

Babcox Justice Complex
Medical Unit AHU
Replacement Project
Addendum Sept 18, 2026

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25 00 11 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – SUMMARY OF WORK

1 - GENERAL

1.01 Application

- 1.01.1 Unless otherwise specified, the *Designated Controls Contractor* in this Specification shall be the Division 25 BAS Contractor.

1.02 Related Sections

- 1.02.1 Section 23 05 93.
1.02.2 Section 23 09 00.

1.03 General Requirements

- 1.03.1 The Specification shall be read as a whole by all parties concerned. Sectioning of the Specification is for convenience only; each section may contain less or more than the completed Work of any Trade.
- 1.03.1.1 The Division 25 BAS Contractor is solely responsible to understand the scope of Work, and make clear to Subcontractors and Equipment Suppliers in other Divisions who are responsible for providing BACnet Interface Devices, on the extent of their Work in this Division.
- 1.03.2 Sections of these Specifications are not intended to delegate functions or to delegate Work and supply to any specific Trade. The Work shall include all labor, materials, equipment and tools required for a complete and working installation as described in the Drawings and these Specifications.
- 1.03.3 Perform all Work as outlined herein and shown on the Drawings and outlined in the Specifications. Provide all materials, tools and labor to complete the installation and commission the Work, to the satisfaction of the Owner.
- 1.03.4 The Work shall be performed by skilled technicians under the direction of experienced project managers/co-coordinators, all of whom shall be properly trained and qualified for this Work.
- 1.03.5 Improper installation or erection of products or supplying and installing unapproved materials, due to failure in complying with the requirements outlined in the Contract Documents, authorizes the Owner to require removal and re-installation at no additional cost for the Work.
- 1.03.6 The Contract Documents shall be interpreted according to the laws of the Place of the Work.
- 1.03.7 Contract Documents include all Drawings and documents prepared for the Work.
- 1.03.8 Where an instruction is given in a clause of these Specifications and it is not obvious to whom the instruction has been given, it shall be deemed to be an instruction given to the Division 25 BAS Contractor responsible for the Work in this Division.
- 1.03.9 Where a list of items to be provided is given in the Specifications, the Division 25 BAS Contractor shall provide all items listed (i.e. the items listed in a series of sub-clauses).
- 1.03.10 Provide means to supply, install, connect and set system to operate to the satisfaction of the Lake County BAS Consultant. If commissioning is specified, Division 25 BAS Contractor shall commission system as specified, to fulfil the intended function to the satisfaction of the Owner.
- 1.03.11 All non-IP network cabling Work shall be done by Division 25 BAS Contractor in accordance with TIA-862 latest Edition. All conduit and pathways to be installed in the Work shall be done in accordance with the requirements outlined in Division 26. All BACnet MS/TP devices shall meet the requirements of EIA-485.
- 1.03.12 Conduit color and tagging requirements:
- 1.03.12.1 The Division 25 BAS Contractor shall run all UL 864 UUKL listed wiring in BLUE conduit.
- 1.03.12.1.1 Affix the conduit that contains UL 864 UUKL listed wiring that is installed in exposed areas with the following label. Install this label on the conduit every 15 ft.

UL 864 UUKL BAS

The Division 25 BAS Contractor shall run all non-UL listed wiring in BLUE conduit. The red label shown above is not required.

- 1.03.13 Free air wiring and wiremould on finished walls and ceilings may only be used with written permission of the Owner.
- 1.03.14 The following Divisions contain BACnet Interface Devices that will be connected to the Owner's BACnet Internetwork for the Work:
 - 1.03.14.1 Division 23.
 - 1.03.14.2 Division 26.
- 1.04 **Note the following terms:**
 - 1.04.1 The term BACnet Master/Slave has been replaced by Manager/Subordinate.
 - 1.04.2 The terms Modbus Master and Modbus Manager are used interchangeably in the Contract Documents.
 - 1.04.3 The terms Modbus Slave and Modbus Subordinate are used interchangeably in the Contract Documents.
- 1.05 **The Place of the Work is the Babcox Justice Complex, Waukegan, IL.**
- 1.06 **Acceptable BAS Division 25 BAS Contractors**
 - 1.06.1 The following Division 25 BAS Contractors are acceptable Division 25 BAS Contractors:
 - 1.06.1.1 Automated Logic Corporation (ALC) Chicago Branch.
 - 1.06.1.1.1 References to Automated Logic, ALC, Division 25, Division 25 BAS Contractor, Controls Contractor, DDC Contractor shall mean the Automated Logic Corporation (ALC) Chicago Branch.
 - 1.06.2 The UL 864 UUKL Work shall be done following the ALC document Part Number WebCTRL_Tenth Ed_SCS (UL 864, 10th Ed. compliant).
- 1.07 **Division 25 BAS Contractor Work Responsibilities:**
 - 1.07.1 Supply, install and commission a complete operating BAS, complete with all Level 0 devices listed, as specified in the Contract Documents.
 - 1.07.1.1 See Schedule 1 – Hardware object list that the Division 25 BAS Contractor shall provide is found in Section 23 09 00. There are additional points specified in the 25 09 sections created for each piece of equipment specified in the Work that the Division 25 BAS Contractor is responsible for providing.
 - 1.07.1.2 See Schedule 2 – Room HVAC Device Matrix. This Schedule is not required for this Bid.
 - 1.07.1.3 See Schedule 3 – BACnet Single Line Diagram and Responsibility Matrix.
 - 1.07.1.4 See Schedule 4 – Object Name Abbreviation Conventions.
 - 1.07.1.5 See Section 25 05 05 Integrated Automation – Common Work Results – Device Interface Integration for equipment with BACnet Interface Devices that is to be integrated into the BAS network.
 - 1.07.1.6 See the individual 25 09 sections of this Specification for equipment for which Division 25 BAS Contractor shall install “stick-built” controls so this equipment can be integrated into the BAS.
 - 1.07.1.6.1 “Stick-built” means that Division 25 BAS Contractor shall provide BAS controls for equipment provided by others using the Point Lists provided in the 25 09 sections created for each piece of equipment required for the Work
 - 1.07.1.6.2 See Drawings for all other Stick-Built points to be supplied and installed under the Work.
 - 1.07.1.7 See the individual 25 20 sections of this Specification for the BACnet Device Interfaces for the equipment, so Division 25 BAS Contractor can integrate this equipment into the BAS.
 - 1.07.2 This Specification defines the minimum equipment and performance requirements for the BASs.
 - 1.07.2.1 The Division 25 BAS Contractor shall not be allowed to deviate from the approved system architecture, location of equipment and equipment specification (as detailed in the Submittals) unless express written approval has been granted by the Owner.
 - 1.07.2.2 If no application for deviation or substitution is made prior to installation, all Work and equipment not in compliance with this Specification or approved as an alternate, shall be rejected and shall be rectified at the Division 25 BAS Contractor's expense.

