components, all panel and component information including quantity and model numbers, location of power source feeding device(s). Document also to include the device model, series, location, and network configuration.
4. EXISTING NETWORK– A VISIO document will be provided by SRP with existing network layout prior to execution of project. The Controls Contractor will then update the network layout reflecting work done during project, matching both SRP's formatting and layout as part of their closeout package.
5. NETWORK LAYOUT – A PDF document created by the Controls Contractor to indicate in a traditional line diagram how existing and new devices in the project will be interconnected and how they will reside on the SRP network. This will indicate not only the type of device, but also protocol, and at completion include the network configuration.

1.7 SUBMITTALS

A. The following submittals will be provided as part of the bid package:

1. Cover page and table of contents for all submitted hardware, software, etc.
2. Hardware Product Data – Provide manufacturer's technical literature for each specified integration device. Minimum technical data requirements must include device dimensions, performance characteristics, electrical characteristics, and installation/startup instructions.
3. PICS statement, BIBB, and BTL listing documents for all BACnet devices.
4. Documentation stating conformance to Modbus Organization for all Modbus devices.
5. Software Product Data - Provide manufacturer's technical literature for the programming software required for each specified integration device. Minimum technical data requirements must include operating system requirements, system resource requirements, programming style, network support, and any required 3rd party drivers and/or applications.
6. Project Team Qualifications – Provide Controls Contractor and Integration Contractor team qualifications. The project team or teams are required to meet the minimum amount personnel noted in Section 25 00 00, Subsection 3.2. Project

team qualifications must meet or exceed the contractor requirements noted in Section 25 00 00, Subsection 1.8.

B. The following submittals will be provided as part of the pre-submittal package:

1. Device Configuration - The information required for initial prior to network addressing assignments includes the following:
   a. Device Name following the SRP standard naming
   b. Device Description describing all the equipment, systems, or portions of that will be controlled or monitored with the device.
   c. Manufacturer
   d. Model number
   e. Series
   f. Firmware version
   g. Protocol
2. Pre-submittal Network Layout – The information required for initial approval prior to product procurement includes the following:
   a. All devices being installed with device name following the SRP standard naming
   b. Any network devices required to be used as gateways or integrators
   c. Manufacturer and model number for each device
   d. Any existing devices that will be utilized on the network including data sharing across the LAN network
   e. Labeling of all networks with protocol type and communication wire type specified or existing.
3. Device Object Identification – The information required for initial approval requires for following for non-programmable devices, and only hardwired objects for programmable devices.
   a. Object Name following the SRP standard naming
   b. Raw Object Name if Object Name cannot be changed internal to the device
   c. Object Type
   d. Object Description
   e. Object Engineering Units
   f. Object Precision
   g. Object Trend Type and Configuration
   h. Object Notification Configuration

C. The following submittals will be provided as part of the submittal package:

1. Cover page and table of contents for every page/document included in the submittal package:
2. Device Configuration – Continuation of Device Configuration requiring the following information before submittals can be approved are as follows:
   a. Network ID for each individual network
   b. Device IDs for each device
   c. DHCP configuration for IP devices
   d. Previous device in daisy chain installation
   e. Hosted Network Information
3. System Graphics – A graphical representation will be presented for each unique system. All graphics provided by the Integration Contractor in this submittal will be based on the SRP graphical standard.

4. Network Layout – An update of the Pre-submittal Network Layout with the following information:
   a. Network ID for each individual network
   b. Device IDs for each device
   c. IP address or Device Instance Number for each device
5. Device Layout – A PDF layout for each unique device requiring the following information:
   a. Device layout with enclosure information, enclosure ID, device name, IP address of Device ID, and manufacturer and model number
   b. Connection to all peripheral equipment with point naming matching the SRP standard, wiring layouts, and bill of material including manufacturer, part numbers, and quantities.
   c. Location of installation for each device and expansion module including panel numbers
   d. Power wiring including power source location, electrical panel number, and breaker number.
   e. Communication wiring including the previous and next device if daisy chain configuration, and switch/port information if IP device.
6. Hardware and Software requirements for any proposed software installations as stated in section *25 11 00 Integrated Automation Software*.
7. Schedule of work provided within one month of contract award, indicating:
   a. Intended sequence of work items
   b. Start date of each work item
   c. Duration of each work item
   d. Planned delivery dates for ordered material and equipment and expected lead times
   e. Milestones indicating possible restraints on work by other trades or situations
   f. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

D. The following submittals will be provided as part of the programming stage as device information becomes available before devices can be installed on the SRP network:
   1. Device Configuration – Continuation of Device Configuration requiring the following information before devices are installed are as follows:
      a. Device Instance Number
      b. Switch ID
      c. Port ID

E. The following will be provided as part of the Checkout Forms for each device
   a. A checkout form will be provided for each device. The checkout form will include, but is not limited to, the following:
      i. Point-to-point testing
      ii. Device Communication Status
      iii. Communication Errors and Repair Requirements
      iv. GUI Function Tests at All Operator Stations

F. The following will be provided as part of the final close-out package:
   1. Cover page and table of contents for every page/document included in the close-out package
   2. Final Network Layout Document in PDF format
   3. Updated SRP's Existing Network Layout Document in VISIO format
   4. Final Device Configuration Document in XLSX and PDF format
   5. Final Device Object Identification in XLSX format
   6. Final Device Layout for each unique device with final updated information, in PDF format
   7. User manuals for all installed or updated software, or any web-based software required for device configuration or programming.
   8. Back-up documents for all configured devices, named with the date of back-up and the device name
   9. O&M manuals in PDF including the following:
      a. Instructions on how to perform any functions, features, etc. mentioned during customer training. This includes any technical manuals for programming and control loop tuning
      b. Complete set of software engineering manuals
      c. Complete system design and engineering manuals as used by manufactures
      d. Copies of all software used for programming and device configuration
      e. Hardware and software maintenance instructions
      f. Equipment submittals, parts lists, installation instructions, etc.
      g. Licensing and warranty information
   10. Deficiency log for any devices or components on pre-existing devices identified during execution of project.

1.8 QUALITY ASSURANCE

A. Coordinate all related network infrastructure changes with SRP. Any changes to network components or infrastructure without prior authorization from SRP is not permitted.

B. The Controls Contractor must adhere to the qualification requirements stated in Division 23, Section 23 09 23.

C. The Integration Contractor must have a minimum of five (5) years of demonstrated technical expertise with building automation systems as well as any subsystem requiring integration during the project duration.

D. Integration Contractor must have a minimum of two (2) full time employees that are Niagara N4 certified and have deployed Niagara N4 software and hardware on a minimum of two (2) or more previous projects. At contract award, at least one (1) Niagara N4 certified employee will be assigned to the project.

E. Materials and equipment will be the catalogued products of manufacturers who regularly engage in production and installation of building automation systems. Materials and equipment will be the manufacturer's latest design that complies with the specification requirements.

F. SRP reserves the right to make the final determination of the qualifications of any Contractor's employees and will have the Contractor's employees removed from the project if they so choose. SRP will make a request in writing to Contractor citing the circumstances and the Contractor will replace any unqualified employee within three (3) business days with no impact to project schedule.

G. Station review must be completed in an interactive working session with SRP personnel. At the conclusion of each review session, a copy of any JACE or Supervisor station backup will be provided in .dist format and submitted to SRP for record purposes.
   1. All hardware, software, components, and accessories must be:
      a. New from the factory
      b. In production and not a legacy product
      c. Supported by the manufacturer
      d. Free of defects
      e. Provided by the same manufacturer for each product type throughout the duration of the project

H. Follow project communication protocol for all correspondence. Any changes, decisions, etc. must be properly documented. Verbal interpretations, clarifications, conversations, etc., are non- binding without proper documentation.

I. RFIs sent to SRP are to address individual requests only with a proposed solution. Multiple issues or incomplete RFI's will be rejected. RFIs will include, but not limited to, the following:
   1. Referenced Drawing
   2. Referenced Specification Number/Section
   3. Contact Person
   4. Request and Proposed Solution

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

1.9 WARRANTY

A. See respective divisions for additional warranty requirements
   1. Section 23 09 23 for DDC warranty requirements.

B. Warranty documentation will be submitted for acceptance to SRP upon completion of the project. SRP and/or a consultant on behalf of SRP will provide written acceptance once it has been determined that the building management system functions satisfactorily during the testing and commissioning phase.

C. Vendor specific warranty information will be provided as part of the Contractor warranty documentation. Any manufacturer's warranty that exceeds 24 months will be extended to SRP.

D. The warranty start date will be the date of acceptance and will be for a period of 12 months after final acceptance.

E. Device failures during the warranty period will be adjusted, repaired, or replaced with no additional cost to SRP.

F. Any standard troubleshooting or routine maintenance completed by SRP will not void any warranty or incur any additional costs.

G. Contractor will respond during normal business hours within 24 hours of a warranty service request.

H. All corrective software modifications made during the warranty period will be updated on all project documentation and updated software files will be provided to SRP for record purposes.

I. Software fixes and firmware updates will be covered throughout the warranty duration with no additional cost to SRP. With approval of SRP and assurance that no existing equipment connections will be adversely affected, patches and updates will be applied within 72 hours of becoming available from the manufacturer.

J. At the end of the warranty period, the Contractor will be responsible for verifying any instance of Tridium Niagara software and firmware is updated to the latest revision.

K. Expiration of the warranty period does not relieve the Contractor of the responsibility to:
   1. Correct all deficiencies identified during the warranty period
   2. Fulfill all specified obligations during the warranty period

L. The Contractor will not be required to warranty reused devices, except those that have been rebuilt or repaired. Reused devices must demonstrate they are in operable condition at the time of acceptance.

M. Parts, labor, and travel will be included during the warranty duration.

1.10 OWNER TRAINING

A. Owner training for integrated equipment will be performed by the Integration Contractor and will be specific to the building management system and any subsystem integrated during the project.

B. Training will not be scheduled until all integrated systems and GUI components are completed, functional and approved by SRP.
   1. If device integration coincides with other subsystem installation, owner training for subsystems may be completed in parallel with training mentioned within this specification.

C. Based upon project size, a minimum of 8 hours of training will provided to SRP, organized into two (2) separate sections at four (4) hours a piece, unless otherwise stated by SRP.

D. Provide a factory-trained instructor or representative 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. The Contractor will provide all equipment and material required for classroom training.

E. Proposed training instructor qualifications will be provided to SRP and subject to approval by SRP.

F. Training will include classroom instruction and hands on field instruction.

G. Minimum requirements for classroom instruction are the following:
   1. Review of project record documentation
   2. Maintenance procedures and schedules
   3. Any pertinent safety requirements
   4. Operator control functions
   5. GUI navigation, including:
      a. Login/logout procedures, password setup, and audit log reporting
      b. Menu penetration and broad overview of the various functions and features
   6. Explanation of Supervisor and JACE station backup procedures
   7. Explanation of procedures to restore any Niagara database. Scenarios to explain include:
      a. Corrupted database restoration
      b. Restoration of database in a new JACE replacing a failed JACE
   8. A detailed review of Niagara wiresheet programming, trending, and alarm database management.
   9. Training manuals will be provided and include screen captures with detailed instructional annotation for each step required to complete all portions of SRP training.
   10. Additional topics can be requested by SRP in advance of the training sessions. Each additional topic will require the Contractor to prepare and submit training manuals with the same level of detail as described above.
   11. All training is subject to be recorded by SRP for internal use.

H. Minimum requirements for field instruction:
   1. Walkthrough of the project to locate integrated components
   2. Demonstration of operation from Supervisor to integrated equipment

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project specific software and all related documentation will become the property of SRP. This includes, but is not limited to, the following:
   1. Graphical Templates
   2. Project Record Drawings
   3. Station Databases
   4. Custom Logic

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination requirements will comply with Division 23, Section 23 09 23. Where the examination requirements of Section 25 00 00 differ from Division 23, Division 23 will take precedence but will not supersede any additional requirements noted herein.

B. Perform site inspection prior to work performed to verify equipment can be installed as noted in the project documentation.

C. Report any discrepancies, conflicts, inadequate conditions, or omissions related to project documentation to Engineer. Resolution must be provided prior to starting rough-in work. Report unacceptable conditions immediately.

D. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. The Controls Contractor will perform, at the Control Contractors expense, necessary changes in specified work caused by failure or neglect to report discrepancies.

E. Promptly request clarification and instruction related to project documentation through the proper RFI procedure.

3.2 PROJECT MANAGEMENT

A. The Contractor will provide the following, in writing:
   1. One employee of the Contractor whose primary responsibility is managing the project. Herein, this person will be known as the Contractor’s Project Manager
   2. One employee of the Contractor whose primary responsibility is supervising installation of the physical building management system hardware. Herein, this person will be known as the Contractor’s Installation Supervisor
   3. One employee of the Contractor whose primary responsibility is to program controllers, program the building management system database, and implement naming and graphical standards provided by SRP. Herein, this person will be known as the Contractor’s Chief Programmer.
      a. Based on the size of the project, more than one programmer, who is an employee of the Contractor, may be utilized. Herein, these people will be known as the Contractor’s Assistant Programmers
      b. Any work performed by the Contractor’s Assistant Programmers must be checked and verified by the Contractor’s Chief Programmer prior to implementation

B. The Contractor will provide the above no later than the project kick-off meeting.

C. The contractors may be split into a Controls Contractor and an Integration Contractor. If the Controls Contractor and the Integration Contractor are the same contractor, approval for each submittal by SRP is still required.

D. The project will generally be divided up into four (4) stages:
   1. Stage 1, Programming
      a. The period between submittal approval, where equipment will be procured and all programming and configuration that can be will be completed prior to installation.
   2. Stage 2, Installation
      a. The period between project start until the physical installation of all controllers, servers, software, and other integration applicable devices has been completed.
   3. Stage 3, Integration and Standards Implementation
      a. The period between the end of Stage 2 until all integratable equipment related to the project have been integrated into the building management system and graphical and naming standards have been implemented.
   4. Stage 4, Project Closeout
      a. The period between the end of Stage 3 until SRP has provided written acceptance of the project.

E. The Contractor will attend all project meetings and provide meeting minutes and action items to all meeting attendees.
   1. Meeting minutes will represent a true and accurate record of the project meeting
   2. Corrections or clarifications to project meeting minutes will be provided by the Contractor within one (1) work week of the issuance date of the project meeting minutes.

F. Project meetings will occur as follows:
   1. During all project stages, project meetings will occur as determined by SRP. SRP will give a minimum of one (1) week notice in advanced of project meeting dates and times.
   2. During all project stages, the Contractor will provide an updated project schedule, with all applicable milestones, at least one (1) day prior to the project meeting.
   3. During Stage 2, the Contractor's Project Manager or the Contractor's Installation Supervisor will be required to attend all project meetings.
   4. During Stage 3, the Contractor's Project Manager and Contractor's Chief Programmer will be required to attend all project meetings.
      a. If requested by SRP, the Contractor's Assistant Programmers may be required to attend project meetings.
   5. During Stage 4, the Contractor's Project Manager and Contractor's Chief Programmer will be required to attend all project meetings.
      a. If requested by SRP, the Contractor's Assistant Programmers may be required to attend project meetings.

G. The Contractor accepts that during Stage 3, SRP may rely on third party consultants to complete an independent review of the Contractor provided project deliverables.

H. The Contractor will maintain red lined copies of as-built drawings on site at all times.

3.3 INSTALLATION

A. All control wiring and device installation will comply with any national and local electrical codes, Division 23, Division 26, and any manufacturer recommendations. Where the requirements of Section 25 00 00 differ from Division 23 or Division 26, Division 23 or Division 26 will take precedence but will not supersede any additional requirements noted herein.

B. All network activities will be coordinated with SRP prior to any work performed.

C. Beginning installation means contractor accepts existing conditions.

D. Verify elevations and measurements prior to installation of materials.

E. Verify door swings for proper clearance before installing.

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

G. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform.

H. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

I. Install equipment with ample space allowed for removal, repair, or changes to equipment. Provide easy access to equipment and wiring without requiring movement of other equipment, which is to be installed or which is already in place.

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

K. Provide enough slack, flexible connections, and isolation to allow for equipment vibration.

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

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

N. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.4 BUILDING MANAGEMENT SYSTEM SWITCH OVER

A. Switch over from the existing building management system to the new building management system will be coordinated with SRP. A representative of SRP may be on site during switch over.

B. Any required downtime to subsystems scheduled for integration into the building management system will be limited to 24 hours.
   1. For integration of HVAC equipment, space temperatures must be maintained in occupied spaces levels approved by SRP throughout the duration of any expected building management system downtime.

C. Sufficient testing of equipment scheduled for integration will be completed before switch-over to ensure readiness, including point to point checkouts and functional testing if necessary.