1.07.3 The Work shall include the following to provide a fully functional BAS to the Owner's satisfaction:

- 1.07.3.1 All BAS devices,
- 1.07.3.2 Level 0 hardware,
- 1.07.3.3 Level 0 software,
- 1.07.3.4 Electrical work as outlined in this Division,
- 1.07.3.5 Integration of BACnet-based equipment controls
- 1.07.3.6 All electronic and computerized control hardware and software and reporting software
- 1.07.3.7 All documentation including control sequence descriptions, Operating and Maintenance Manuals as outlined in the Contract Documents, All related auxiliary items required herein, such as: wiring, conduit, thermowells, metering devices and all other required devices as outlined in the Contract Documents,
- 1.07.3.8 All documentation including control sequence descriptions, Operating and Maintenance Manuals.
- 1.07.3.9 All startup, training, commissioning and closeout services as outlined in the Contract Documents.
- 1.07.3.10 See Divisions 23 and 26 for additional BAS Work requirements to be performed by the Division 25 BAS Contractor.

1.08 Compliance With Code

- 1.08.1 Perform Work in accordance with national codes including all amendments up to tender closing date and other codes of state or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- 1.08.2 Meet or exceed requirements of:
 - 1.08.2.1 Contract Documents
 - 1.08.2.2 Specified standards, codes and referenced documents
- 1.08.3 Comply with the requirements of the latest edition of the applicable UL standards, the requirements of National, State or local Codes, and all other Authorities Having Jurisdiction. These codes and regulations constitute an integral part of these Specifications.
- 1.08.4 Submit equipment to the local Electrical Authority for special inspection and obtain approval before delivery of equipment to site where there is no alternative to supply equipment that is UL listed.
- 1.08.5 In case of conflict, applicable Codes take precedence over the Contract Documents. In no instance reduce the standard or scope of Work or intent established by the Drawings and Specifications by applying any of the codes referred to herein.

1.09 Permits, Fees And Inspections By Authorities

- 1.09.1 Apply for, obtain and pay for all permits, licenses, inspections, examinations and fees required before starting any Work. Submit any additional information requested by the Authorities Having Jurisdiction. Should the Authorities Having Jurisdiction require the information on specific forms, fill in these forms with the required information.
- 1.09.2 Before starting any Work, submit the required number of copies of Drawings and Specifications to the Authorities Having Jurisdiction for their approval and comments. Comply with any changes requested as part of the Contract, but notify the Controls Consultant immediately of such changes, for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required.
- 1.09.3 Arrange for inspection of all Work by the Authorities Having Jurisdiction over the Work. For acceptance for Total Completion, the Division 25 BAS Contractor must furnish an unconditional Certificate of Acceptance from the Authority Having Jurisdiction.

1.10 Division 25 BAS Contractor BACnet Gateway Installation Scope of Work

- 1.10.1 Systems requiring Division 25 BAS Contractor to provide BACnet gateways to integrate non-BACnet Interface Devices provided by others in the Work, shall include, but not be limited to, the following:
 - 1.10.1.1 See Section 25 20 23.09.00 Integrated Automation –BACnet Interface Device (Gateways/Native BACnet Devices) – Automation Display (ADi) Panels (All Types)

1.11 Division 25 Owner Supplied Device Integration Scope of Work

- 1.11.1 Systems requiring Division 25 BAS Contractor to add controls to equipment provided by the Owner or his agents shall include, but not be limited to, the following:

1.11.1.1 NONE

1.12 Division 25 BAS Contractor Stick Built Device Integration Scope of Work

1.12.1 Systems requiring Division 25 BAS Contractor to add controls to equipment provided by others shall include, but not be limited to, the following:

1.12.1.1 See Sections 25 09 23.21.23 to 25 09 23.72.00 inclusive for Work responsibilities. Each section identifies the Division 25 BAS Contractor that is responsible for the Work in these sections.

1.13 Division 25 BAS Contractor BACnet Interface Device Integration Scope of Work

1.13.1 See Sections 25 14 23.36 to 25 20 28.31.11 inclusive for Work responsibilities for BACnet Device Integration on equipment provided by Division 25 and by others. Each section identifies the Division 25 BAS Contractor that is responsible for the Work in these sections.

1.14 Division 25 BAS Contractor Wired Connection (Auxiliary Contact) Interface Device Integration Scope of Work.

1.14.1 Systems requiring a hardwired connection to a Device provided by others shall include, but not be limited to, the following:

1.14.1.1 NONE.

1.15 Requirements for BAS Hardware and Software Provided by Division 25 BAS Contractor.

1.15.1 See Section 25 13 16 3.06 for allowed network protocols and device Levels to be permitted in the Work.

1.15.2 The following devices and protocols are not allowed in the Work under any circumstances:

1.15.2.1 Level 2/2A devices/

1.15.2.2 Proprietary or legacy controllers at any Level.

1.15.2.3 LonTalk devices at any Level.

1.15.2.4 The only time that Level 3 devices can be used in the Work is when they are used as terminal equipment controllers or to connect to space temperature points.

1.15.3 Level 0 Hardware Requirements

1.15.3.1 There is no Level 0 hardware requirement in the Work. If the existing WebCTRL installation requires upgrades, Division 25 BAS Contractor shall include the costs to upgrade the existing WebCTRL installation. Owner will alter existing or shall spin up new Virtual Machine(s) (VM) as required by the Division 25 BAS Contractor for the Work of this project.

1.15.3.1.1 Division 25 BAS Contractor is responsible for providing a Submittal showing the VM requirements including items such as memory and disk space .NET, SQL, Microsoft Server 2019 or appropriate latest version and other items needed for the Division 25 BAS Contractor's software to operate.

1.15.3.1.2 The Owner will grant temporary administrative rights to the Division 25 BAS Contractor to install and configure the software and to install updates as necessary.

1.15.3.2 Software packages like WebCTRL that require user machine or domain administrative rights to run are not allowed in the Work.

1.15.4 Level 0 Software Requirements

1.15.4.1 References to "Front End" are to the ALC WebCTRL proprietary graphics creation/configuration and device programming tool that runs on a VM that shall provide the required trending, alarming and scheduling requirements specified in this Division 25 Specification.

1.15.4.2 The Front End shall act as a BACnet client to all the BACnet server devices provided in the Work.

1.15.4.3 The Front End software license shall allow for an unlimited number of objects to be accessed.

1.15.4.4 The Front End shall allow for a maximum of 10 simultaneous connections to the Front End Webserver. Division 25 BAS Contractor shall provide up to 10 accounts and passwords to Owner. The Owner shall provide the access rights for each account.

1.15.4.5 Division 25 BAS Contractor is responsible for creating all graphics, trends, schedules and alarms using their Front End software. See Sections 25 15 11 and 25 15 11.01 for the graphics and reporting requirements.

- 1.15.4.6 The Front End shall provide access to all BAS OCL programming listings, documentation, etc. supplied/developed in this project.
- 1.15.4.7 Division 25 BAS Contractor is responsible for providing an account and a password at the Front End to the Equipment Supplier of any BACnet MS/TP device that is connected to the Division 25 BAS Contractor's BACnet MS/TP network(s) so the Equipment Supplier can view and change parameters of objects for that device.
 - 1.15.4.7.1 Access is restricted to the graphics, trends, alarms and schedules created for these device(s) only that are provided in the Work.
 - 1.15.4.7.2 Division 25 BAS Contractor shall provide an audit log of any transactions for review by the Owner.
 - 1.15.4.7.3 Division 25 BAS Contractor is not responsible for any equipment damage or problems as a result of the actions taken by any third party Equipment Suppliers who provide BACnet interface devices as part of their Work.
- 1.15.4.8 The Front End shall provide an audit log of any transactions for review by the Owner for all user accounts.
- 1.15.4.9 Division 25 BAS Contractor shall include the costs of upgrading the existing WebCTRL Front End software to the latest revision. Upgrade the Front End software license to allow for an unlimited number of objects to be accessed.
- 1.15.5 Level 1/1A Device Locations and Requirements
 - 1.15.5.1 Division 25 BAS Contractor shall provide a network of Level 1/1A BACnet/IP and/or BACnet MS/TP devices needed for the Work to provide the points as outlined in the Stick-Built Sections 25 09 23.21.23 to 25 09 23.72.00 inclusive. Refer to the individual sections for Division 25 BAS Contractor. Refer to Contract Plans and Specifications for locations and quantities.
 - 1.15.5.2 The Lake County BAS Consultant is not responsible for determining and specifying locations and quantities of any BACnet device or other devices provided in the Work. ~~This~~ It is the responsibility of the Engineer-of-Record Syska Hennessy Group to specify locations and quantities.
 - 1.15.5.3 Division 25 BAS Contractor shall provide one or more Level 1 BACnet/IP devices to network to all the BACnet MS/TP devices provided by Division 25 BAS Contractor. Map the points from the MS/TP devices into the BACnet/IP devices if that is required by the Division 25 BAS Contractor's hardware.
 - 1.15.5.3.1 All points supplied and installed by Division 25 BAS Contractor shall conform to the Lake County naming convention. Names shall be approved via the Shop Drawing process.
 - 1.15.5.4 All Level 1 devices shall come with a local display device attached to it or as an outboard BACnet MS/TP device that is part of the BAS panel MS/TP network.
 - 1.15.5.5 If the terminal equipment controllers are considered Level 1 controllers by the Division 25 BAS Contractor's equipment architecture, the space thermostat/sensor may be considered the local display device in the Work.
 - 1.15.5.6 All devices in the Work shall be UL 864 UUKL listed devices. There shall be no exceptions to this requirement.
 - 1.15.5.6.1 BAS devices in the Work shall comply with the 10th Edition of the UL 864 UUKL Standard.
 - 1.15.5.6.2 BAS devices that only compliant with the 9th Edition of UL 864 UUKL are not allowed in the Work.
 - 1.15.5.6.3 The existing 9th Edition BAS equipment for AHUs 01, 02, 03 and 04 shall be left in place to operate on the current network.
 - 1.15.5.6.4 The Division 25 BAS Contractor is not allowed to use this 9th Edition network to install and network new 10th Edition equipment.
 - 1.15.5.6.5 The Division 25 BAS Contractor shall isolate the 9th and 19th Edition networks so communications are completely segregated.
 - 1.15.5.6.6 The only allowed connection is that both networks ultimately provide communications to WebCTRL in a non-UL manner.