D. Functional performance tests of integrated equipment will be performed once integration and switch over has been completed.
   1. Functional performance tests will comply with Division 1, Sections 01 91 00 and 01 91 13 and Division 23, Section 23 09 23.
   2. Demonstration of control loop response and adherence to sequences of operation will not be required for integrated field devices not scheduled for replacement, unless otherwise specified by SRP.
   3. The Integration Contractor will allow time to perform function tests of all integrated equipment with a consultant on behalf of SRP prior to project completion.

3.5 BUILDING MANAGEMENT SYSTEM EQUIPMENT DEMOLITION

A. Demolition of existing building management system hardware and/or software scheduled for replacement will not occur until SRP has confirmed demolition may commence.
   1. The Integration Contractor will be responsible for steps taken to minimize equipment outages wherever possible.
   2. A demolition plan will be submitted to SRP for approval. The demolition plan must be submitted no later than two weeks prior to commencement of work on site.
   3. Demolished building management system hardware will be handed over to SRP once demolition is complete, unless otherwise stated by SRP.

END OF SECTION

APPENDIX A – OBJECT NAMING STANDARD

1.1 SUMMARY

A. The Object Naming Standard will pertain to all new BACnet devices.

B. Standard objects include:
   1. Schedule Objects.
   2. Trend Objects.
   3. Notification (Alarm) Objects.
   4. Control and Monitoring Objects.

C. Existing devices will not be required to adhere to the Object Naming Standard, unless otherwise specified by SRP.
   1. If the Object Naming Standard is requested for use by SRP for existing devices, it is the responsibility of the Controls Contractor to investigate object character limitations for older controller lines before implementation.

D. Object names will be the combination of several elements that are represented by a standardized list of abbreviations.
   1. If an abbreviation for a new object does not exist in this naming standard, the Integration Contractor will generate a new object based upon the standardized list of abbreviations. This new object will then be submitted to SRP for approval prior to implementation.

1.2 OBJECT NAMING STRUCTURE

A. Object names will be structured as follows:
   1. [Device Identifier]_[Object Identifier]

B. Device Identifier Structure:
   1. Will be provided to the Controls Contractor by SRP alongside the Device Configuration spreadsheet.
   2. Will mimic the asset management identifiers currently in place at SRP.
   3. Structure:
      a. [Site][Building][Equipment Type][Floor][Equipment Number]
   4. Characters will total of 10 or 11.
      a. 11 characters are permitted for equipment counts greater than 99 on a single floor (e.g. VAVs).
      b. For all other equipment, maximum allowable characters will be 10.

C. The Object Identifier will be named accordingly based upon the object function and will adhere to the standardized abbreviations noted within this appendix.

D. Spaces and special characters are not permitted for use in the object naming structure.
   1. Underscores (“_”) are the exception and may be used in lieu of an empty space between the Device Identifier and the Object Identifier.

E. Complete Object Name Example:
1. Credit Union Building, Building 1, Air Handler 1, First Floor, Supply Fan 1 Enable.
a. CU01AHU101_SaFan1Ena.

1.3 ABBREVIATIONS AND TYPICAL SYSTEM OBJECTS

A. Site Locations
1. *16* – 16th Street Facility.
2. *27* – 27th Street Facility.
3. *CO* – Corbell Data Center.
4. *CU* – Credit Union Building.
5. *EV* – East Valley Service Center.
6. *FH* – Fountain Hills.
7. *FT* – Foothills Training Center.
8. *IS* – Information Services Building.
9. *KY* – Kyrene Generating Station.
10. *PA* – Project Administration Building.
11. *PB* – Papago Buttes Facility.
12. *PC* – Pinal Customer Center.
13. *PO* – Power Operations Building.
14. *SH* – Sky Harbor.
15. *SS* – Southside Water Facility.
16. *ST* – San Tan Generating Station.
17. *TE* – Tempe Service Center.
18. *WV* – West Valley Service Center.
19. *XC* – Crosscut Facility.

B. Equipment
1. *AHU* – Air Handling Unit.
2. *ACU* – Air Conditioning Unit.
3. *BOI* – Boiler.
4. *CHL* – Chiller.
5. *CAC* – Computer Room Air Conditioning Unit.
6. *CTW* – Cooling Tower.
7. *FCU* – Fan Coil Unit.
8. *FPB* – Fan Powered Box.
9. *MUA* – Makeup Air Unit.
10. *PMP* – Pump.
11. *ACU* – Roof Top Unit/Air Conditioning Unit.
12. *VAV* – Variable Air Volume Unit.

a. Note: *VAV* encompasses all terminal unit types.

C. Cooling (Air)/Heating (Air)/Actuated Objects

1. Coil Objects:
   a. Coil objects will be prepended with the system type (xxx). System types include:
      i. *Chw* – Chilled Water.
      ii. *DirEvap* – Direct Evaporative.
      iii. *Hw* – Hot Water.
      iv. *IndEvap* – Indirect Evaporative.
   b. Hardwired Input Objects:
      i. *(xxx)CoilEntAirTmp* – Coil Entering Air Temperature (°F).
      ii. *(xxx)CoilLvgAirTmp* – Coil Leaving Air Temperature (°F).
      iii. *(xxx)CoilRTmp* – Coil Water Return Temperature (°F).
      iv. *(xxx)CoilSTmp* - Coil Water Supply Temperature (°F).
2. Staged Objects.
   a. Staged objects will be prepended with the system type (xxx) followed by the stage number (n).
   b. Example: DX Stage 1 | DxStg1
   c. System types include:
      i. *Dx* – Direct Expansion.
      ii. *ElecHt* – Electric Heating.
      iii. *GasHt* – Gas Heating.
   d. Where only a single stage exists within the system, object will still be named “Stg1”.
   e. Hardwired Input Objects:
      i. *(xxx)Stg(n)Alm* – Stage Alarm (Alarm/Normal).
      ii. *(xxx)Stg(n)EntAirTmp* – Stage Entering Air Temperature (°F).
      iii. *(xxx)Stg(n)LvgAirTmp* – Stage Leaving Air Temperature (°F).
      iv. *(xxx)Stg(n)Sts* – Stage Status (On/Off).
   f. Hardwired Output Objects:
      i. *(xxx)Stg(n)Cmd* – Stage Command (On/Off).
      ii. (xxx)*Stg(n)Ena* – Stage Enable (On/Off).
   g. Virtual Read Only Objects:
      i. *(xxx)Stg(n)FailAlm* – Stage Fail Alarm (Alarm/Normal).
      ii. *(xxx)Stg(n)HandAlm* – Stage in Hand Alarm (Alarm/Normal).
      iii. *(xxx)Stg(n)Lckout* – Stage Lockout (Locked Out/Normal).
      iv. *(xxx)Stg(n)LpTm* – Stage Loop Time Setpoint (Minutes).
      v. *(xxx)Stg(n)RnTm* – Stage Run Time (Hours).
   h. Virtual Read/Write Objects:
      i. *(xxx)Stg(n)FailAlmDly* – Stage Fail Alarm Delay (Seconds).
      ii. *(xxx)Stg(n)HandAlmDly* – Stage in Hand Alarm Delay (Seconds).
      iii. *(xxx)Stg(n)IntDly* – Stage Delay (Seconds).
      iv. *(xxx)Stg(n)LckoutRst* - Stage Lockout Reset (Reset/Off).
      v. *(xxx)Stg(n)LpBiasSp* – Stage Loop Bias Setpoint (n/a).
      vi. *(xxx)Stg(n)LpDbSp* – Stage Loop Deadband Setpoint (Varies).
      vii. *(xxx)Stg(n)LpDGainSp* – Stage Loop Differential Gain Setpoint (n/a).
      viii. *(xxx)Stg(n)LpIGainSp* – Stage Loop Integral Gain Setpoint (n/a).
      ix. *(xxx)Stg(n)LpPGainSp* – Stage Loop Proportional Gain Setpoint (n/a).
      x. *(xxx)Stg(n)MinOffTm* – Stage Minimum Off Time (Minutes).

xi. *(xxx)Stg(n)MinOnTm* – Stage Minimum On Time (Minutes).
xii. *(xxx)Stg(n)OffDly* – Stage Off Delay (Seconds).
xiii. *(xxx)Stg(n)OnDly* – Stage On Delay (Seconds).

3. Actuated Objects (Valves and Dampers):
   a. Objects will be prepended with two parts. First is system type (xxx) followed by equipment designation (yyy).
   b. Example: Chilled Water Valve | ChwVlv
   c. Valve objects will be prepended with the system type (xxx). System types include:
      i. *BlrIso* – Boiler Isolation. Typically, only used in plant related systems.
      ii. *ChlrIso* – Chiller Isolation. Typically, only used in plant related systems.
      iii. *Chw* – Chilled Water.
      iv. *DirEvap* – Direct Evaporative.
      v. *Hw* – Hot Water.
      vi. *HxIso* – Heat Exchanger Isolation. Typically, only used in plant related systems.
      vii. *IndEvap* – Indirect Evaporative.
      viii. *TwrIso* – Tower Isolation. Typically, only used in plant related systems.
   d. Damper objects will be prepended with the system type (xxx). System types include:
      i. *Ea* – Exhaust Air.
      ii. *Ma* – Mixed Air.
      iii. *MinOa* – Minimum Outside Air.
      iv. *Oa* – Outside Air.
      v. *Ra* – Return Air.
      vi. *Sa* – Supply Air. Will also be used for VAV and Fan Powered Box dampers.
   e. Equipment designations (yyy) include:
      i. *Dmp* – Damper.
      ii. *Vlv* – Valve.
   f. Hardwired Input Objects:
      i. *(xxx)(yyy)ClsSts* – Closed Status (On/Off).
      ii. *(xxx)(yyy)OpnSts* - Open Status (On/Off).
      iii. *(xxx)(yyy)Pos* – Position (%).
   g. Hardwired Output Objects:
      i. *(xxx)(yyy)ClsEna* – Closed Enable (On/Off).
      ii. *(xxx)(yyy)Cmd* – Command (%).
      iii. *(xxx)(yyy)Ena* – Enable (On/Off).
      iv. *(xxx)(yyy)OpnEna* - Open Enable (On/Off).
   h. Virtual Read Only Objects:
      i. *(xxx)(yyy)FailAlm* –Fail Alarm, General (Alarm/Normal).
      ii. *(xxx)(yyy)FailClsAlm* – Fail Closed Alarm (Alarm/Normal).
      iii. *(xxx)(yyy)FailOpnAlm* – Fail Open Alarm (Alarm/Normal).
      iv. *(xxx)(yyy)Lckout* – Lockout (Locked Out/Normal).
   i. Virtual Read/Write Objects:
      i. *(xxx)(yyy)FailAlmDly* – Fail Alarm Delay (Seconds).
      ii. *(xxx)(yyy)FailDifSp* – Fail Alarm Differential Setpoint (%).
      iii. *(xxx)(yyy)LckoutRst* – Lockout Reset (Reset/Off).
      iv. *(xxx)(yyy)LpBiasSp* – Loop Bias Setpoint (n/a).
      v. *(xxx)(yyy)LpDbSp* – Loop Deadband Setpoint (%).

vi. *(xxx)(yyy)LpDGainSp* – Loop Differential Gain Setpoint (n/a).
vii. *(xxx)(yyy)LpIGainSp* – Loop Integral Gain Setpoint (n/a).
viii. *(xxx)(yyy)LpPGainSp* – Loop Proportional Gain Setpoint (n/a).
ix. *(xxx)(yyy)LpTm* – Loop Time Setpoint (Minutes).
x. *(xxx)(yyy)MaxPos* – Maximum Position Setpoint (%).
xi. *(xxx)(yyy)MinPos* – Minimum Position Setpoint (%).

D. Filter Objects
1. Filter objects will be prepended with the filter type (xxx). Filter types include:
a. *Flt* – Filter, Generic.
b. *FinFl*t – Final Filter.
c. *OaFlt* – Outside Air Filter.
d. *PreFlt* – Pre-Filter.
e. *RaFlt* – Return Air Filter.
2. Virtual Read Only Objects:
a. *(xxx)Alm* – Alarm, General (Alarm/Normal).
3. Virtual Read/Write Objects:
a. *(xxx)AlmDly* – Alarm Delay (Seconds).

E. Measurements (Air)
1. Measurement objects will be prepended with the system type (xxx) and measurement designation (yyy).
2. System types include:
i. *Bldg* – Building.
ii. *Da* – Discharge Air.
iii. *Ea* – Exhaust Air.
iv. *Ma* – Mixed Air.
v. *Oa* – Outside Air.
vi. *Ra* – Return Air.
vii. *Rm* – Room.
viii. *Sa* – Supply Air.
b. Discharge air will be used with equipment supplying air to a room or zone, and supply air will be used with equipment supplying air to downstream equipment (e.g. VAV air handler supplying terminal units).
3. Measurement designations include:
a. *CO2* – Carbon Dioxide (ppm).
b. *DewTmp* – Dewpoint Temperature (°F).
c. *Hum* – Humidity (%).
d. *StPr* – Static Pressure (in/Wc or psi).
e. *Tmp* – Dry Bulb Temperature (°F).
f. *VelFlow* – Velocity Flow (fpm).
g. *VolFlow* – Volumetric Flow (cfm).
h. *WbTmp* – Wet Bulb Temperature (°F).
4. Hardwired Input Objects:
a. *(xxx)(yyy)* – Shows current sensed value (Varies).
5. Virtual Read Only Objects:
a. *(xxx)(yyy)HiAlm* – High Alarm (Alarm/Normal).
b. *(xxx)(yyy)LoAlm* – Low Alarm (Alarm/Normal).

c. *(xxx)(yyy)SpDifAlm* – Differential Setpoint Alarm (Alarm/Normal).

6. Virtual Read/Write Objects:
   a. *(xxx)(yyy)HiAlmDly* – High Alarm Delay (Seconds).
   b. *(xxx)(yyy)HiSp* – High Setpoint (Varies).
   c. *(xxx)(yyy)LoAlmDly* – Low Alarm Delay (Seconds).
   d. *(xxx)(yyy)LoSp* – Low Setpoint (Varies).
   e. *(xxx)(yyy)MaxSp* - Maximum Setpoint (Varies).
   f. *(xxx)(yyy)MinSp* - Minimum Setpoint (Varies).
   g. *(xxx)(yyy)Sp* – Setpoint (Varies).
   h. *(xxx)(yyy)SpDif* – Differential Setpoint (Varies).
   i. *(xxx)(yyy)SpDifAlmDly* – Differential Setpoint Alarm Delay (Seconds).

F. Measurements (Water)

1. Measurement objects will be prepended with the system type (xxx) and measurement designation (yyy).
2. System types include:
   a. *Chw* – Chilled Water.
   b. *Cw* – Condenser Water.
   c. *HxChw* – Heat Exchanger Chilled Water.
   d. *HxCw* – Heat Exchanger Condenser Water.
3. Measurement designations include:
   a. *DifPr* – Differential Pressure (in/Wc or psi).
   b. *RPr* – Return Pressure (in/Wc or psi).
   c. *RTmp* – Return Temperature (°F).
   d. *RVelFlow* – Return Velocity Flow (fps).
   e. *RVolFlow* – Return Volumetric Flow (gpm).
   f. *SPr* – Supply Pressure (in/Wc or psi).
   g. *STmp* – Supply Temperature (°F).
   h. *SVelFlow* – Supply Velocity Flow (fps).
   i. *SVolFlow* – Supply Volumetric Flow (gpm).
4. Alarm Objects:
5. Hardwired Objects:
   a. *(xxx)(yyy)* – Shows current sensed value (Varies).
6. Virtual Read Only Objects:
   a. *(xxx)(yyy)HiAlm* – High Alarm (Alarm/Normal).
   b. *(xxx)(yyy)LoAlm* – Low Alarm (Alarm/Normal).
   c. *(xxx)(yyy)SpDifAlm* – Differential Setpoint Alarm (Alarm/Normal).
7. Virtual Read/Write Objects:
   a. *(xxx)(yyy)HiAlmDly* – High Alarm Delay (Seconds).
   b. *(xxx)(yyy)HiSp* – High Setpoint (Varies).
   c. *(xxx)(yyy)LoAlmDly* – Low Alarm Delay (Seconds).
   d. *(xxx)(yyy)LoSp* – Low Setpoint (Varies).
   e. *(xxx)(yyy)MaxSp* - Maximum Setpoint (Varies).
   f. *(xxx)(yyy)MinSp* - Minimum Setpoint (Varies).
   g. *(xxx)(yyy)Sp* – Setpoint (Varies).
   h. *(xxx)(yyy)SpDif* – Differential Setpoint (Varies).
   i. *(xxx)(yyy)SpDifAlmDly* – Differential Setpoint Alarm Delay (Seconds).