1.16 Division 25 BAS Contractor Networking Scope of Work

- 1.16.1 All non-IP network cabling Work shall be done by Division 25 BAS Contractor in accordance with EIA/TIA 568C.
- 1.16.2 All conduit and pathways shall be installed in the Work shall be done accordance with ANSI/TIA/EIA-569B.
- 1.16.3 The Division 25 BAS Contractor shall assume that the Intranet at the Place of Work networks all buildings together using an IP infrastructure. Provide a BACnet Annex J router to pass messages from the Place of Work to the Owner's server farm via the LAN connection on the BACnet Internetwork.
 - 1.16.3.1 It shall be the Division 25 BAS Contractor's responsibility to configure each BACnet router.
 - 1.16.3.2 Each BACnet router shall be configured such that all network layer error messages are directed to a specific workstation using the BACnet ConfirmedTextMessage service.
 - 1.16.3.3 ALC shall provide software to manage alarm transmission to the Front End. ALC shall add an entry in the Recipient_List and create Notification Class objects to send alarm data to their Front End.
- 1.16.4 The Division 25 BAS Contractor is expected to co-ordinate the Work with Division 27.
 - 1.16.4.1 All references in this Division 25 to Division 27 are to the Electrical Contractor or the Trade designated by the General Contractor to perform this Work
- 1.16.5 Division 27 shall provide all IP network drops to within 3 ft. of the BACnet/IP BACnet Interface Device.
 - 1.16.5.1 Division 27 shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the Intranet.
 - 1.16.5.2 Division 27 will assign blocks of IP addresses and BACnet Interface Device instance numbers so there are no address duplications as future BASs are installed.
 - 1.16.5.3 It shall be the Division 25 BAS Contractor's responsibility to initially configure each router with routing tables containing all network numbers that are part of the IP subnet using the specified network numbering scheme for the Work.
 - 1.16.5.4 Division 25 BAS Contractor shall co-ordinate network numbering so BASs in all buildings can reside on the Owner's Intranet. The Owner shall provide a list of acceptable network numbers for the Division 25 BAS Contractor.
 - 1.16.5.5 It shall be the Division 25 BAS Contractor's responsibility to initially configure each router with routing tables containing all network numbers that are part of the IP subnet using the specified network numbering scheme for the Work.
 - 1.16.5.6 Broadcasts are not allowed on the Intranet. There are existing BBMDs on the Intranet. This Division 25 BAS Contractor has a dedicated IP subnet for this Work. This new 10th Edition network requires its own subnet and BBMD. Provide a Submittal for approved for any new BBMDs required in the Work. Configure any new BBMDs to prevent broadcast "storms".
 - 1.16.5.7 The Owner shall provide credentials for the email account used to transmit alarms to a remote wireless device (e.g., cell phone).
 - 1.16.5.8 The Owner will set conventions for object names, graphic layouts and colorization standards that will be applied to this BAS and all future BASs.
 - 1.16.5.9 The Owner has set up an Intranet of BASs to segment this traffic from the rest of the traffic at the Place of the Work. Lake County BAS Consultant shall work with the Owner's IT department to connect this BAS to the Intranet. Lake County BAS Consultant is responsible for meeting all security requirements set out by the Owner a user-ID and password can be assigned to allow approved BACnet Interface Device suppliers to remotely connect to the Owner's Intranet.
 - 1.16.5.10 Lake County BAS Consultant shall co-ordinate selection of MAC addresses so there is no potential for duplication of addresses on the Owner's Intranet. Owner uses port binding with the MAC address as a security measure. Provide a list of the MAC addresses to be used so the Owner can verify that there are no duplicate MAC addresses.
 - 1.16.5.11 The Division 25 BAS Contractor shall create two BACnet MS/TP networks for the devices in the Work.
 - 1.16.5.11.1 The first BACnet MS/TP network shall be for UL 864 UUKL 10th Edition listed devices as defined in the Contract Documents including the AHUs, ADi panel, Air Terminal Units and any other device that is part of the Smoke Evacuation System.

1.16.5.11.2 The second BACnet MS/TP network is for devices that do not require a UL 864 UUKL listing including flow meters.