G. Modes (Air)

1. Mode objects will be prepended with the mode type (xxx).
2. Mode types include:
   a. *ClMode* – Cooling Mode.
   b. *DehumMode* – Dehumidifying Mode.
   c. *EconMode* – Economizer Mode.
   d. *FanMode* – Fan Mode.
   e. *HmdMode* – Humidifying Mode.
   f. *HtMode* – Heating Mode.
   g. *VentMode* – Ventilation Mode.
3. Fan Mode will only utilize Enable and Runtime objects.
4. General Virtual Read Only Objects:
   a. *(xxx)RnTm* – Runtime (Hours).
5. General Virtual Read/Write Objects:
   a. *(xxx)Ena* – Enable (On/Off).
   b. *(xxx)MinOffTm* – Minimum Off Time (Minutes).
   c. *(xxx)MinOnTm* – Minimum On Time (Minutes).
   d. *(xxx)OffDly* – Off Delay (Seconds).
   e. *(xxx)OnDly* – On Delay (Seconds).
6. Temperature Only Read/Write Virtual Points:
   a. *(xxx)DaTmpOffDifSp* – Discharge Air Temperature Off Differential Setpoint (°F).
   b. *(xxx)DaTmpOnDifSp* – Discharge Air Temperature On Differential Setpoint (°F).
   c. *(xxx)OaEnaDb* – Outside Air Enable Deadband (°F).
   d. *(xxx)OaEnaSp* – Outside Air Enable Setpoint (°F).
   e. *(xxx)RmTmpOffDifSp* – Room Temperature Off Differential Setpoint . (°F)
   f. *(xxx)RmTmpOnDifSp* – Room Temperature On Differential Setpoint (°F).
   g. *(xxx)SaTmpOffDifSp* – Supply Air Temperature Off Differential Setpoint (°F).
   h. *(xxx)SaTmpOnDifSp* – Supply Air Temperature On Differential Setpoint (°F).
7. Humidity Only Read/Write Virtual Points:
   a. *(xxx)RaHumOffDifSp* – Return Air Humidity Off Differential Setpoint (%).
   b. *(xxx)RaHumOnDifSp* – Return Air Humidity On Differential Setpoint (%).
   c. *(xxx)RmHumOffDifSp* – Room Humidity Off Differential Setpoint (%).
   d. *(xxx)RmHumOnDifSp* – Room Humidity On Differential Setpoint (%).
8. Ventilation Only Read/Write Virtual Points:
   a. *(xxx)RaCO2OffDifSp* – Return Carbon Dioxide Off Differential Setpoint (ppm).
   b. *(xxx)RaCO2OnDifSp* – Return Carbon Dioxide On Differential Setpoint (ppm).
   c. *(xxx)RmCO2OffDifSp* – Room Carbon Dioxide Off Differential Setpoint (ppm).
   d. *(xxx)RmCO2OnDifSp* – Room Carbon Dioxide On Differential Setpoint (ppm).

H. Motor Controlled Objects (Fans and Pumps)

1. Objects will be prepended with the system type (xxx), equipment designation (yyy), and the equipment number (n).

2. Where only an air system contains a single fan or a coil booster pump, the object will drop the number (n).
3. Example: Exhaust Fan 1 | EaFan1.
4. Fan objects will be prepended with the system type (xxx). System types include:
   a. *Ea* – Exhaust Air.
   b. *Oa* – Outside Air.
   c. *Ra* – Return Air.
   d. *Sa* – Supply Air.
   e. *Twr* – Tower. Typically, only used in plant related systems.
5. Pump objects will be prepended with the system type (xxx). System types include:
   a. *Chw* – Chilled Water.
   b. *Cw* – Condenser Water Pump.
   c. *DirEvap* – Direct Evaporative.
   d. *Hw* – Hot Water.
   e. *IndEvap* – Indirect Evaporative.
   f. *PriChw* – Primary Chilled Water. Typically, only used in plant related systems.
   g. *SecChw* – Secondary Chilled Water. Typically, only used in plant related systems.
6. Equipment designations (yyy) include:
   a. *Fan* – Fan.
   b. *Pmp* – Pump.
7. Alarm Objects:
8. Hardwired Input Objects:
   a. *(xxx)(yyy)(n)Alm* – Alarm (Alarm/Normal).
   b. *(xxx)(yyy)(n)Cur* – Current (A).
   c. *(xxx)(yyy)(n)Spd* – Speed (%).
   d. *(xxx)(yyy)(n)Sts* – Status (On/Off).
9. Hardwired Output Objects:
   a. *(xxx)(yyy)(n)Cmd* – Command (On/Off).
   b. *(xxx)(yyy)(n)Ena* – Enable (On/Off).
10. Virtual Read Only Objects:
    a. *(xxx)(yyy)(n)Cur* – Current (A).
    b. *(xxx)(yyy)(n)Enrg* – Energy (kW).
    c. *(xxx)(yyy)(n)EnrgTot* – Total Energy (kW).
    d. *(xxx)(yyy)(n)FailAlm* – Fail Alarm (Alarm/Normal).
    e. *(xxx)(yyy)(n)Frq* – Frequency (Hz).
    f. *(xxx)(yyy)(n)HandAlm* – Hand Alarm (Alarm/Normal).
    g. *(xxx)(yyy)(n)Lckout* – Lockout (Locked Out/Normal).
    h. *(xxx)(yyy)(n)MtrTmp* – Motor Temperature (°F).
    i. *(xxx)(yyy)(n)OffDly* – Off Delay (Seconds).
    j. *(xxx)(yyy)(n)OnDly* – On Delay (Seconds).
    k. *(xxx)(yyy)(n)Pwr* – Power (kW).
    l. *(xxx)(yyy)(n)RnTm* – Runtime (Hours).
    m. *(xxx)(yyy)(n)Spd* – Speed (%).
    n. *(xxx)(yyy)(n)VAC* – Volts AC (V).
    o. *(xxx)(yyy)(n)VfdAlm* – VFD Alarm (Alarm/Normal).
    p. *(xxx)(yyy)(n)VfdTmp* – VFD Temperature (°F).

q. *(xxx)(yyy)(n)Warn* – Internal VFD Warning (Warning/Normal).

11. Virtual Read/Write Objects:
    a. *(xxx)(yyy)(n)AutoMode* – Auto Mode (On/Off).
    b. *(xxx)(yyy)(n)FailAlmDly* – Fail Alarm Delay (Seconds).
    c. *(xxx)(yyy)(n)HandAlmDly* – Hand Alarm Delay (Seconds).
    d. *(xxx)(yyy)(n)LckoutRst* - Lockout Reset (Reset/Off).
    e. *(xxx)(yyy)(n)LpBiasSp* – Loop Bias Setpoint (n/a).
    f. *(xxx)(yyy)(n)LpDbSp* – Loop Deadband Setpoint (%).
    g. *(xxx)(yyy)(n)LpDGainSp* – Loop Differential Gain Setpoint (n/a).
    h. *(xxx)(yyy)(n)LpIGainSp* – Loop Integral Gain Setpoint (n/a).
    i. *(xxx)(yyy)(n)LpPGainSp* – Loop Proportional Gain Setpoint (n/a).
    j. *(xxx)(yyy)(n)LpTm* – Loop Time Setpoint (Minutes).
    k. *(xxx)(yyy)(n)MinOffTm* – Minimum Off Time (Minutes).
    l. *(xxx)(yyy)(n)MinOnTm* – Minimum On Time (Minutes).

I. Optimization Objects and Setpoints:
1. Basic Temperature Control Setpoints (Air):
    a. Temperature control objects will be prepended with the occupancy type (xxx), followed by the conditioning designation (yyy).
    b. Occupancy types include:
        i. *Occ* – Occupied
        ii. *Unocc* – Unoccupied
    c. Conditioning designations include:
        i. *Ht* – Heating.
        ii. *Cl* – Cooling.
    d. Virtual Read Only Objects:
        i. *(xxx)*(yyy)*RnTm* – Run Time (Hours).
    e. Virtual Read/Write Objects:
        i. *(xxx)(yyy)MinOffTm* – Minimum Off Time (Minutes).
        ii. *(xxx)(yyy)MinOnTm* – Minimum On Time (Minutes).
        iii. *(xxx)(yyy)TmpSp* – Temperature Setpoint (°F).
        iv. *(xxx)(yyy)TmpDif* – Temperature Differential (°F).
        v. *(xxx)(yyy)DaTmpSp* – Discharge Air Temperature Setpoint (°F).
        vi. *(xxx)(yyy)SaTmpSp* – Supply Air Temperature Setpoint (°F).
2. Optimized Start Read Only Virtual Objects:
    a. *OptStrtAvgZnTmp* – Optimized Start Average Zone Temperature (Multizone, °F).
    b. *OptStrtClSts* – Optimized Start Cooling Status (On/Off).
    c. *OptStrtHtSts* – Optimized Start Cooling Status (On/Off).
    d. *OptStrtLastStrtTm* – Optimized Start Next Start Time (Date/Time).
    e. *OptStrtMaxStrtTm* – Optimized Start Maximum Start Time (Hours).
    f. *OptStrtMinStrtTm* – Optimized Start Minimum Start Time (Hours).
    g. *OptStrtNextOccTm* – Optimized Start Next Occupied Time (Date/Time).
    h. *OptStrtNextStrtTm* – Optimized Start Next Start Time (Date/Time).
    i. *OptStrtZnTmp* – Optimized Start Average Zone Temperature (Single Zone,°F).
3. Optimized Start Read/Write Virtual Objects:
    a. *OptStrtClEna* – Optimized Start Cooling Enabled (On/Off).
    b. *OptStrtClSp* – Optimized Start Cooling Setpoint (°F).

c. *OptStrtHtEna* – Optimized Start Heating Enabled (On/Off).
d. *OptStrtHtSp* - Optimized Start Heating Setpoint (°F).

4. Optimized Stop Read Only Virtual Objects:
   a. *OptStopAvgZnTmp* – Optimized Stop Average Zone Temperature (Multizone, °F).
   b. *OptStopLastStopTm* – Optimized Stop Next Stop Time (Date/Time).
   c. *OptStopMaxStopTm* – Optimized Stop Maximum Stop Time (Hours).
   d. *OptStopMinStopTm* – Optimized Stop Minimum Stop Time (Hours).
   e. *OptStopNextOccTm* – Optimized Stop Next Occupied Time (Date/Time).
   f. *OptStopNextStopTm* – Optimized Stop Next Stop Time (Date/Time).
   g. *OptStopZnTmp* – Optimized Stop Average Zone Temperature (Single Zone,°F).

J. Plant Objects:
   1. Building Load Objects:
      a. Building load objects will be prepended with the system type (xxx).
      b. System Types Include:
         i. *Chlr* – Chiller.
         ii. *Blr* – Boiler.
      c. Alarm Objects:
         i. *(xxx)FailAlm* – Fail Alarm (Alarm/Normal).
         ii. *(xxx)FailAlmDly* – Fail Alarm Delay (Seconds).
         iii. *(xxx)HandAlm* – Hand Alarm (Alarm/Normal).
         iv. *(xxx)HandAlmDly* – Hand Alarm Delay (Seconds).
         v. *(xxx)Lckout* – Lockout (Locked Out/Normal).
         vi. *(xxx)LckoutRst* - Lockout Reset. Alarm (Reset/Off).
      d. Hardwired Input Objects:
         i. *(xxx)Cap* – Capacity (%).
         ii. *(xxx)Cur* – Current (A).
         iii. *(xxx)Sts* – Status (On/Off).
         iv. *(xxx)Alm* – Alarm (Alarm/Normal).
      e. Hardwired Output Objects:
         i. *(xxx)Ena* – Enable (On/Off).
         ii. *(xxx)STmpSp* – Supply Temperature Setpoint (°F).
      f. Virtual Read Only Objects:
         i. *(xxx) Cap* – Capacity (%). Used only if equipment has integration card and hard wiring is unavailable.
         ii. *(xxx) Sts* – Status (On/Off). Used only if equipment has integration card and hard wiring is unavailable.
         iii. *(xxx)HeadPr* – Head Pressure (in/Wc or psi).
         iv. *(xxx)RnTm* – Run Time (Hours).
         v. *(xxx)Ton* – Tonnage (Ton).
      g. Virtual Read/Write Objects:
         i. *(xxx) STmpSp* – Supply Temperature Setpoint (°F). Used only if equipment has integration card and hard wiring is unavailable.
         ii. *(xxx)Ena* – Enable (On/Off). Used only if equipment has integration card and hard wiring is unavailable.
         iii. *(xxx)HeadPrSp* – Head Pressure Setpoint (in/Wc or psi).
         iv. *(xxx)MinOffTm* – Minimum Off Time (Minutes).
         v. *(xxx)MinOnTm* – Minimum On Time (Minutes).

vi. *(xxx)OffDly* – Off Delay (Seconds).
vii. *(xxx)OnDly* – On Delay (Seconds).

K. Reset Objects:
1. Reset objects will be prepended with the system type (xxx), direction of flow (yyy) and measurement designation (zzz).
a. System types typically include:
i. *Chw* – Chilled Water.
ii. *Hw* – Hot Water.
iii. *Oa* – Outside Air. Typically, not used with Trim and Respond.
iv. *Sa* – Supply Air.
b. Direction of flow typically includes:
i. *S* – Supply
ii. *R* – Return.
c. Measurement designations typically include:
i. *DifPr* – Differential Pressure (in/Wc or psi).
ii. *StPr* – Static Pressure (in/Wc or psi).
iii. *Tmp* – Temperature (°F).
d. Direction of flow is generally used for water system temperature only. If the object does not relate to a water system temperature, the direction of flow (yyy) is dropped from the object name.
e. Example: Supply Air Temperature Reset Setpoint | SaTmpRstSp
f. General Read Only Virtual Objects:
i. *(xxx)(yyy)(zzz)RstTotZnReq* – Reset Total Zone Requests (n/a).
g. General Read/Write Virtual Objects:
i. *(xxx)(yyy)(zzz)RstSp* – Reset Setpoint (Varies).
ii. *(xxx)(yyy)(zzz)RstMinSp –* Reset Minimum Setpoint (Varies).
iii. *(xxx)(yyy)(zzz)RstMaxSp –* Reset Maximum Setpoint (Varies).
iv. *(xxx)(yyy)(zzz)RstInitSp –* Reset Initial Setpoint (Varies).
v. *(xxx)(yyy)(zzz)RstDlyTmSp –* Reset Delay Time Setpoint (Minutes).
vi. *(xxx)(yyy)(zzz)RstTmStepSp* – Reset Time Step Setpoint (Seconds).
h. Trim and Respond Read/Write Virtual Objects:
i. *(xxx)(yyy)(zzz)RstIgReqSp* – Reset Ignored Requests Setpoint (n/a).
ii. *(xxx)(yyy)(zzz)RstTrimSp* – Reset Trim Setpoint (Varies).
iii. *(xxx)(yyy)(zzz)RstRespSp* – Reset Respond Setpoint (Varies).
iv. *(xxx)(yyy)(zzz)RstRespRat* – Reset Respond Rate (Minutes).
v. *(xxx)(yyy)(zzz)RstRespMaxSp* – Reset Maximum Respond Setpoint (Varies).
vi. *ZnImpSp* – Zone Importance Multiplier (n/a).
i. Demand Response Read/Write Virtual Objects:
i. *(xxx)(yyy)(zzz) RstReqDnSp* – Reset Requests Down Setpoint (Varies).
ii. *(xxx)(yyy)(zzz) RstReqUpSp* – Reset Requests Up Setpoint (Varies).

L. Schedule Objects
1. Schedule objects will be prepended with the system type (xxx). System types include:
a. *Bldg* – Building.
b. *Sys* – System or Unit.
c. *HwPlnt* – Hot Water Plant.
d. *ChwPlnt* – Chilled Water Plant.

2. Virtual Read Only Objects:
   a. *(xxx)SchedLastOccTm* – Last Scheduled Occupied Time (Date/Time).
   b. *(xxx)SchedLastUnoccTm* – Last Scheduled Unoccupied Time (Date/Time).
   c. *(xxx)SchedNextOccTm* – Next Scheduled Occupied Time (Date/Time).
   d. *(xxx)SchedNextUnoccTm* – Next Scheduled Unoccupied Time (Date/Time).
   e. *(xxx)SchedSts* – Schedule Status (Occupied/Unoccupied).
3. Virtual Read/Write Objects:
   a. *(xxx)Sched* – Schedule (Editable Schedule Object).

M. Rotation Objects:
1. Rotation objects can be prepended with the system type (xxx), equipment (yyy), a rotation designation (zzz), and the rotation number (n).
2. System types typically include:
   a. *PriChw* – Primary Chilled Water.
   b. *SecChw* – Secondary Chilled Water.
   c. *Cw* – Condenser Water.
   d. *Hw* – Hot Water.
3. Equipment types typically include:
   a. *Pmp* – Pump.
   b. *Chlr* – Chiller.
   c. *Blr* – Boiler.
   d. *Hx* – Heat Exchanger.
4. Rotation designations include:
   a. *Lead* – Lead.
   b. *Lag* – Lag.
   c. *Stby* – Standby.
5. The rotation number (n) will only be used in instances where multiple pieces of equipment may be lead/lag/standby at once for the same system.
6. If the object is a chiller, tower, boiler, or heat exchanger, the system type (xxx) is dropped from the object name.
7. Virtual Read Only Objects:
   a. *(xxx)(yyy)(zzz)(n)* – Shows current lead/lag/standby equipment.
   b. *(xxx)(yyy)NextRotTm* – Next Rotation Time (Date/Time).
   c. *(xxx)(yyy)RotSeq* – Rotation Sequence (Varies).
8. Virtual Read/Write Virtual Objects:
   a. *(xxx)(yyy)(zzz)(n)Ena* – Enable (On/Off).
   b. *(xxx)(yyy)(zzz)(n)MinOffTm* – Minimum Off Time (Minutes).
   c. *(xxx)(yyy)(zzz)(n)MinOnTm* – Minimum On Time (Minutes).
   d. *(xxx)(yyy)(zzz)(n)OffDly* – Off Delay (Seconds).
   e. *(xxx)(yyy)(zzz)(n)OffSp* – Off Setpoint (Varies).
   f. *(xxx)(yyy)(zzz)(n)OnDly* – On Delay (Seconds).
   g. *(xxx)(yyy)(zzz)(n)OnSp* – On Setpoint (Varies).
   h. *(xxx)(yyy)RotCmd* – Rotation Command (On/Off).
   i. *(xxx)(yyy)RotSched* – Rotation Schedule (Editable Schedule Object).

N. Object Abbreviation Spreadsheet

Term	Abbreviation
Access Denied	AcDn
Access Granted	AcGr
Acidity	Acd
Active	Actv
Actual	Act
Actual Cooling	ActCl
Actual Heating	ActHt
Actuator	Actr
Address	Add
Adjustable, Adjust	Adj
Air	Air
Air Conditioning	AirCond
Air Dryer	AirDry
Air flow measuring station	Afms
Air handling unit	Ahu
Alarm	Alm
Alkalinity	Alk
Alternate	Alt
Alternating current	Ac
Amperage/Current	Amp
Analog Input	AI
Analog Output	AO
Apparent	App
Apparent Power (kVA)	AppPwr
Approach	Aprch
Array Water	Aryw
Arrestor	Arr
Aspirating	Asp
Audio indicator (buzzer)	Audio
Authority	Auth
Automatic	Auto
Automatic Demand Response	Adr
Automatic transfer switch	Ats
Auxilliary	Aux
Average	Avg
Back	Bck
Balance / Balancing	Bal
Baseboard	Bb

Baseline	Base
Battery	Batt
Bias	Bias
Bibb	Bib
Binary Input	BI
Binary Output	BO
Boiler	Blr
Booster	Bstr
Box	Box
Branch	Brnch
Building	Bldg
Building Static Pressure	BldgStPrs
Button	Btn
Buzzer	Buzz
Bypass	Byp
Cabinet	Cab
Calendar	Cldr
Calibration	Cal
Capacity	Cap
Capillary	Cplry
Carbon dioxide	Co2
Carbon monoxide	Co
Card	Crd
Caution	Ctn
C-factor	Cfctr
Change/Changeover/Switchover	Chg
Chilled Water	Chw
Chilled Water Entering	ChwEnt
Chilled Water Leavin	ChwLvg
Chilled water return	Chwr
Chilled water supply	Chws
Chiller	Chlr
Circuit	Ckt
Circulation	Circ
City	City
Class	Class
Clear	Clr
Close/closed	Cls
Coefficient	Coeff

Coil	Coil
Cold deck	Cd
Cold deck Temp	CdTmp
Combined	Cmb
Combiner	Comb
Combustion	Cmbs
Command	Cmd
Common	Cmn
Compressor	Cmpr
Computer room air conditioning	Crac
Condensate	Cndst
Condenser	Cnd
Condenser Pan	CdPan
Condenser Water	Cw
Condenser Water Pump	CwPmp
Condenser Water Return	Cwr
Condenser Water Supply	Cws
Conditioning	Cond
Conductivity	Cdv
Constant air volume	Cav
Contactor / Contact	Cont
Control	Ctrl
Control variable (loop)	Cv
Controller	Ctlr
Convector	Conv
Cool Down	ClDn
Cooling	Cl
Cooling coil	Cc
Cooling tower	Ct
Cooling tower fan	CtFan
Coordinated universal time	Utc
Corridor	Corr
Count	Cnt
County	Cnty
Critical	Crit
Current	Cur
Current transformer	CurXfmr
Current Transformer Ratio	CurXfmrRatio
Cycle	Cyc

D Gain	DGain
Damper	Dmpr
Day	Day
Day of month	Dom
Day of week	Dow
Deadband	Db
Deck	Deck
Decrease	Dec
Dehumidify	Dehum
Delay	Dly
Demand	Dmd
Demand Response	DmdRsp
Demand-Controlled Ventilation	Dcv
Depth	Dpth
Detector	Det
Device	Dev
Dew point	Dew
Diesel fuel	Df
Differential	Dif
Differential Pressure	DifPrs
Direct Acting	DirAct
Direct current	Dc
Direct Expansion (DX)	Dx
Direct Normal	DirNorm
Direct/direction	Dir
Disable	Dsa
Discharge	Dis
Discharge Air	Da
Discharge Air Pressure	DaPrs
Discharge Air Temperature	DaTmp
Display	Disp
Distance	Dist
Diverting	Div
Domestic hot water	Dhw
Domestic hot water return	Dhwr
Domestic hot water supply	Dhws
Domestic water	Dw
Door	Door
Down	Dn

Drawing	Dwg
Drive (Vfd)	Drive
Dry Bulb	DryB
Dual duct	Dd
Duct	Duct
Early (Optimal start-stop)	Erly
East	E
Economizer/Economizing	Econ
Effective	Eff
Effective Cooling	EffCl
Effective Heating	EffHt
Effective Occupancy	EffOcc
Ejection	Eject
Electric	Elec
Electric duct heat/heater/heating	Edh
Electric heat	Eh
Electric preheat	Eph
Electric reheat	Erh
Electric vehicle	Ev
Electric Vehicle Identification	Evid
Electric-to-pneumatic	Ep
Element	Elmt
Emergency	Emer
Emergency Stop Switch	Ess
Enable	Ena
Energy	Enrg
Engine	Eng
Entering	Ent
Entering Water Temp	Ewt
Enthalpy	Enth
Error (loop)	Err
Evaporative	Evap
Exhaust	Exh
Exhaust Air	Ea
Exhaust tracks supply	Ets
Exported	Exp
External/exterior	Ext
Face bypass	Fbyp
Face bypass Damper	FbypDmpr

Factor	Fct
Fail	Fail
Fall (season)	Fall
Fan	Fan
Fan coil unit	Fcu
Fan terminal unit	Ftu
Fast Fan Speed	Fast
Fault	Fault
Feedback	Fdbk
Filter	Flt
Final	Fin
Fire	Fire
Firmware	Frmw
Flame	Flm
Flange	Flg
Float	Float
Floor	Flr
Flow	Flw
Forward	Fwd
Free cooling	Fcl
Free heating	Fht
Freezer	Frz
Frequency	Frq
Frost	Frst
Fuel oil	Fo
Gas	Gas
Gauge	Gauge
Generator	Gen
Global	Glb
Glycol	Gly
Glycol Return	Glyr
Glycol Supply	Glys
Gray water	Gw
Green	Grn
Gross (as opposed to Net)	Grs
Ground	Grd
Group	Grp
Hand	Hand
Hardware	Hrdw

Head	Head
Heat Exchanger	Hx
Heat Pump	Hp
Heat Recovery Unit	Hru
Heat recovery water	Hrw
Heater	Htr
Heating	Ht
Heating coil	Hc
Held Open Too Long	Otl
High	Hi
High End of Reset Scale	RstH
High Head Pressure	HiHeadPrs
High Temp	HiTmp
High Temp Cut Out	Htco
H-O-A/Hand-Off-Auto	Hoa
Hood	Hood
Horizontal	Hor
Hot deck	Hd
Hot deck Temp	HdTmp
Hot Water	Hw
Hot Water Pump	HwPmp
Hot Water Return	Hwr
Hot Water Supply	Hws
Humidity/Humidifier	Hum
Ice storage	Ice
Identification	Id
Ignore	Ign
Increase	Inc
Increment	Inct
Index	Index
Indirect	Ind
Indoor air quality	Iaq
Indoor environmental quality	Ieq
Induction	Induct
Infectious	Inf
Initial	Init
Inlet	Inlet
Inlet guide vanes	Igv
Input	In

Instance	Inst
Integral gain (loop)	IGain
Interstage	Int
Interval	Intv
Invalid	Invd
Inverter	Inv
Irradiance	Irrad
Irrigation	Irrg
Irrigation water	Irrgw
Isolation	Iso
K-factor	Kfctr
Lag	Lag
Lap	Lap
Last	Last
Late	Late
Lead	Lead
Leaving	Lvg
Leaving Water Temp	Lwt
LEED (for energy efficiency)	Leed
Leisure	Lsr
Length	Lgth
Level	Lvl
Limit	Lmt
Line (electrical)	Ln
Line-line (electrical)	LnLn
Line-neutral (electrical)	LnNeut
Link	Lnk
Liquid	Liq
Local	Local
Local time clock	Ltc
Lock	Lck
Lockout	Lckout
Loop	Lp
Louver	Lvr
Low	Lo
Low temp Cut out	LoTmpCo
Main	Main
Make up water	Muw
Make-up	Mu

Manifold	Mf
Manual	Man
Manufacturer	Mfr
Maximum	Max
Maximum Position	MaxPos
Media access control	Mac
Medium	Med
Meter	Meter
Minimum	Min
Minimum On Time	MinOnTm
Minimum Position	MinPos
Miscellaneous	Misc
Mixed Air	Ma
Mixed Air Temp	MaTmp
Mixing	Mix
Mode	Mode
Mode (mathematical)	Mmod
Model	Model
Modulation, Modulating	Mod
Morning cool down	Mcdn
Morning Warm-Up	Mwup
Motor	Mtr
Multi zone	Mz
Multi/multiple	Multi
Negative	Neg
Net (as opposed to Gross)	Nt
Network	Net
Neutral (electrical)	Neut
Next	Next
Night	Nght
Normal	Norm
Normally Closed	NormClsd
Normally Open	NormOpn
North	N
Notification	Ntfcn
Occupied	Occ
Occupied Cooling	OccCl
Occupied Heating	OccHt
Off	Off

Offset	Offst
Oil	Oil
On	On
One	One
Open	Opn
Operator	Oper
Optimal start stop	Oss
Optimized	Opt
Out	Out
Outside Air	Oa
Outside Air Damper	OaDmpr
Over	Ov
Overload	Ol
Override	Ovrd
Overtime	Ovt
Oxidation reduction potential	Orp
P Gain	PGain
Pan	Pan
Panel	Pnl
Parallel	Par
Parallel fan terminal unit	Pftu
Peak	Peak
Performance	Perf
Persistent	Prst
Phase	Phs
Phase A	Phsa
Phase B	Phsb
Phase C	Phsc
Phase Reversal	PhsRev
Photovoltaic	Pv
PID (loop)	Pid
Pilot	Plt
Plane of array	Poa
Plant	Plnt
Pneumatic	Pneu
Pool	Pool
Position	Pos
Positive	Posv
Power	Pwr

Power distribution unit	Pdu
Power Factor	PwrFct
Power Induction Unit	PwrInductUnit
Pre	Pre
Precipitation	Precip
Pressure	Prs
Pressure Differential	PrsDif
Previous	Prev
Primary	Pri
Primary Chilled Water	PriChw
Priority	Priority
Process variable (loop)	Procv
Processor board	Pcb
Proportional	Prop
Protective	Prot
Protective (medical isolation)	Pro
Pulse, Pulses	Pls
Pump	Pmp
Radiant	Rad
Ramp	Rmp
Range	Rng
Rate	Rate
Ratio	Ratio
Reactive (electrical)	Rct
Real (electrical)	Real
Real Power (kW)	RelPwr
Received	Rcvd
Recool	Rcl
Recovery, Recovered	Rcv
Reduction	Red
Reference	Ref
Refrigerant	Rfg
Regenerate/-d/-ing	Rgn
Reheat	Rh
Reheat coil	Rhc
Rejected	Rejct
Rejection, Rejected	Rej
Relative Humidity (%)	RelHum
Relay	Rly

Relief	Rlf
Relinquish	Rlq
Remaining	Rmg
Remote	Rmt
Repeater	Rptr
Request	Req
Reset	Rst
Respond	Resp
Return	Ret
Return Air	Ra
Return Air Fan	RaFan
Reverse Acting	RevAct
Reverse/reversal	Rev
Roof top air handling unit	Rtu
Room	Rm
Rotate	Rot
Router	Rtr
Run	Rn
Run Time (hours)	RnTm
Sash	Sash
Schedule	Sched
Season/Seasonal	Season
Secondary	Sec
Secondary Chilled Water	SecChw
Select/selector/selection	Sel
Sensor	Snsr
Sequence	Seq
Serial Number	Serial
Series	Ser
Series fan terminal unit	Sftu
Service	Svc
Setpoint	Sp
Short	Short
Short Cycle	ShortCyc
Shoulder (season)	Shldr
Shutdown	Shutdn
Single duct	Sd
Slow	Slw
Slow Fan Speed	Slow

Smoke	Smk
Snow , Snow-melt	Snw
Snowmelt	Snwmlt
Software	Sftw
Solar	Sol
Solar thermal water return	Stwr
Solar thermal water supply	Stws
Source	Src
South	S
Speed	Spd
Spring (season)	Sprg
Stage	Stg
Standard	Std
Standby	Stby
Start	Strt
Static (pressure)	St
Status	Sts
Step	Step
Stop	Stp
Storage	Stor
Strainer	Str
Suction	Sct
Summer	Sumr
Sump	Sump
Superheat	Spht
Supply	Sup
Supply air	Sa
Supply air fan	SaFan
Switch	Sw
Switchgear	Swgear
System	Sys
Tamper	Tmpr
Tank	Tnk
Target	Tgt
Temperature	Tmp
Tempered water	Tw
Tempered water return	Twr
Tempered water supply	Tws
Temporary	Temp

Temporary Occupancy	TempOcc
Temporary Override	TempOvrd
Terminal unit	Tu
Thermal energy	Therm
Thermal Overload	ThermOl
Third	Third
Time	Tm
Time of day	Tod
Timer	Tmr
Ton	Ton
Total	Tot
Total harmonic distortion	Thd
Tracking	Trk
Transducer	Xdcr
Transformer	Xfmr
Trend (History)	Td
Trim	Trm
Trip	Trp
Turbidity	Turb
Two	Two
Type	Type
Ultraviolet	Uv
Unbalanced	Unbal
Under	Un
Under Floor Static Pressure	UnFlrStPrs
Underwriters Laboratories	Ul
Uninterruptible Power Supply	Ups
Unit	Unit
Unit Heater	UnitHtr
Unit ventilator	UnitVent
Unix system	Unix
Unlocked	Unlkd
Unoccupied	Unocc
Up	Up
User	Usr
Utility	Util
Valid	Vld
Value	Val
Valve	Vlv

Vane	Vane
Variable	Var
Variable air volume	Vav
Variable frequency drive	Vfd
Variable refrigerant volume	Vrv
Variable volume & temperature	Vvt
Velocity	Vel
Ventilation	Vent
Version	Ver
Vibration	Vib
Virtual	Vrt
Volatile organic compounds	Voc
Volt amperes	Va
Voltage	Vlt
Volumentric	Vol
Warm Up	WarmUp
Warm/Cool	WmCl
Warning	Warn
Water	Wtr
Water Source Heat Pump	WtrSrcHtPmp
Water treatment system	Wts
Water Under Floor	WtrUnFlr
Weekday	Wkdy
Weekend	Wknd
Well	Well
West	W
Wet bulb	Wb
Wheel (energy wheel)	Whl
Wind	Wind
Winter (season)	Wint
Wireless	Wrls
Zone	Zn

END OF SECTION

APPENDIX B – GRAPHICAL STANDARD FOR NIAGARA N4

1.1 GENERAL INFORMATION

A. Graphics will be created and stored on the SRP supervisor utilizing graphical standards outlined in this document.

B. Graphics will be organized into the file structures, as outlined in this standard.

C. Controllers will be organized into a standardized folder structure, as outlined in this standard.

D. Graphics will be rendered as N4 HTML 5 views. Any graphic pages that in any way depend on browser-side-applets are not permitted.