1.17 Division 25 BAS Contractor Execution Scope of Work

- 1.17.1 The Division 25 BAS Contractor must run all wiring in blue conduit with red UL 864 UUKL labels specified in this Division. Refer to 25 00 11 for additional labelling requirements.
- 1.17.2 Wiremould may only be used with written permission of the Owner.
- 1.17.3 All electrical control wiring supplied in this Section, including interlock wiring below 50 V required for the Work, except where otherwise noted, shall be provided by the Division 25 BAS Contractor. Division 25 BAS Contractor shall provide wire and conduit to each BAS device. BAS devices shall be mounted in new device enclosures (tub).
- 1.17.4 All wiring in "wet" locations shall be wired to satisfy watertight wiring requirements (see Specification and Contract Documents for additional details).
- 1.17.5 The Plans and Specifications show general locations for BAS panels. All panel locations shall be approved by the Lake County BAS Consultant.
- 1.17.6 The Division 25 BAS Contractor is responsible for providing equipment or protection of equipment that is suitable to the environment in the Work.
- 1.17.7 Allow for in-situ approval of new devices if required by the Authority Having Jurisdiction.
- 1.17.8 The Specification may include Control Sequences which require additions and alterations to the mechanical systems or electrical systems (e.g., addition of Hand-Off-Autos (HOAs)) in order to achieve the control strategy outlined in the Control Sequences Sections. The Division 25 BAS Contractor is responsible for identifying such Work to be done that is outside the scope of this Specification.
- 1.17.9 The Division 25 BAS Contractor shall provide the BAS hardware and software necessary for 10% additional spare points.
 - 1.17.9.1 These spare points shall include transducers for AOs, transmitters and other devices to make the spare points functional. These spare devices supplied shall match other devices supplied in the Work.
 - 1.17.9.2 Analog output feedback on all Stick-Built damper and valve operators is not required.
- 1.17.10 In addition, the Division 25 BAS Contractor shall provide the BAS memory, hardware and software necessary to have a 33% expansion capability for each point type or hardware object type on a device-by-device basis.
 - 1.17.10.1 Division 25 BAS Contractor shall size the control cabinet to provide for this expansion capacity. Wiring in cabinets shall accommodate this point expansion capability without requiring any relocation of, or extension to, wiring.
 - 1.17.10.2 The Division 25 BAS Contractor shall ensure that the network can accommodate additional devices without having to upgrade the devices required for the Work.

1.18 Division 25 BAS Contractor Testing, Adjusting and Balancing (TAB) Scope of Work

- 1.18.1 Provide support to TAB for all Work items within this section. See 23 05 93 for Division 25 BAS Contractor responsibilities.
- 1.18.2 Follow equipment start-up procedures as recommended by Manufacturer unless otherwise specified.
- 1.18.3 TAB shall advise Division 25 BAS Contractor, Mechanical Contractor and Owner of any adjustments, changes, or additions required to systems.

1.19 Division 25 BAS Contractor BACnet Object Type Mapping Scope of Work

- 1.19.1 Division 25 BAS Contractor shall not use the existing OFVI VMs to map in points from third party devices provided in the Work as these VMs are not UL 864 UUKL listed devices.
- 1.19.2 Division 25 BAS Contractor shall provide additional Level 1 BAS devices that are UL 864 UUKL listed to meet the object mapping requirements of the Work.

1.20 Division 25 BAS Contractor Graphics Scope of Work

- 1.20.1 Division 25 BAS Contractor is responsible for creating all graphics, trends, schedules and alarms using their Front End software. See Sections 25 15 11 and 25 15 11.01 for the graphics and reporting requirements.

1.21 Division 25 BAS Contractor Alarming, Trending and Scheduling Requirements

- 1.21.1 Division 25 BAS Contractor shall provide up to 400 discrete alarms in the Work. Generate NC and EE objects so the alarms can be processed by a BACnet client.
- 1.21.2 Division 25 BAS Contractor shall provide 144 samples of 30 minute trends for each hardware and software input, output and setpoint in the Work. Provide enough panel memory space to permit all these trends to be stored in the BAS panels. If a panel does not support trending, then provide the trends for that panel in a panel with the available memory. Upload trends to the Front End server using BACnet services. Store trends on the server for a minimum of 90 days.
- 1.21.3 Division 25 BAS Contractor shall provide 100 long term trends on the Front End. These trends shall have 15 minute intervals and shall be kept for a minimum of five years on the Division 25 BAS Contractor's Front End.
- 1.21.4 Division 25 BAS Contractor shall provide up to 5 schedules.
- 1.22 **Division 25 BAS Contractor Commissioning Scope of Work**
 - 1.22.1 Provide a complete commissioning and performance test in the presence of the Owner(s) per Section 25 08 00 and 25 08 03.
 - 1.22.2 The commissioning forms in 25 08 00 only need to be completed for hardware not software points provided by Division 25 or others in the Work.
 - 1.22.3 The Lake County BAS Consultant shall provide commissioning forms for commissioning the software points for each BACnet Interface Device. Division 25 BAS Contractor shall participate in the commissioning of each BACnet Interface Device using the Division 25 BAS Contractor's Front End software. See each BACnet Interface Device Specification section in this Specification.
 - 1.22.3.1 Interconnections to and commissioning the connections to the BAS devices supplied and installed by Division 25 BAS Contractor.
 - 1.22.3.2 Allow for on-site time to co-ordinate this Work with other Trades.
 - 1.22.3.3 Assisting the Mechanical Contractor with start-up of devices under BAS control.
 - 1.22.4 Division 25 BAS Contractor is responsible for working with other Trades (particularly Mechanical and Electrical) to co-ordinate Work and to resolve construction problems. Co-ordinate the interconnections to and commissioning of the connections to BACnet-based controllers integrated into equipment supplied by other Divisions. Allow for on-site time to co-ordinate this Work with other Trades.
 - 1.22.5 Division 25 BAS Contractor is responsible for co-ordination Work to run controls in trenches provided by other Divisions.
 - 1.22.6 Division 25 BAS Contractor is responsible for providing the necessary staff and equipment so the BAS shall be ready for the projected start-up date shown in the Contract Documents.
 - 1.22.7 See Section 25 08 03 for Division 25 BAS Contractor UL 864 UUKL Smoke Evacuation System Commissioning responsibilities.
- 1.23 **Warranty Requirement**
 - 1.23.1 See the Contract Documents for warranty requirements.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

**25 00 13 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – ALL TRADES WORK
RESPONSIBILITIES**

1 - GENERAL

1.01 Application

- 1.01.1 This Specification Section applies to Mechanical and Electrical Contractor(s) or Trades as well as all Equipment Suppliers who are responsible for providing BACnet Interface Devices and auxiliary contacts with their equipment per this Specification.
- 1.01.2 This Specification Section also part of the Work of the Division 25 BAS Contractor.