E. Static images are permitted on ductwork and piping only. All other graphical representations must be animated wherever possible

F. Proxy point naming will remain unchanged. The graphic bindings will be updated to match the proxy point names

G. Any hyperlinks outside of the SRP firewall are prohibited from being added to any Niagara graphics

H. Vendor names, logos, or other vendor identification or promotion are not permitted on the graphics

I. Creating new folders or alteration of any of the files in the SRP_Standards folder is prohibited

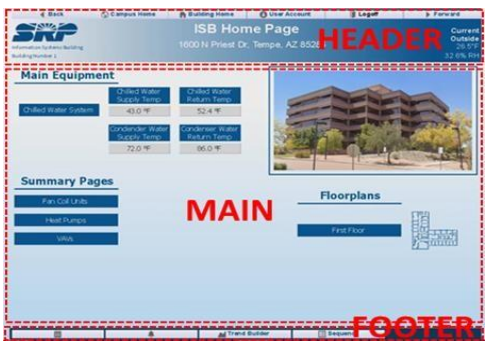
J. Objects, graphics, and anything needed to create new graphics using this Standard Implementation Guide will be available on the SRP Niagara N4 supervisor

1.2 STANDARD GRAPHIC LAYOUT

A. Graphics are defined as equipment graphics, summary graphics, popup graphics, or navigation graphics. Graphic types are described below.

1. Equipment Graphics:

a. Equipment graphics consist of a standard background size, px includes for a header and footer graphics, and a main graphic. The standard backgrounds are located under SRP_Standards > Backgrounds.

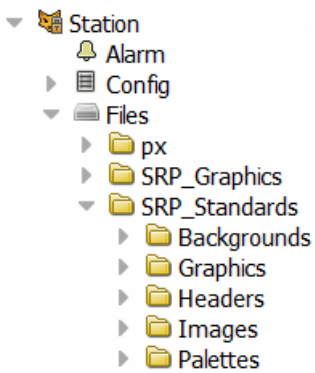


2. Summary Graphics:
   a. Summary graphics consist of a standard background size, and px includes for a header and footer graphic. These will include either a floorplan graphic or px includes with definable variables for equipment summaries. Summary graphics will include all applicable equipment required for the summary graphics as detailed in the Main Graphic Specifications section. If all the information does not fit on a single summary graphic, navigation buttons will be included for ease of navigation between the different graphics.
3. Navigation Graphics:
   a. Navigation graphics consist of the navigation background under SRP_Standards. This consists of px includes for the building specific header and footer graphics only. Home pages are considered navigation pages, and requirements for these are detailed in the Main Graphic Specifications section. Other navigation pages will be specified by SRP.
4. Popup Graphics:
   a. Popup graphics are for additional information not on the main graphics. Standard popup graphics are in SRP_Standards. Acceptable types of information used for popup graphics as detailed in the Main Graphic Specifications section. A template background for popup graphics can be found in SRP_Standards > Background for any new popups not available in the standards. Unlike other graphics, the size of this canvas is relative to the information contained and does not require any px includes.
   b. The Popup Graphics are hyperlinked to corresponding main graphics with a Popup Binding. The button for the Popup binding can be found in the standard palettes. The size of the popup window will be set to 50 pixels more on both the height and width of the corresponding popup graphic canvas size to allow for the window frame.

1.3 LOCATING STANDARD GRAPHICS

A. All standard graphics including px pages, images, and tools will be organized in the Niagara N4 file structure under SRP_Standards.

B. The standards file structure is illustrated as follows:



1. Backgrounds – Consists of folders for equipment template backgrounds, graphic backgrounds for px includes, and navigation backgrounds configured in the approved sizes.
2. Graphics – Consists of all approved standard graphic px includes, organized into subfolders by system/equipment types. System/equipment specific headers, footers, and popups will be located in the graphics folder in their respective subfolders.
3. Headers – Consists of the standard headers formatted and sized to match background sizes.
4. Footers – Consists of the standard footers formatted and sized to match background sizes.

5. Images – Consists of all the standard, non-building specific image files used in any of the standard graphics, headers, buttons, etc. Building specific images will be saved under their respective Active Graphic File.
6. Palettes – Consists of all the standard palettes with the pre-formatted points, buttons, objects, etc. as outlined in this graphic standard.

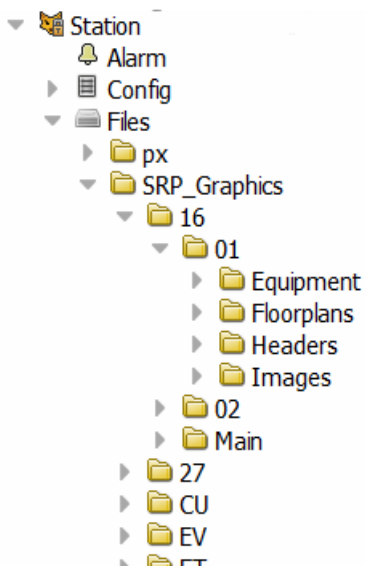
1.4 ACTIVE GRAPHIC FILE LOCATIONS

A. All graphics being used for live devices on the Niagara N4 supervisor are classified as active graphics. Active graphics and all corresponding images, navigation files, etc. will be organized and stored in the SRP_Graphics folder.

B. Each site has its own folder depicted by the two-digit abbreviation code. In each site folder, there is a Main folder for all site specific and non-building specific graphics (Example includes site home page). Each site folder will also include a folder for each building on that site, depicted by a two-digit number.

C. Any graphics, images, or other files that are not active due to controllers being removed or newer graphics being used, are to be removed.

D. The standardized organization of each individual building file structure is illustrated as follows:



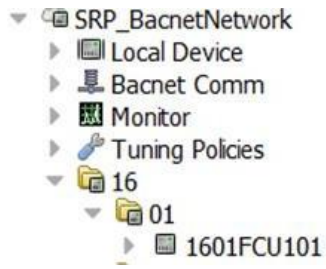
1. Equipment – All graphics, unless stated otherwise, will be organized in this folder. This folder will also include all equipment specific documents, charts, etc. Each equipment with unique graphics will have a folder matching the equipment name. For equipment that share a multiple graphic, a folder will be created referencing the equipment type. See details for naming in the Main Graphic Specification section.
2. Floorplans – Floorplan graphics, as outlined in this standard, will be organized into the Floorplans folder.
3. Headers – Every building will have a pre-formatted set of headers. These headers will be stored in this Headers folder.
4. Images – All images used in a specific building, that are not part of a palette will be stored in the Images folder. This folder also includes a Floorplans subfolder that will include all the approved and pre-formatted floorplan image files for the building.

1.5 NIAGARA DEVICES

A. All JACEs will be mapped into the Niagara N4 Supervisor. This will be for JACE communication alarming and backups ONLY. No points, trends, alarms, etc. will be mapped as Niagara points from the JACEs into the supervisor.

B. JACEs will be organized in the Niagara Driver folder by site and by building with folder structures and naming following the same standard as laid out in the BACnet Controllers section.

1.6 BACNET DEVICES



A. Under the BACnet Network driver will be a folder for each site depicted by the site two-character abbreviation code. Each site folder will also include subfolders for each building located on that site, depicted a two-digit building number.

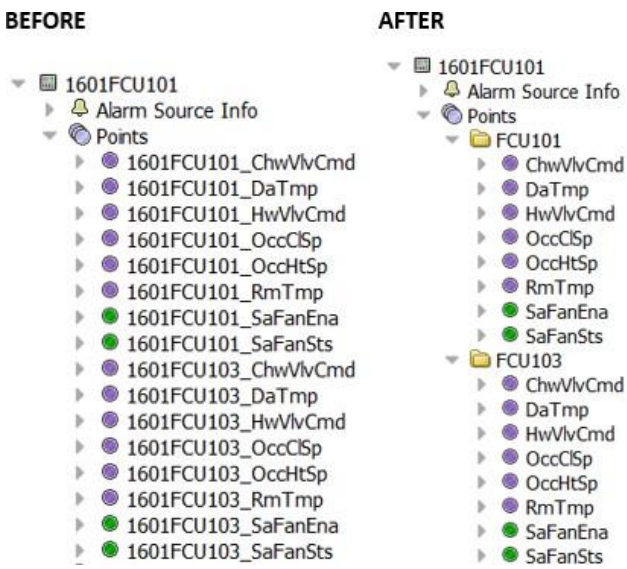
B. Devices will be organized in their corresponding building subfolder. The device name will remain unchanged from discovery unless otherwise specified by SRP.

1.7 BACNET POINTS

A. All points will be proxied from the device directly into the points folder under the corresponding device.

B. The BACnet points will then be manipulated and organized as follows:

1. Each system/equipment referenced in the proxied point names will require a BACnet points folder that matches their corresponding system/equipment names. This is true even if there is only one system.
2. The points will be organized into their corresponding equipment folder. All points will be moved, not copied, from the root points folder.
3. Once points are organized in their respective system or equipment folders, the site/building/equipment identifier will be removed from the proxied name.
4. Graphics for the system/equipment will be mapped to the BACnet point folders as specified in the Implementing a Standard Graphic section.



1.8 BACNET NOTIFICATIONS

A. BACnet notifications will be proxied through the device Alarms folder. Each device will be configured to route the alarms to the site and building default class (Example 1610_Default). See more information on alarming and additional alarm requirements in the Niagara Alarming section.

1.9 BACNET TRENDING

A. All trending will be mapped over as BACnet trend objects from the BACnet devices directly. Trending will be set to import every (1) hour from the field devices into the Niagara platform. Trending storage for Niagara JACEs will be limited to (2) two weeks of data before rollover will occur. Trending for the Niagara Supervisor platforms will be unlimited.

B. Unless pre-approved by SRP, no trending will be created as Niagara trend objects, and no trends will be mapped between Niagara platforms.

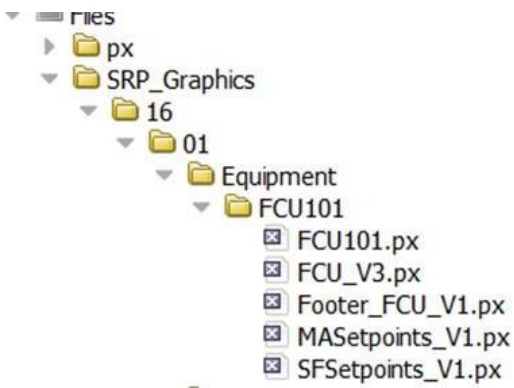
1.10 BACNET SCHEDULES

A. All schedules will be mapped over as BACnet schedule objects from the BACnet controller directly. See more information on scheduling and additional schedule requirements in the Niagara Schedules section.

1.11 IMPLEMENTING STANDARD GRAPHICS

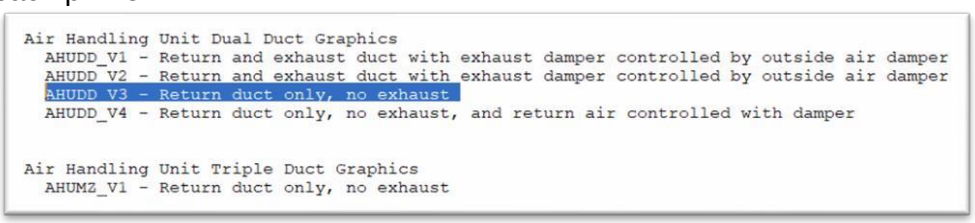
A. Create Graphic Folder:

1. In SRP_Graphics, locate the Equipment folder under the Site/Building and create a folder with the same name as the equipment (Example AHU3). Any graphics or documents relevant to this equipment will be organized in this new folder.
2. For equipment that shares graphics, reference the Main Graphic Specifications section on folder naming.



B. Using Equipment Graphic Standard:

1. Look in the SRP_Standards folder for an existing graphic that closely resembles the equipment or system configuration.
   a. Graphics are organized by system type
   b. In each system type folder (e.g. Air Handling Units > Multi Deck Units), reference the Sumary.txt file(s) for a summary of the system configuration for each px file.



2. Copy the selected equipment standard graphic for the main graphic to the equipment folder created in SRP_Graphics. Do not rename this file.
3. After identifying the size of the main graphic, select the corresponding background graphic size from the SRP_Standards Background folder and copy it to the new

equipment folder. Rename the background graphic to match the equipment (folder) name.

4. Copy all relevant footers and popups necessary for the graphic into the equipment folder created in SRP_Graphics.
5. Points or images not required on the graphic for this specific equipment type can be deleted in the copied graphics. Nothing will be deleted or changed in the versions stored in SRP_Standards.
6. New sensors, points, links, etc can be added as needed to the copied graphic as necessary.
7. New graphic standards are required when the system does not exist, or there is a significant difference in equipment, piping, etc. from the closest existing standard drawing. All new graphic standards are to be created by or pre-approved for creation and use by SRP.

1.12 GRAPHIC FOLDER MAPPING

A. All graphics for BACnet controllers will be mapped to a folder as follows:

1. Equipment specific graphics controlled predominantly by a single device will be mapped to the folder matching the device name under points. See the BACnet Devices section for folder references.

Slot Sheet

Slot	#	Name	Display Name	Definition	Flags	Type
Property	0	AHUSummary	AHUSummary	Dynamic	o	baja:PxView
Property	1	Title	Title	Dynamic		baja:String
Property	2	Description	Description	Dynamic		baja:String

2. Equipment controlled by multiple devices will be mapped to a folder created under the building folder in the BACnet network folder. See the Main Graphics Specification section for more detail on folder naming and mapping.
3. All folders with graphic mappings utilizing a px include header will require the addition of two slots (Title and Description) for the header graphic. All points in the graphic will be relativized after the appropriate graphic is applied to the folder.

1.13 GRAPHIC HEADER

A. Each main graphic requires a header matching the size of the background graphic canvas. Each building has pre-configured headers (Small, medium, and large) that can be found in the SRP_Graphics file folder structure in the Headers folder.

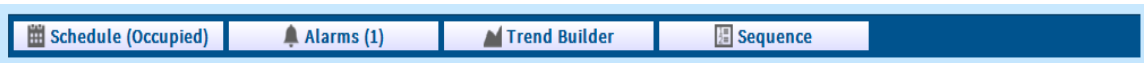
B. Button description and actions are as follows (All links are completed with bajaui:Value Binding):

1. Preconfigured BackButton from the kitPx palette

2. Campus Home button with a link to the Home.px main campus page
3. Building Home button to be linked to the homepage for the building, different on every set of header templates.
4. Link to the user accounts page to edit user parameters based on user security level.
5. Preconfigured LogoffButton from the kitPx palette.
6. Preconfigured ForwardButton from the kitPx palette.
7. The unbound text fields set up on BoundLabel objects. The top text field is used for the site identifier and the bottom text field is used for the building identifier.
8. A BoundLabel object with ord set to the slot:Title.
9. A BoundLabel object with ord set to the slot:Description.
10. A set of BoundLabels. These will have the kitPx:Bound Label Binding properties ord set to the sensed values of a local weather station attached to the building or located on site. If a local weather station is unreliable, a reading may be obtained via weather application native to Niagara that will allow you to obtain weather data uploaded from other local weather stations. The top text box is the current temperature, and the bottom text box is the current humidity.

1.14 GRAPHIC FOOTERS

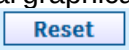
A. Graphic footers are required whenever an additional links are needed outside of the hyperlinks/actions available in the header, and the links on the graphic specific to the graphic contents.



B. Pre-built footers are included in SRP_Standards. However, if any changes are necessary, all preconfigured buttons/links (listed here) are available in standards palette and on graphic templates. Some examples included are as follows:
   1. Schedule – Link to the schedule, no special graphic, just the schedule itself
   2. Alarms – Link to the alarm module for the lowest level available (Equipment level if available, then building level)
   3. Trend Builder – Link to trends folder for equipment, see more information in the Trending section.
   4. Sequence – Link to a PDF of the equipment sequence of operation saved on the Niagara N4 supervisor
   5. Link to Parent Graphic – Link to the parent graphic, as stated in the Main Graphic Specifications section.

1.15 GRAPHIC LINKS

A. All active graphics for systems/equipment will have required links to equipment, setpoints, and trends on the graphic, that are not included in the header or footer. These are defined in the Main Graphic Specifications section, and are depicted as follows:

1. All pre-built charts are to be linked to the corresponding graphic with the pre-configured chart button. 
2. All equipment detail graphics (e.g. equipment communication card, VFD) are to be linked with the pre-configured information button. 
3. All additional graphical setpoints are to be linked to the graphic is a popup setpoints link button. 

1.16 GRAPHIC IMAGES

A. All active graphics must be generated using one of the following palettes:
   1. kitPxGraphics.
   2. webChart.
   3. Bajaui.

B. If additional pallets are desired for graphical generation, they must be approved SRP prior to implementation.

C. All images from any graphic module must remain in the default px folder in the file structure. This folder is prohibited from being altered in any way.

D. All palette images Value Binding properties, unless otherwise noted, must be set as follows:
   1. hyperlink to null.
   2. summary to null.
   3. popupEnable to false.

E. All images not from a palette must be in an Image object and are not permitted to be in a Label object.

F. All images must be saved in the proper image folder in the file structure as follows:
   1. Images used in template headers or backgrounds will be stored in the SRP_Standards Images folder.
   2. Main navigation graphic images for site navigation graphics will be stored in the SRP_Graphics site specific Main Images folder
   3. Building specific graphics will be stored in the SRP_Graphics building specific Main Images folder

G. All images must be formatted to a size matching the Picture object and must have the scale set to None. Scaling of images is not permitted.

1.17 GRAPHIC POINTS AND LABELS

A. All graphical points and labels will need to be configured to match the SRP Point Naming Standards. All pre-formatted labels and points are available in the standard palettes on the SRP Niagara Supervisor. All hardwired, controlled setpoints, and alarms will be

visible on main graphics. All other points, including lockout points, configuration points, and detailed alarms, will be available on popup graphics.

B. There are three different label options for main graphics (Not including headers) as follows:
   1. Points Label – Used for all point name labeling.
   2. Equipment Label – For sub equipment labeling.
   3. Table Label – Headers for all table data in summary graphics.

C. There are three different bound label options as follows:
   1. Write Points – For all points that have a set or an override option.
   2. Read Points – For all points that do not have a set or an override option.

D. All points will be configured as followed:
   1. Writeable points that are intended for override only will have the SET action flag hidden.
   2. All writable points will have their Emergency Override and Emergency Auto action flags hidden.
   3. All writable points will have a facet to limit the max override time to (8) hours.
   4. All points that have an available trend will have the points hyperlink property set to the corresponding trend.

E. Numeric points, if not already configured in the controller, will have the units and precisions set to the following standards:

Category	**Engineering Unit**	**Abbrev**	**Precision**
Electrical Voltage	Alternating Current Volts	VAC	0.1
Electrical Current	Amperes	A	0.1
Thermal Energy	British Thermal Unit	BTU	0.1
Natural Gas Volume	Therms	THERM	0.1
Air Flow Volume	Cubic Feet per Minute	cfm	1
Electrical Voltage	Direct Current Volts	VDC	0.1
Temperature	Fahrenheit	°F	0.1
Air Flow Velocity	Feet per minute	fpm	0.1
Water Volume	Gallons	Gal	1
Electrical Power (Real)	Gigawatt	GW	1
Time	Hours	h	0.1
Natural Gas Volume	Hundred Cubic Feet	CCF	1
Air Pressure	Inches of Water Column	inWC	0.01
Air Pressure Differential	Inches of Water Column	inWCD	0.01
Electrical Energy (Apparent)	Kilovolt-ampere-hour	kVAh	1
Electrical Power (Apparent)	Kilovolt-amperes	kVA	1
Electrical Power (Real)	Kilowatt	kW	1
Electrical Energy (Real)	Kilowatt-hour	kWh	1

Electrical Power (Real)	Megawatt	MW	1
Electrical Current	Milliamps	mA	0.1
Thermal Energy	Million BTU	MMBTU	1
Electrical Voltage	Millivolts	mV	0.1
Time	Minutes	m	0.1
Electrical Energy (Real)	MW-hour	MWh	1
Carbon Dioxide (CO2)	Parts per Million	ppm	1
Carbon Monoxide (CO)	Parts per Million	ppm	1
Volatile Organic Compound (VOC)	Parts per Million	ppm	1
Relative Humidity	Percentage	%	0.1
Modulating Command / Feedback	Percentage (Open/Closed)	%	1
Water Pressure	Pounds per Square Inch	psiG	0.1
Water Pressure Differential	Pounds per Square Inch Differential	psiD	0.1
Time	Seconds	s	1
Thermal Energy	Thousand BTU	MBTU	1
Natural Gas Volume	Thousand Cubic Feet	MCF	1
Thermal Energy	Tons of Cooling	Tons	0.1
Electrical Energy (Apparent)	Volt-ampere-hour	Vah	0.1
Electrical Power (Apparent)	Volt-amperes	VA	0.1
Electrical Power (Real)	Watt	W	0.1
Electrical Energy (Real)	Watt-hour	Wh	0.1

F. Boolean points, if not already configured in the controller, will have the following TRUE/FALSE values:
   1. Enable – Enable/Disable.
   2. Alarm – Alarm / Normal.
   3. Status (With exceptions to actuators) – On/Off.
   4. Actuator Status – Open/Closed.
   5. Reset – Reset/Off.

1.18 NIAGARA ALARMING

A. Each site and building will be pre-configured for each of the alarm classes (Default, Critical, and Emergency) and the alarms will be routed accordingly. There will be a general alarm console for all alarms across all SRP sites. Additional alarm consoles will be added for each site and building, and will named after each site and building (Ex. 27_Alarms and 2701_Alarms). These site and building specific alarm consoles will be bound to the alarms link button on each graphic footer.

B. Each building and site will also have a total number of alarms counted for both the default and critical alarms linked to a numeric point for each building footer to depict the total number of active alarms (Ex 2701_AlmCnt).

C. Alarms will be organized into two classes per building.

D. Critical and Emergency Alarms:
   1. Niagara alarm objects will be created for alarms that are classified by SRP as Critical or Emergency. These may be duplicate alarms to the default alarms.
   2. Each created alarm will have the alarm class configured to match the correct site, building, and critical class.
   3. See Division 23, Section 23 09 93 for required alarms.

1.19 NIAGARA SCHEDULES

A. All main graphics, floorplans, alarm consoles, trends, charts, and documents will be included in a nav file.

B. The naming and the organization of the navigation tree is laid out in the Main Graphics Specification sections. The icons for the navigation tree will reflect the example navigation tree in the graphic standards.

C. Under each graphic component in the navigation tree, include the following components where applicable and if the components exist:
   1. Trends – Linked to a blank trend builder, and under include all the corresponding equipment trends linked to a trend builder.
   2. Charts – Linked to a blank trend builder, and under include all the pre-configured charts for the corresponding equipment.
   3. Schedule – Linked to the schedule for the corresponding equipment.
   4. Sequence – Linked to the PDF of the sequence for the corresponding equipment.

1.20 MAIN GRAPHIC SPECIFICATIONS

A. Each of the following graphics in this section and the Detail Graphics Specifications section has the following information:
   1. Navigation Tree Configuration - How the equipment will be referenced in a navigation tree file
   2. Popup Graphics – Required popup graphic buttons.
   3. Graphic Links – Required links on the equipment page to other main graphics.

B. Air Compressor:
   1. Navigation Tree Configuration - In root of building nav file with component named Air Compressor.
   2. Popup Graphics – No popup graphics for this equipment.
   3. Graphic Links - Graphic will not require any links.

C. Air handling Unit – Fan Coil Units:
   1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
   2. Popup Graphics – Supply Air Temperature Reset, Optimized Configurations, Mode Lockouts.
   3. Graphic Links – As follows:

a. Link to hot water plant or building heat exchanger if hot water coil.
b. Link to steam boiler plant if steam coil.
c. Link to chilled water plant if chilled water coil.
d. Link to air compressor if pneumatic controls.
e. Link to any VFD information graphics.

D. Air handling Unit – Outside Air Units:
1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
2. Popup Graphics – Supply Air Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts, Recovery Setpoints.
3. Graphic Links – As follows:
a. Link to zone summary page (if multi-zone).
b. Link to recovery unit if separate graphic.
c. Link to hot water plant or building heat exchanger if hot water coil.
d. Link to steam boiler plant if steam coil.
e. Link to chilled water plant if chilled water coil.
f. Link to air compressor if pneumatic controls.
g. Link to any VFD information graphics.

E. Air handling Unit – Multi Deck Units:
1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
2. Popup Graphics – Hot Deck Temperature Reset, Cold Deck Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts.
3. Graphic Links – As follows:
4. Link to any other units controlling space in addition to current unit.
5. Link to zone summary page.
6. Link to hot water plant or building heat exchanger if hot water coil.
7. Link to steam boiler plant if steam coil.
8. Link to chilled water plant if chilled water coil.
9. Link to air compressor if pneumatic controls.
10. Link to any VFD information graphics.

F. Air handling Unit – Multi Zone Units:
1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
2. Popup Graphics – Hot Deck Temperature Reset, Cold Deck Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts.
3. Graphic Links – As follows:
4. Link to zone summary page.
5. Link to hot water plant or building heat exchanger if hot water coil.
6. Link to steam boiler plant if steam coil.
7. Link to chilled water plant if chilled water coil.
8. Link to air compressor if pneumatic controls.

9. Link to any VFD information graphics.

G. Air handling Unit – Single Zone Units:
1. Navigation Tree Configuration - In AHU Summary component with component matching AHU name.
2. Popup Graphics – Supply Air Temperature Reset, Static Pressure Reset, Optimized Configurations, Mode Lockouts.
3. Graphic Links – As follows:
4. Link to zone summary page.
5. Link to hot water plant or building heat exchanger if hot water coil.
6. Link to steam boiler plant if steam coil.
7. Link to chilled water plant if chilled water coil.
8. Link to air compressor if pneumatic controls.
9. Link to any VFD information graphics.

H. Boiler Summary Graphic:
1. Navigation Tree Configuration - In Hot Water System component with component matching Boiler name (Example Boiler 1).
2. Popup Graphics – None required.
3. Graphic Links – As follows:
4. Link to hot water system / steam boiler plant graphic (Footer Link).

I. Building Hot Water Circulation Graphic:
1. Navigation Tree Configuration - In Hot Water System component with component named Circulation Pumps.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to hot water system / steam boiler plant graphic (Footer Link).
   b. Link to any VFD information graphics.

J. Building Heat Exchangers:
1. Navigation Tree Configuration - In root of building nav file with component named Building Heat Exchanger.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to feeding hot water system / steam boiler plant graphic.
   b. Link to feeding chilled water system
   c. Link to circulation pumps.
   d. Link to any VFD information graphics.

K. Chilled Water Plant:
1. Navigation Tree Configuration - In root of building nav file with component named Chilled Water System.
2. Popup Graphics – System Enable Setpoints, Chilled Water Setpoint Reset, Chilled Water Pressure Reset, Lead/Lag Settings.

3. Graphic Links – As follows:
4. Link to cooling tower graphic.
5. Link to any VFD information graphics.
6. Link to air compressor if pneumatic controls.

L. Chiller Summary Graphic:
1. Navigation Tree Configuration - In Hot Water System component with component matching Chiller name (Example Chiller 1).
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to chilled water plant (Footer Link).

M. Cooling Tower(s):
1. Navigation Tree Configuration - In Chilled Water System component with component named Cooling Towers.
2. Popup Graphics – System Enable Setpoints, Chilled Water Setpoint Reset, Chilled Water Pressure Reset, Lead/Lag Settings.
3. Graphic Links – As follows:
   a. Link to chilled water system graphic (Footer Link).
      i. Link to any VFD information graphics.

N. CRAC Units:
1. Navigation Tree Configuration - In root of building nav file with component named CRAC Units.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to floorplan.

O. Deionized Water System:
1. Navigation Tree Configuration - In root of building nav file with component named Deionized Water System.
2. Popup Graphics – None required.
3. Graphic Links – None required.

P. Domestic Water Systems:
1. Navigation Tree Configuration - In root of building nav file with component named Domestic Water System.
2. Popup Graphics – None required.
3. Graphic Links – None required.

Q. Emergency Generator:
1. Navigation Tree Configuration - In root of building nav file with component named Emergency Generator.
2. Popup Graphics – None required.
3. Graphic Links – None required.

R. Exhaust Fans:
   1. Navigation Tree Configuration - In Exhaust Fans component with component named matching exhaust fan name (ex EF01).
   2. Popup Graphics – None required.
   3. Graphic Links - None required.

S. Fan Coil Unit:
   1. Navigation Tree Configuration - In FCU Summary component with component matching FCU name.
   2. Popup Graphics – None required.
   3. Graphic Links – As follows:
      a. Link to hot water plant or building heat exchanger if hot water coil.
      b. Link to chilled water plant if chilled water coil.
      c. Link to air compressor if pneumatic controls.

T. Fan Powered Box:
   1. Navigation Tree Configuration - Under serving air handling unit component under Terminal Unit Summary component with component matching FPB name.
   2. Popup Graphics – None required.
   3. Graphic Links – As follows:
      a. Link to serving air handling unit (Footer Link).
      b. Link to hot water plant or building heat exchanger if hot water coil.
      c. Link to air compressor if pneumatic controls.

U. Lab Systems:
   1. Navigation Tree Configuration - In root of building nav file with component named Lab System Summary.
   2. Popup Graphics – None required.
   3. Graphic Links – None required.

V. Solar Systems:
   1. Navigation Tree Configuration - In root of building nav file with component named Solar System.
   2. Popup Graphics – None required.
   3. Graphic Links – As follows:
   4. Link to Utilities graphic.

W. Unit Vents:
   1. Navigation Tree Configuration - In Unit Vent Summary component with component matching unit Vent name.
   2. Popup Graphics – None required.
   3. Graphic Links – As follows:
   4. Link to hot water plant or building heat exchanger if hot water coil.

X. VAV Terminal Unit:

1. Navigation Tree Configuration - Under serving air handling unit component under Terminal Unit Summary component with component matching VAV name.
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to serving air handling unit (Footer Link).
   b. Link to hot water plant or building heat exchanger if hot water coil.
   c. Link to air compressor if pneumatic controls.

Y. VFD Summary:

1. Navigation Tree Configuration - Under system component VFD serves in VFD component with component matching VFD name (Ex CHWP1).
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to system graphic for the system the VFD serves (Footer Link).

Z. Window Controls:

1. Navigation Tree Configuration - In root of building nav file with component named Window Control.
2. Popup Graphics – None required
3. Graphic Links – None required

AA. Zone:

1. Navigation Tree Configuration - Under serving air handling unit component under Terminal Unit Summary component with component matching Zone name (Zone 1).
2. Popup Graphics – None required.
3. Graphic Links – As follows:
   a. Link to serving air handling unit (Footer Link).
   b. Link to hot water plant or building heat exchanger if hot water coil.
   c. Link to chilled water plant if chilled water coil.
   d. Link to air compressor if pneumatic controls.

1.21 DETAIL GRAPHIC SPECIFICATIONS:

A. The detail graphic specifications include main building pages, floorplans, and summary graphics. For each of these graphics, reference the standard graphics and standards palette for formatting of shapes, labels, and points.

B. AHU Summary Graphics:

1. Includes all air handling units in a specific building. The information included in an AHU summary graphics (if available) is as follows:
   a. Name of AHU (Ord to graphic Slot:displayName) with hyperlink to graphic.
   b. Area served (Ord to graphic Slot:Description) with hyperlink to Floorplan.
   c. Occupancy (Ord to active occupancy point) with hyperlink to schedule.
   d. Supply Fan Status
   e. Space temperature

i. If multiple zones are served, the average of all space temperatures will be represented.

f. Discharge air temperature or Supply air temperature
g. Static Pressure
h. Alarm Status
i. Terminal unit summary button – Add if AHU Terminal summary exists and link to that graphic.

2. Graphic location specifications as follows:
   a. PX Location – Graphic on AHUSummary folder
   b. Navigation Tree Configuration - In root of building nav file with component named AHU Summary.

C. AHU Terminal Summary:

1. Includes all the terminal units for any air handling unit with multiple zones or terminal devices. The information included in an AHU Terminal Summary graphics (if available) is as follows:
   a. Name of Terminal Units (Ord to graphic Slot:displayName) with hyperlink to graphic.
   b. Area served (Ord to graphic Slot:Description)
   c. Occupancy (If space has separate occupancy from unit).
   d. Space temperature
   e. Active space temperature setpoint
   f. Heat Stage Command or Hot Water Valve Command
   g. Fan Command
   h. Fan Status
2. Graphic location specifications as follows:
3. Controller Location – Graphic on folder named after sir handling unit (Ex. AHU01Summary)
4. Navigation Tree Configuration – Under the serving air handler component with named component Terminal Unit Summary.