1.02 Related Sections

- 1.02.1 Section 23 05 93.
- 1.02.2 Section 23 09 00.

1.03 General Requirements

- 1.03.1 The Specification shall be read as a whole by all parties concerned. Sectioning of the Specification is for convenience only; each section may contain less or more than the completed Work of any Trade.
- 1.03.2 Sections of these Specifications are not intended to delegate functions or to delegate Work and supply to any specific Trade. The Work shall include all labor, materials, equipment and tools required for a complete and working installation as described in the Drawings and these Specifications.
- 1.03.3 Perform all Work as outlined herein and shown on the Drawings and outlined in the Specifications. Provide all materials, tools and labor to complete the installation and commission the Work, to the satisfaction of the Owner.
- 1.03.4 The Work shall be performed by skilled technicians under the direction of experienced project managers/co-coordinators, all of whom shall be properly trained and qualified for this Work.
- 1.03.5 Improper installation or erection of products or supplying and installing unapproved materials, due to failure in complying with the requirements outlined in the Contract Documents, authorizes the Owner to require removal and re-installation at no additional cost for the Work.
- 1.03.6 The Contract Documents shall be interpreted according to the laws of the Place of the Work.
- 1.03.7 Contract Documents include all Drawings and documents prepared for the Work.
- 1.03.8 Where an instruction is given in a clause of these Specifications and it is not obvious to whom the instruction has been given, it shall be deemed to be an instruction given to the Division 25 BAS Contractor and Equipment Suppliers responsible for the Work in this Division:
- 1.03.9 Where a list of items to be provided is given in the Specifications, the Division 25 BAS Contractor and Equipment Suppliers shall provide all items listed (i.e., the items listed in a series of subclauses). **Where there is a reference or a link to a clause, the subclauses shall also apply to the reference made to the clause.**
- 1.03.10 In this Division “Provide” means to supply, install, connect and set system to operate to the satisfaction of the Lake County BAS Consultant. If commissioning is specified, Division 25 BAS Contractor shall commission system as specified, to fulfil the intended function to the satisfaction of the Owner.
- 1.03.11 All non-IP network cabling Work shall be done by Division 25 BAS Contractor and Equipment Suppliers in accordance with TIA-862 latest Edition. All conduit and pathways to be installed in the Work shall be done accordance with the requirements outlined in Division 26. All BACnet MS/TP devices shall meet the requirements of EIA-485. The Division 25 BAS Contractor and Equipment Suppliers shall run all wiring in BLUE conduit. Free air wiring and wiremould on finished walls and ceilings may only be used with written permission of the Owner.
- 1.03.12 The following Divisions contain BACnet Interface Devices that will be connected to the Owner’s BACnet Internetwork for the Work:
 - 1.03.12.1 Division 23.
 - 1.03.12.2 Division 26.
 - 1.03.12.3 **Any references to Division 28 in the Contract Documents shall refer to Division 26.**
- 1.03.13 The term BACnet Master/Slave has been replaced by Manager/Subordinate.
- 1.03.14 The terms Modbus Master and Modbus Manager are used interchangeably in the Contract Documents.
- 1.03.15 The terms Modbus Slave and Modbus Subordinate are used interchangeably in the Contract Documents.