D. Exhaust Fan Summary:

1. Includes all the exhaust fans not dedicated to a specific air handling unit. The information included in an Exhaust Fan Summary graphics (if available) is as follows:
   a. Name of Exhaust Fan (Ord to graphic Slot:Title) with hyperlink to graphic.
   b. Area served (Ord to graphic Slot:Description) with hyperlink to Floorplan.
   c. Space temperature
   d. Active space temperature setpoint
   e. Building/Space Pressure
   f. Building/Space Pressure Setpoint
   g. Fan Command
   h. Fan Status - Linked to trend or chart if available.
2. Graphic location specifications as follows:
   a. Controller Location – Graphic on EFSummary folder.
   b. Navigation Tree Configuration – Under the serving air handler component with named component Exhaust Fan Summary.

1.22 FLOORPLANS AND HVAC DETAIL

A. Each floorplan for a building will be available as a graphic. The HVAC/Detail floorplan will include various points, hyperlinks and a compass indicating a minimum of North. All zones will need to be represented with a polygon object formatted matching the graphic standard. These polygons will be grey, and highlight yellow when the mouse hovers over the zone, allowing the zone name to pop-up. A zone would represent a space temperature, air handler space sensors, TU sensors, radiators, etc. Each zone will hyperlinked to the specific zone graphic. Other links and points will be included if applicable:

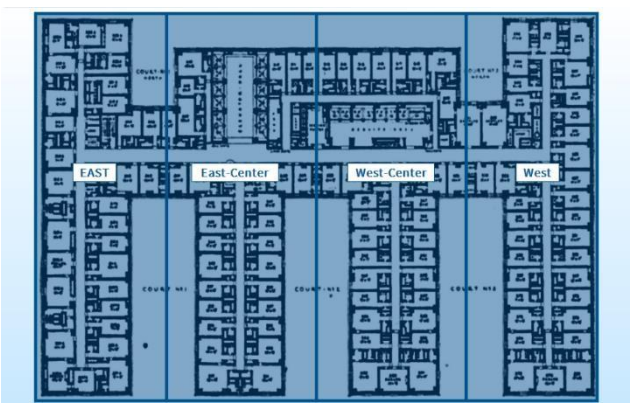
1. Zone space temperature and labels are to be located closest to actual physical location of the zone sensor, with hyperlink to equipment graphic.
2. Any notes or information required for floorplan.

B. Graphic location specifications as follows:

1. Controller Location – Graphic in floorplans folder, on a folder named matching the graphic name (Example Floorplan_HVAC_01).
2. Navigation Tree Configuration – Under the Floorplan component in the HVAC component. If it is the only graphic for the floor (Floor not split into smaller graphics), component will match floor number (Floor01). If this is a smaller part of a floor, it will be under the floor number component with component matching the direction (Example West).

C. Floorplan Navigation:

1. If a floorplan for an individual floor is too large for a single graphic, it will be broken into partial floorplans (e.g. East and West). A floorplan graphic called a Navigation Floorplan will be created. This graphic will show the whole floorplan for its respected floor and show how the floorplan will be segmented with rectangles and labels. Pre-formatted examples are available.



2. On every partial floorplan graphic (a section of a floorplan from a navigation floorplan), the bottom right corner will include a navigation image. This will be a smaller representation of the whole floor, and highlight the current are being viewed in the active floorplan Add data center/server (CRAC) critical alarms and fume hood low flow graphic.
3. Partial floorplans will also have a link in the footer to link back to the corresponding navigation floorplan graphic.
4. Graphic location specifications as follows:

a. Controller Location – Graphic in floorplans folder, on a folder named matching the graphic name (Example Floorplan_Navigation_01).
b. Navigation Tree Configuration – Under the Floorplan component in both the HVAC and Lighting component This will be the graphic for the floors that have the split components underneath (Example Floor01).

D. Main Graphics Page:
1. Each main graphic page will require hyperlinks to the following graphics when completed:
a. Building alarm console.
b. All equipment summary pages that are not linked from another summary page (e.g. Lighting Panel Summary graphics are hyperlinked to Lighting Summary pages) named appropriately and hyperlinked to the corresponding summary page.
c. Utility Summary.
d. Air Compressors.
e. Hot Water Plants (With system status).
f. Building Heat Exchanger (With system status).
g. Chilled Water Plants (With system status).
h. Domestic Water and/or Deionized Water (With system status).
i. Emergency Generator (With system status).

END OF SECTION

APPENDIX C – DEVICE DATA SPREADSHEET

Step 1 - Provide to SRP for Address Information							Provided by SRP After Step 1						
Device Name	Device Description	Manufacturer	Model	Series	Firmware Version	Protocol	IP Address	UDP Port	Network ID	BACnet ID	Instance Number	Switch ID	Port ID

Step 2 - Provide to SRP for Approval prior to Installation						
MAC Address	DHCP (Yes/No)	Previous Device (If daisy chain configuration)	Hosted Network 1	Hosted Network 2	Hosted Network 3	Hosted Network 4

Note: Excel spreadsheet will be provided to the contractor in .xlsx format.

END OF SECTION

APPENDIX D – OBJECT NAMING SPREADSHEET

Step 1 – Provide to SRP for Object Naming Acceptance									
Device Name	**Proposed Object Name**	**Object Type**	**Object Instance ID**	**Units/Non-Numeric Display**	**Precision**	**Trend Type**	**CoV Tolerance**	**Trend Interval**	**Additional Commissioning Trend**

Step 1 – Provide to SRP for Object Naming Acceptance					Provided by SRP After Step 1			
Commissioning Trend Interval	**Read/Write**	**Graphic**	**Alarm**	**Description**	**Comments**	**Acceptance Status**	**Checked By**	**Date**

Note: Excel spreadsheet will be provided to the contractor in .xlsx format.

END OF SECTION

SECTION 25 11 00

INTEGRATED AUTOMATED NETWORK DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This section defines the requirements for any network equipment required to move data between networks or translate data to an IP network layer.

B. Related Sections:
   1. 25 00 00 Integrated Automation
   2. 25 14 00 Integrated Automation Local Control Units
   3. 25 15 00 Integrated Automation Software

1.2 REFERENCES

A. Refer to 25 00 00 Integrated Automation.

1.3 ACRONYMS

A. Refer to 25 00 00 Integrated Automation.

1.4 DEFINITIONS

A. Refer to 25 00 00 Integrated Automation.

1.5 SYSTEM DESCRIPTION

A. Refer to 25 00 00 Integrated Automation.

1.6 SUBMITTALS

A. Refer to 25 00 00 Integrated Automation.

B. Network Layout submittal will be required prior to any product approval.

C. Network Configuration submittal will be required prior to execution of any work.

1.7 QUALITY ASSURANCE

A. New devices used for transport of BACnet data must be native-BACnet and BTL listed unless otherwise approved by SRP.

B. Coordinate all related network infrastructure changes with SRP before execution of the work.

C. Network configuration and device identification is configured by SRP and must be pre-approved prior to set-up and execution.

D. The control system contractor will confirm compatibility between supervisory software and server hardware.

E. Any devices will have SRP set up as administrative user, and all default user and administration accounts will be deactivated or removed.

F. Refer to 25 00 00 Integrated Automation.

1.8 WARRANTY

A. Refer to 25 00 00 Integrated Automation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Any network device proposed for permanent installation must adhere to the following:
   1. Must utilize BACnet/IP as one of its primary communication protocols and must be discoverable on any BACnet network.
   2. Must be license and maintenance cost free to remain functional with any BACnet system.
   3. Must have full set-up and configuration available through IP address connection in web browser.
   4. Must come with a secondary RJ45 communication port for temporary local connection to the controller. This connection must support data backup, commissioning, programming, and configuration functions.
   5. Must not be limited in their ability to communicate with a specific brand or model with exception of approved gateways for proprietary network applications.

2.2 MANUFACTURED UNITS

A. The following are the Basis of Design for Integrated Automated Network Devices. All makes and models are subject to compliance requirements set forth by SRP.

B. All products must be new, currently manufactured, and supported by the manufacturer.

C. Spare parts or replacement equipment must be available for a minimum of 5 years after contract completion.

D. Bridges:
   1. Siemens SCALANCE XC Series.

E. Routers:
   1. Contemporary Controls BASRT-B (Unmanaged, temporary use by contractor).
   2. Cisco CSR 1000V (For Cloud and SaaS applications).

F. Gateways:
   1. Babel Buster BB3-7101 (B-GW).

G. Integrators:
   1. Niagara Jace 8000 (B-BC).

2.3 BACNET INTEROPERABILITY BUILDING BLOCKS

A. In addition to the minimum required BACnet Interoperability Building Blocks (BIBBS) per each device profile set forth by ASHRAE, the following will also be required:
   1. B-BC:
      a. DS-COV-A/B
      b. DS-M-A
      c. DS-V-A
      d. AE-VN-A
      e. AE-VM-A
      f. SCHED-VM-A
      g. T-ATR-A
      h. T-V-A
      i. DM-TS-A
      j. DM-R-B
      k. DM-OCD-B
      l. DM-ANM-A
      m. DM-ADM-A
      n. DM-ATS-A
      o. DM-MTS-A
   2. B-GW:
      a. DS-RPM-B
      b. DS-WPM-B
      c. DS-COV-B
      d. DM-RD-B

2.4 BRIDGES

A. Bridges are not approved for installation on SRP network.

B. All required connections across different data-link layers will need to be documented and submitted to SRP for approval and to be configured by SRP on the SRP network.

C. Bridges required for proprietary sub-network will not be connected to the SRP network and must be approved by SRP.

2.5 ROUTERS

A. Routers are not approved for installation on the SRP network by any party other than SRP.

B. Wireless devices are not approved for use on the SRP network, and any sub-network wireless devices will need to be approved by SRP.

C. Any routers temporarily installed for remote access must be approved by SRP prior to installation. While installed, no device connected to or accessible from the router will be on the SRP network.

D. Any routers required for Cloud/SaaS applications will be approved by SRP to assess any security issues or concerns with the SRP network.

2.6 GATEWAYS

A. Gateways may be installed for translation of communication protocols to BACnet/IP for devices that are not native BACnet/IP from the manufacturer.

B. Gateways will only be approved where BACnet Building Controllers or Integrators are not an economical or viable option.

C. Gateways installed for permanent use must adhere to following:

1. BTL and UL Listed.
   a.
2. Web configuration.
   a. No additional software will be required to configure the gateway.
3. Capable of baud rates at 76800 or greater.
4. Capable of DHCP configuration.
5. Rated for operation at 0°C to 50°C (32°F to 120°F).
6. DIN rail mountable.

2.7 INTEGRATORS

A. Integrators must be approved for installation on the SRP network.

B. Integrators will be configured as BACnet devices. Data sent and received between multiple integrators and/or the network supervisor must use the BACnet protocol, unless otherwise specified by SRP.

C. Trend and scheduling objects must be configurable and data store storage available in any integrator.

D. Integrators may be used as an input monitoring device so long as IO modules for monitoring only if they are installed for primary use as an integrator and is more economical than another device installation.

E. Integrators must also adhere to the following:
   1. Must be capable of acting as a protocol gateway between network supervisor and field devices.
   2. Must be capable of acting as a BACnet Broadcast Management Device (BBMD).
   3. Must be modular in nature to allow for future capacity expansion. This includes data storage capacity as well as necessary IO modules for monitoring purposes.
   4. Integrators with point count or device count limitations must be sized for total point and/or device count plus 10% capacity.
   5. Must include an uninterruptible real time clock. This clock must keep time of day, day of week, month, and year information. The supervisory controller must also be capable of syncing its time with the building automation server, and sync time to all field level controller.
   6. BTL and UL listed.
   7. DIN rail mountable.
   8. Minimum of 4GB of flash storage space.
   9. Must support SSL and TLS encryption.

PART 3 - EXECUTION

3.1 NETWORK COMMUNICATION REQUIREMENTS

A. For network communication requirements reference section *25 12 00 Integrated Automation Network Configuration*

3.2 GENERAL INSTALLATION

A. For installation requirements, reference section *25 00 00 Integrated Automation*

3.3 INTEGRATORS

A. Any new Integrators installed on the network will pass all data as BACnet objects over the SRP IP network. No data will be shared as any other language unless approved by SRP for specific applications.

B. Integrators must be used as gateways only for devices that are not capable of trending or scheduling and where no BACnet Building Controller is available.

C. Must be furnished with an uninterruptable power supply if one did not previously exist. This uninterruptible power supply must only supply emergency power for their respective supervisory controller and must adhere to the following:
   a. DIN rail mounted within the same controller enclosure.
   b. Emergency power for a minimum of one hour.
   c. Outputs for UPS alarms and status.

D. For network setup and configuration reference section *25 12 00 Integrated* Automation *Network Configuration*

END OF SECTION

SECTION 25 12 00

INTEGRATED AUTOMATION NETWORK CONFIGURATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section defines the networking protocols to be utilized by the SRP building automation network.

B. Related Sections:
   1. 25 00 00 Integrated Automation
   2. 25 11 00 Integrated Automation Network Devices

1.2 REFERENCES

A. Refer to *25 00 00 Integrated Automation.*

1.3 DEFINITIONS

A. Refer to *25 00 00 Integrated Automation.*

1.4 SYSTEM DESCRIPTION

A. Refer to *25 00 00 Integrated Automation*.

1.5 SUBMITTALS

A. Refer to *25 00 00 Integrated Automation.*

1.6 QUALITY ASSURANCE

A. Coordinate all related network infrastructure changes with SRP. Any changes to network components or infrastructure without prior authorization from SRP is not permitted.

B. Network configurations for IP devices is assigned by SRP, and any devices not matching the approved designation will not be allowed on the SRP network.

C. All new BACnet devices must be BTL listed unless otherwise approved by SRP.

D. All Modbus devices must be a member of the Modbus Organization and must comply with all Modicon protocol standards.

E. BBMD devices can only be setup on the SRP network with SRP approval.

1.7 WARRANTY

A. Refer to *25 00 00 Integrated Automation.*

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SITE WIDE GENERAL NETWORK COMMUNICATION REQUIREMENTS

A. All network activities will be coordinated with SRP prior to any work performed.

B. Field devices will be integrated to the enterprise level utilizing the BACnet/IP protocol.

C. Integrators will convert all serial communications to BACnet/IP for integration into the supervisors.

D. Any field devices with a separate enterprise level that cannot be translated to BACnet/IP shall be capable of data sharing via an XML data transfer process.

E. Portions of the SRP building management system lie on a local VLAN. These existing legacy components will remain as is unless otherwise specified by SRP.

F. New building management TCP/IP devices will utilize DHCP. Static IP devices are not permitted unless otherwise specified by SRP.

G. For IP devices, SRP will provide IP address configuration and device. The Controls Contractor will configure and assign the following as follows:
   1. Each sub network ID will be the IP address and the number of routed networks on the device as a single digit-number.
   2. Devices will be given unique sequential instance IDs from instance IDs with no skipped values.
   3. Devices will be given device ID that matches the network ID on which it resides followed by the device instance ID as a two digit-number.

H. The below protocols are permitted on the SRP building management network:
   1. BACnet
      a. BACnet/IP is permitted everywhere.
      b. BACnet MS/TP is permitted in limited capacity. See section 3.2 for details.
   2. Modbus
      a. Modbus TCP
      b. Modbus RTU in limited capacity. See section 3.2 for details.

3. TCP/IP
    a. Tridium FOX/FOXS
4. HTTP/HTTPS

3.2 CONTROL AND MONITORING OF NETWORK COMMUNICATION

A. Any new IP device will have the ethernet protocol disabled prior to installation onto the SRP building management network.

B. New field devices will be BACnet/IP, unless building design constraints deem BACnet/IP as an ineffective design option.
    1. For equipment where BACnet/IP is not an effective option, BACnet MS/TP may be permitted under special circumstances upon approval by SRP. These circumstances are:
        a. Where it makes sense to use a single BACnet/IP controller on a major piece of equipment to route data from multiple minor devices, such as VAV boxes.
        b. To integrate 3rd party devices that do not support BACnet/IP, such as VFDs or packaged roof top units.

C. New metering devices will be BACnet/IP. Where BACnet/IP is unavailable for metering devices, Modbus TCP is the acceptable alternative. Metering devices will not utilize serial RS-485 communication protocols unless otherwise specified by SRP.

D. IP device ports will be configured as follows:
    1. IP port 1 will be configured to the approved SRP IP device configuration parameters.
    2. Where available, IP port 2 will be configured to a generic IP address specified by the SRP device configuration standards for direct connection.
    3. Any additional IP ports will be disabled.

END OF SECTION

SECTION 25 14 00

INTEGRATED AUTOMATION FIELD DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This section defines the requirements for field level controllers for the SRP building management system.