- 1.03.16 The Place of the Work is the Babcox Justice Complex, Waukegan IL.
- 1.04 Related Sections**
- 1.04.1 Other Trades Sections.
- 1.04.1.1 Section 01 31 13.13 - BACnet and Other Device Interface Integration
- 1.04.1.2 Section 23 05 05 - BACnet and Other Device Interface Integration
- 1.04.1.3 Section 25 05 05 - BACnet and Other Device Interface Integration
- 1.04.1.4 Section 26 05 05 - BACnet and Other Device Interface Integration
- 1.04.2 Application of Division 01 requirements to All Trades providing BACnet Interface Devices in the Work.
- 1.04.2.1 Provision of Submittals Section.
- 1.04.2.2 Demonstration and Training Section.
- 1.04.2.3 Commissioning Section.
- 1.05 BACnet Interface Device Scope of Work**
- 1.05.1 See the BACnet Interface Device Single Line Diagram for details attached as part of Schedule 3.
- 1.06 All Trades Responsibilities for BAS Administration and Common Work Results (applies to all BACnet Device Types and all aspects of the Work)**
- 1.06.1 The BACnet Single Line Diagram and Responsibility Matrix assigns responsibilities for the following items:
- 1.06.1.1 Provision of permits for BACnet Interface Devices.
- 1.06.1.2 Arranging for Special acceptance of for BACnet Interface Devices by the Authority Having Jurisdiction.
- 1.06.1.3 Provision of Submittals for BACnet Interface Devices.
- 1.06.1.4 Preparation of the Project Work Plan for BACnet Interface Devices.
- 1.06.1.5 Commissioning of BACnet Interface Devices.
- 1.07 All Trades Responsibilities for the Installation and Wiring Work**
- 1.07.1 The demarcation of Work and the responsibilities between Division 25 and other Divisions shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
- 1.07.1.1 The BACnet Single Line Diagram and Responsibility Matrix demarcation of Work is superseded by the specific Work responsibilities listed in the BACnet Interface Device Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive.
- 1.08 All Trades Responsibilities for the BAS and BACnet Interface Device Software**
- 1.08.1 This table in the BACnet Single Line Diagram and Responsibility Matrix assigns responsibilities for the following items:
- 1.08.1.1 Provision of BAS and non-BAS Software applications.
- 1.08.1.2 IP wiring responsibilities by Division 27.
- 1.08.1.3 Non-IP wiring responsibilities by the Equipment Suppliers using BACnet MS/TP, Modbus, LonTalk or other proprietary protocols.
- 1.08.1.4 Provision of accounts for authorized users to access the BACnet Interface Device and the embedded Webserver (if an embedded Webserver is provided with the Equipment Supplier's BACnet Interface Device).
- 1.09 All Trades Responsibilities for the Networking Work**
- 1.09.1 See Section 25 00 13 and Consultant Contract Documents for cabling, network, conduit and pathway standards to be followed. **See also Sections 25 05 13, 25 05 26 and 25 05 28 for details.**
- 1.09.2 The Division 25 BAS Contractor shall assume that the Intranet or Enterprise LAN at the Place of Work networks all buildings together uses an IP infrastructure. Provide a BACnet Annex J router to pass messages from the Place of Work to the Owner's server farm via the LAN connection on the BACnet Internetwork.
- 1.09.2.1 It shall be the Division 25 BAS Contractor's responsibility to configure each BACnet router.
- 1.09.2.2 Each BACnet router shall be configured such that all network layer error messages are directed to a specific workstation using the BACnet ConfirmedTextMessage service.

- 1.09.2.3 Division 25 BAS Contractor shall provide software to manage alarm transmission to the Front End. Division 25 BAS Contractor shall add an entry in the Recipient_List and create Notification Class objects to send alarm data to the Division 25 Contractor's Front End.
- 1.09.3 The Division 25 BAS Contractor and all Equipment Suppliers who are providing BACnet/IP devices as shown in the BACnet Single Line Diagram and Responsibility Matrix shall co-ordinate their IP networking Work with Division 27. **All references in this Division 25 to Division 27 are to the Electrical Contractor or the Trade designated by the General Contractor to perform this Work.**
 - 1.09.3.1 Division 27 shall provide all IP network drops to within 3 ft. of the BACnet/IP BACnet Interface Device.
 - 1.09.3.2 Owner shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the Intranet.
 - 1.09.3.3 Owner will assign blocks of IP addresses and BACnet Interface Device instance numbers so there are no address duplications as future BASs are installed.
 - 1.09.3.4 It shall be the Owner's responsibility to initially configure each router with routing tables containing all network numbers that are part of the IP subnet using the specified network numbering scheme for the Work.
 - 1.09.3.5 Division 25 BAS Contractor and all Equipment Suppliers who are providing BACnet/IP devices as shown in the BACnet Single Line Diagram and Responsibility Matrix shall co-ordinate network numbering to eliminate duplications so BASs in all buildings can reside on the Owner's Intranet. The Owner shall provide a list of acceptable network numbers for use by the Division 25 BAS Contractor and the Equipment Suppliers.
 - 1.09.3.6 Broadcasts are not allowed on the Intranet – also referred to as the Lake County Enterprise LAN. There are existing BBMDs on the Lake County Enterprise LAN. All BACnet Interface Devices and BAS panels provided by Division 25 BAS Contractor shall be on a dedicated IP subnet set up by the Owner. Division 25 BAS Contractor shall create a new BBMD on this subnet to allow for the transmission and receiving of BACnet messages on the Owner's Enterprise LAN. Only one BBMD is allowed so as to prevent broadcast "storms". Equipment Suppliers of BACnet Interface Devices do not have to support BBMD functionality unless the device has to be installed on a separate subnet.
 - 1.09.3.7 The Owner shall provide credentials for the email account used to transmit alarms to a remote wireless device (e.g., cell phone).
 - 1.09.3.8 The Owner will set conventions for BACnet device object names, graphic layouts and colorization standards that will be applied to the BACnet Interface Device Work.
 - 1.09.3.9 The Owner has set up an Intranet of BASs to segment this traffic from the rest of the traffic at the Place of the Work. Lake County BAS Consultant shall work with the Owner's IT department to connect this BAS to the Intranet. Owner shall provide the terms and conditions for meeting all security requirements set out by the Owner a user-ID and password can be assigned to allow approved BACnet Interface Device suppliers to remotely connect to the Owner's Intranet.
 - 1.09.3.10 Division 25 BAS Contractor and Equipment Suppliers shall provide the MAC address(s) as a Shop Drawing so the Owner to avoid the potential for duplication of addresses on the Owner's Intranet. Owner uses port binding with the MAC address as a security measure. Provide a list of the MAC addresses to be used so the Owner can verify that there are no duplicate MAC addresses.
- 1.10 **All Trades Responsibilities for the Built-up BACnet Interface Device Type**
 - 1.10.1 The BACnet Single Line Diagram and Responsibility Matrix define the responsibilities for all Trades in the Work for this BACnet Interface Device Type.
 - 1.10.2 This is a series of devices provided by one or more Equipment Suppliers that will be built up and then networked together to create a single device with a single connection to the BACnet Internetwork.
 - 1.10.3 This BACnet Interface Device Type presumes that:
 - 1.10.3.1 There are one or more devices provided by a single Equipment Supplier or several Equipment Suppliers that require assembly or installation or networking on site to create a single BACnet Interface Device.
 - 1.10.3.2 The device may come pre-programmed from the Equipment Supplier or additional programming or configuration is required by the Equipment Supplier to meet the sequence of operations shown in the Contract Documents.