B. Related Sections:
   1. *25 00 00 Integrated Automation*
   2. *25 11 00 Integrated Automation Network Devices*
   3. *25 12 00 Integrated Automation Network Configuration*

1.2 REFERENCES

A. Refer to *25 00 00 Integrated Automation.*

1.3 DEFINITIONS

A. Refer to *25 00 00 Integrated Automation.*

1.4 SYSTEM DESCRIPTION

A. Refer to *25 00 00 Integrated Automation.*

1.5 SUBMITTALS

A. Refer to *25 00 00 Integrated Automation.*

1.6 QUALITY ASSURANCE

A. Multiple controllers will not be networked together to control a single piece of equipment.

B. Functional tests on existing field controllers will be performed prior to integration into the Niagara N4 building management system.

C. BACnet devices must be BTL listed unless otherwise specified by SRP.

D. All Modbus devices must be a member of the Modbus Organization.

E. The ability to manipulate sequences, timers, setpoints, etc. as required to meet or exceed the design intent of the equipment served.

F. Devices specified for installation must be able to adhere to the following:

1. Store setpoints and schedules in non-volatile memory.
2. Support energy saving conservation measures with no additional controller hardware.
3. Be configured as stand-alone system control in the event of a network failure.
4. Can manipulate sequences, timers, setpoints, etc. as required to meet or exceed the design intent of the equipment served.

G. Refer to 25 00 00 Integrated Automation for general quality assurance requirements.

1.7 WARRANTY

A. Refer to 25 00 00 Integrated Automation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Products will be stored according to manufacturer's recommendations.

B. Products will be stored in their original manufacturers packaging until installation.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

A. BACnet IP will be the default communication protocol for all new field controllers. Where building constraints prevent the use of BACnet/IP, BACnet MS/TP is the preferred alternative communication protocol for field controllers.

B. BACnet MS/TP is utilized, new field controllers must come with built in end of line resistors.

C. Additional field controller requirements include the following:
1. Must have a fusible overcurrent protection. Fuse must be replaceable.
2. Must not be limited in their ability to communicate with a specific brand or model.
3. Must have a minimum operating temperature range between 32° F and 122° F.
4. Must withstand a humidity range of 0-90%, non-condensing.
5. Must have diagnostic LEDs for communication and power.
6. Must be license and maintenance cost free to remain functional with any BACnet system.
7. All programming and configuration from a remote workstation must be allowed.
8. Must allow for complete communication architecture for all building automation system field devices and any integrated 3rd party devices.
9. Must include an uninterruptible real time clock. This clock must keep time of day, day of week, month, and year information. The field controller must also be capable of syncing its time with the building automation system.

2.2 MANUFACTURED UNITS

A. Subject to requirement compliance, devices from one of the following manufacturers are preferred:
   1. Acuity Brands/Distech Controls.
   2. Johnson Controls.
   3. Honeywell International.

B. The following are the Basis of Design for Integrated Automation Field Devices. All makes and models are subject to compliance requirements set forth by SRP.

C. BACnet Advanced Application Controller (B-AAC):
   1. Distech Controls ECB-600 Series.

D. BACnet Application Specific Controller (B-ASC):
   1. Distech Controls ECB-203 Series.

E. BACnet Building Controller (B-BC):
   1. Distech Controls ECY-S1000 Series.

F. BACnet Smart Actuators (B-SA):
   1. Johnson Controls PCX3723.

G. BACnet Smart Sensor (B-SS):
   1. Honeywell International Class 3200 Smart Meter.

2.3 BACNET INTEROPERABILITY BUILDING BLOCKS

A. In addition to the minimum required BACnet Interoperability Building Blocks (BIBBS) per each device profile set forth by ASHRAE, the following will also be required:
   1. B-BC:
      a. DS-COV-A/B
      b. T-VMT-E-B
      c. DM-OCD-B
   2. B-AAC:
      a. DS-COV-B
      b. AE-ESUM-B
   3. B-ASC:
      a. DS-RPM-B
      b. DS-WPM-B
      c. DS-COV-B
      d. SCHED-I-B
      e. DM-RD-B
      f. DM-TS-B
   4. B-SA
      a. DS-RPM-B
      b. DS-WPM-B

c. DS-COV-B
d. DM-RD-B
e. DM-TS-B

5. B-SS:
   a. DS-RPM-B
   b. DS-WPM-B
   c. DM-TS-B

2.4 PROGRAMMABLE DEVICES

A. All physical, electrical, and programming requirements for HVAC controls are referenced in section *23 09 23 Instrumentation and Controls for HVAC*.

B. Programmable controllers must be BACnet BTL listed controllers must support local BACnet calendar and scheduling objects, trend objects, and notification objects.

C. Devices listed with BACnet profile B-BC will be used for any field equipment that consists of multiple pieces of sub equipment (Including but not limited to terminal controls, VFDs, or integrated communication cards).

D. Devices listed with BACnet profile B-AAC may be used with all other field equipment that does meet the requirement for B-BC devices and B-BC devices are not available or economical.

E. Devices listed with BACnet profile B-ASC controllers may be permitted for use so long as it meets all of the other criteria required for a programmable controller and neither B-BC or B-AAC devices are not available or economical.

F. All non-native BACnet controllers must be approved by SRP.

G. IP devices will be set-up as DHCP devices and must have pre-approved network configuration from SRP following procedure documented in division section *25 00 00 Integrated Automation*

H. All device addressing requirements are documented in division section *25 12 00 Integrated Automation Network Configuration*

I. Multiple field controllers will not be used to control a single piece of equipment where critical sensor data must be sent over the building management network for adequate equipment control. The controls contractor must instead specify field controllers capable of expandable input/output modules.

J. Any building management system hardware installed on any SRP owned site will not be limited in their ability to communicate with a specific brand or model.

K. Controllers will be programmed to function as standalone equipment in the event of a network failure. This includes fallback values setpoints, as well as continued trending and notifications.

2.5 NON-PROGRAMMABLE DEVICES

A. Any devices specified must have any required trending and scheduling setup as BACnet objects internal to the non-programmable device.

B. Any non-programmable IP devices that will not have the trending and scheduling internally configured will require an Integration Contractor to setup trending scheduling on the Niagara supervisor.

C. Any non-programmable serial devices that will not have the trending and scheduling internally configured will require a hard-wired integrator specified as part of the project to configure all trending and scheduling.

D. Any existing integration devices can only be used if approved by SRP prior to project design approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Existing field controllers will remain as they are at the time of the project and will be integrated into the Niagara N4 building management system without loss of functionality.

B. If an existing field controller is unable to be integrated into the Niagara N4 building management system due to loss of functionality, the specific losses in function will be documented and a replacement field controller will be quoted by the controls contractor and presented to SRP for evaluation. SRP will then determine how to proceed with the field controller in question.

C. The Controls contractor will provide the new field controllers, and all required miscellaneous hardware for system monitoring and control of equipment.

D. New field controller location and connection to the SRP building management system must be approved by SRP prior to any work performed.

E. All device addressing will be setup as indicated in section *25 12 00 Integrated Automation Network Configuration.*

F. Existing controllers will not be readdressed, unless otherwise specified by SRP.

G. Provide additional input and output modules as required to meet point list requirements. Total required inputs and outputs must be approved by SRP prior to any work performed.

3.2 SCHEDULES

A. Scheduling as defined in this section will be completed by Controls Contractor or documented to proper completion by Integration Contractor as defined in section *25 00 00 Integrated Automation.*

B. Schedules will be set up as BACnet Schedule Objects and will follow the SRP Object Naming Standard

C. Devices that support BACnet schedule objects must be configured directly in the device.

D. Devices that do not support BACnet schedule objects must be configured in the IP device routing the serial device.

E. Scheduling that cannot be configured internally or in a device through which it is routed must be presented to SRP with where scheduling will be completed and how it will flow over the network.

F. Scheduling in programmable devices will be set up as follows:
   1. Building schedule set up as a binary schedule object will be BACnet linked from Niagara Supervisor
   2. Equipment schedule set up as an analog schedule object will be BACnet linked from Niagara supervisor
   3. When equipment schedule is 0, the building schedule will be the active schedule
   4. When the equipment schedule is 1 (unoccupied) or 2 (occupied) the equipment schedule will be the active schedule.
   5. If any optimized start/stop operation is required, refer to [REFERENCE] for required configuration.

G. Any zoned control, defined equipment schedule will be utilized for individual zone control.

H. Schedule programming will have BACnet a BACnet binary object indicating which schedule is active in the device.

I. Schedule programming will have a BACnet binary object failing to a null value, allowing the bypass control of the schedule.

3.3 TRENDING

A. Trending as defined in this section will be completed by Controls Contractor or documented to proper completion by Integration Contractor as defined in section *25 00 00 Integrated Automation.*

B. Devices that support BACnet trend objects must be configured directly in the device.

C. Devices that do not support BACnet trend objects must be configured in the IP device routing the serial device.

D. Trending that cannot be configured internally or in a device through which it is routed must be presented to SRP with where trending will be completed and how it will flow over the network.

E. Devices must be specified to have enough memory to store at minimum (72) hours of trends without rolling or losing any data.

F. Devices will be set-up to export trends as BACnet objects directly to the supervisor.

G. Trending will be named to match the object naming standard. This will be the object name with a trend identification at the end of the name to provide a unique object name.

H. Trending in programmable controllers will be set up as follows:
   1. Hardwired points and points from COM link devices will be trended.
   2. Calculated and read-only virtual points will be trended. Write points will not be trended unless otherwise noted in the project design documents.
   3. Modulating commands and calculated setpoints will be set up as COV trends with the pre- defined change value at least 1% of the intended range of the control.
   4. All measurements and other analog points will be set up as INT trends with the pre- defined time value at 5 minutes.

I. Trending in non-programmable controllers will be set up as follows:
   1. Only points proxied to the front-end graphics will be trended.
   2. All proxied points that indicate state or mode will be set up as COV trends.
   3. All analog points for monitored values will be set up as INT trends with the pre-defined time value at 5 minutes.
   4. All binary points will be set up as COV trends.

J. Trending setup and discovery in supervisor will be completed by Integration Contractor andis referenced in section *25 15 00 Integrated Automation Software*

3.4 NOTIFICATIONS

A. Notifications as defined in this section will be completed by Controls Contractor or documented to proper completion by Integration Contractor as defined in section *25 00 00 Integrated Automation.*

B. Notification will be set up as BACnet Notifications Objects and will follow the SRP Object Naming Standard

C. Devices that support BACnet Notification Objects have all notification programmed internally

D. Devices that do not support BACnet Notification Objects must be configured directly in the IP device to which it is hardwired.

E. Notifications that cannot be configured internally or in a device to which it is directly hard-wired must be presented to SRP with where alarming will be completed and how it will flow over the network.

F. Notifications in programmable controllers will be set up as follows:
   1. Notification parameters will be programmed into device and have a binary BACnet object following the SRP Object Naming Standard
   2. Binary BACnet objects for alarm objects will be set up with trending as stated in the Trending section of this division

3. No hardwired objects will be referred to as alarm but instead as a status or a relay, as defined in the object Naming Standard
4. All alarms and notifications will be configured as OFFNORMAL
5. All failed sensors or loss of communication to devices will be configured as FAULTS

G. Alarm classes will be set up by building and by one of four classes (Emergency, Critical, Maintenance, or Faults) as determined by the specific trade division.

H. If no alarm class is defined, the default alarm class for OFFNORMAL events will be critical, and the default alarm class for FAULTS will be Faults.

END OF SECTION

SECTION 25 15 00

INTEGRATED AUTOMATION SOFTWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This section defines the requirements for any supervisory software or software setup required to read and write data across the network, store and archive data, and display data in a graphical user interface.

B. Related Sections:
   1. *25 00 00 Integrated Automation*
   2. *25 14 00 Integrated Automation Field Devices*

1.2 REFERENCES

A. Refer to *25 00 00 Integrated Automation.*

1.3 ACRONYMS

A. Refer to *25 00 00 Integrated Automation.*

1.4 DEFINITIONS

A. Refer to *25 00 00 Integrated Automation*.

1.5 SYSTEM DESCRIPTION

A. Refer to *25 00 00 Integrated Automation*.

1.6 SUBMITTALS

A. Refer to *25 00 00 Integrated Automation.*

1.7 QUALITY ASSURANCE

A. SaaS and Cloud based applications must adhere to the following national and international standards:
   1. ISO/IEC 27001
   2. ISO/IEC 27017

1.8 WARRANTY

A. Refer to *25 00 00 Integrated Automation.*

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Non-SRP hosted servers or workstations will not be permitted for installation. Any hardware requirements for software installation will be coordinated with SRP for virtual server requirements and access.

B. Any licensing or service level agreements must adhere to the following requirements:
   1. SRP listed as the owner
   2. Open to third-party services and applications, and not limited to a specific brand, contractor, or manufacturer
   3. Listed as OPEN for maintenance and upgrades, not limiting to a specific contractor or brand of software unless software is brand specific. Tridium is not a brand specific product.

C. Software installed on-site will not be licensed for expiration where the software will cease to function fully as when license is not expired.

D. For any proprietary systems that do not have a BACnet/IP option for communication between field devices and Niagara Supervisor, supervisory software must be capable of XML data transfer to and from the Niagara Supervisor.

2.2 SAAS AND CLOUD BASED APPLICATIONS/STORAGE

A. All information will be available for export by the customer to a standard usable file format at any time

B. Any data stored at rest or in transit between the cloud service and SRP will be encrypted.

C. Any SaaS must have a dedicated instance for SRP. Public infrastructure is prohibited.

D. Detailed audit logs must also be available to SRP.

E. Applications will not have any licensing and will only have service level agreements.

F. Any installed routers for data transfer to off-site service must be approved by SRP prior to approval

G. The ability to increase storage space on any application must be available to SRP at any time during the SLA.

H. If option is available, the storage location for off-site storage must be the closest in physical location to SRP.

PART 3 - EXECUTION

3.1 NETWORK COMMUNICATION REQUIREMENTS

A. *For network requirements of field devices and data configuration, see section 25 14 00 Integrated Automation Field Devices*

3.2 SAAS/CLOUD PRODUCTS

A. SLA agreements will be signed by SRP and can be canceled by SRP at any time with no penalties or fees.

B. SRP will have full access rights available to customers for SaaS or Cloud service.

C. Any product installation must adhere to the following sections:
   1. 25 10 00 Network Equipment
   2. 25 12 00 Network Configuration

D. For internet connections for data transfers, SRP must be supplied with the HTTPS address to be placed on the ALLOWED List.

E. Any services that will need to be run on the server will need to be pre-approved by SRP, and proper access will need to be granted to the approved Controls Contractor user to set up the services.

3.3 SUPERVISORY SOFTWARE

A. Supervisory software must be installed by Controls Contractor by licensed representative of the product.

B. Software being installed must be the newest version available, and must be updated to the newest available version as stated in section *25 00 00 Integrated Automation*

C. Any additional software required for configuration or maintenance must also be installed on the same server as the supervisory software.

D. Install files, updates, and patches must be stored on the server that they are installed.

E. Any access to the internet for updates or access for remote support external to the Controls Contractor approved for the project is prohibited.

F. SRP will have administration account created in any installed supervisory software prior to project close-out, and all generic and default accounts will be deactivated or removed.

3.4 DEVICE CONFIGURATION/PROGRAMMING SOFTWARE

A. Any software required for installed field device programming, configuration, or maintenance will be installed on an SRP server as part of the project.

B. If an older version of software is installed and the newer version will have an adverse effect with existing device connections, both software will need to be installed in parallel if existing devices cannot be upgraded as part of project.

C. If parallel versions of software are installed, documented step-by-step on switching between and using both software must be presented to SRP at close-out and demonstrated in training session.

3.5 NIAGARA DATA INTEGRATION

A. Data integration into the Niagara Supervisor will be completed by the Integration Contractor.

B. Any device names or object names that cannot be renamed internal to the device to match the SRP Object Naming Standard must be documented as stated in section *25 00 00 Integrated Automation.*

C. Any device or object naming that does not match the approved or is noted in the documents provided for renaming from the Controls Contractors will be the responsibility of the Controls Contractor to resolve at no additional charge.

D. Trending will be discovered into the Niagara Supervisor and set up to import every 30 minutes. Meta-data tagging for history grouping will be added as stated in the SRP Graphic Standard

E. Notifications will **NOT** be discovered into the Niagara Supervisor, and will instead be recreated as Niagara Alarm Objects matching the alarm configuration classes in the SRP Graphic Standard.

F. Schedules will be discovered into the Niagara Supervisor, and BACnet export linked to the appropriate Niagara Schedules, set up to export every 15 minutes.

G. Navigation trees (.nav files) will be updated to include all new graphics and mappings and will match the existing Navigation Trees and as laid out in the SRP Graphic Standard.

H. Graphics will be completed using the SRP standard graphics, and as laid out in the SRP Graphic Standard.

END OF SECTION