- 1.10.3.3 The device may come pre-programmed from the Equipment Supplier or additional programming or configuration is required by the Equipment Supplier to fulfill the Work requirements.
- 1.10.3.4 Division 25 BAS Contractor is responsible for networking the BACnet MS/TP devices together on a single network and for providing a single network connection to the BACnet Internetwork. If the Equipment Supplier's BACnet Interface Device is a BACnet/IP device, the Division 25 BAS Contractor is responsible for communicating and controlling this device. See the BACnet Single Line Diagram for the network architecture requirements.
- 1.10.3.5 There are Work requirements by Division 25 BAS Contractor and Equipment Suppliers that need to be co-ordinated on site. The demarcation of Work responsibilities between Division 25 and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
 - 1.10.3.5.1 Any exceptions to these responsibilities as defined in the BACnet Single Line Diagram and Responsibility Matrix are shown in Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive.
- 1.10.4 The following applies to all the BACnet Interface Device Object Lists provided in this Specification:
 - 1.10.4.1 Mapped Object List Column: Unless otherwise stated, this is the name to be provided in the BACnet Interface Device that follows the Lake Count naming convention specified in 25 05 53 2.04.
 - 1.10.4.2 Read/Write Column: This is to be determined by the Equipment Supplier.
 - 1.10.4.3 Supply Device Column: The object is to be supplied by the Equipment Supplier.
 - 1.10.4.4 Install Device Column: The object is to be installed by the Equipment Supplier.
 - 1.10.4.5 Power Device Column: The object is to be powered by the Equipment Supplier.
 - 1.10.4.6 Wire Device Column: The object is to be wired by the Equipment Supplier.
 - 1.10.4.7 Pgm Device Column: The object is to be programmed by the Equipment Supplier.
 - 1.10.4.8 Alarmable Column: All objects are considered to be Alarmable.
 - 1.10.4.9 Alarm Limits Column: This is to be determined by the Equipment Supplier.
 - 1.10.4.10 Alarm Type Column: This is to be determined by the Equipment Supplier.
 - 1.10.4.11 Graphics Column: This is to be done by Division 25 BAS Contractor.
 - 1.10.4.12 Trend Column: This is to be done by Division 25 BAS Contractor.
 - 1.10.4.13 Com'd Column: This box will be checked by the Lake County BAS Consultant with the object is commissioned.
 - 1.10.4.14 Units Column: This is to be determined by the Equipment Supplier.
 - 1.10.4.15 Description Column: This is to be determined by the Equipment Supplier.
 - 1.10.4.15.1 Where an Object List does not show these columns, the Division 25 BAS Contractor and all Equipment Suppliers shall assume that the responsibilities listed in these columns still apply to that Object List.
- 1.10.5 Division 25 BAS Contractor is responsible for controlling this device that includes:
 - 1.10.5.1 mapping BACnet Objects in the BACnet Interface Device from the Equipment Supplier's BACnet/IP device. ~~S See 25-00-11 1.11 for details.~~ **See Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive for Division 25 BAS Contractor Work responsibilities.**
 - 1.10.5.2 providing a BACnet network connection to the device if the device is a BACnet MS/TP device.
 - 1.10.5.3 creating a setpoint, enable/disable signal to control the device if the Equipment Supplier's device contains writeable points.
 - 1.10.5.4 scheduling the device
 - 1.10.5.5 monitoring the device's points so that alarms can be created.
 - 1.10.5.6 creating trends.
 - 1.10.5.7 Division 25 BAS Contractor is responsible for providing an account and a password at the Front End to the Equipment Supplier of any BACnet MS/TP device that is connected to the Division 25 BAS Contractor's BACnet MS/TP network(s) so the Equipment Supplier can view and change parameters of objects for that device.
 - 1.10.5.7.1 Access is restricted to the graphics, trends, alarms and schedules created for these device(s) only that are provided in the Work.

1.10.5.7.2 Division 25 BAS Contractor shall provide an audit log of any transactions for review by the Owner.

1.10.5.8 All Equipment Suppliers responsible for providing BACnet Interfaces in the Work shall provide up to 5 accounts and passwords to Owner for their BACnet Interface Devices. The Owner shall provide the access rights for each account.

1.10.5.9 Division 26 is responsible for power wiring to the device.

1.11 All Trades Responsibilities for the Plant Controller BACnet Interface Device Type

1.11.1 The BACnet Single Line Diagram and Responsibility Matrix define the responsibilities for all Trades in the Work for this BACnet Interface Device Type.

1.11.2 This device is a Device Manager that acts as a controller to, or a Plant Controller of, a series of BACnet or non-BACnet proprietary Interface Devices provided by the Equipment Supplier.

1.11.3 This BACnet Interface Device Type presumes that:

1.11.3.1 This Device Manager/Plant Controller device is provided by the same Equipment Supplier as the equipment that this device controls.

1.11.3.2 This Device Manager/Plant Controller device shall be wired separately as it manages one or more Manager or Subordinate devices on the equipment to provide sequencing or lead/lag control on a standalone control for local area network consisting of the equipment that is networked to this device manager/plant controller.

1.11.3.2.1 Any wiring and panel installations between the Plant Controller and the individual controlled devices is by the Equipment Supplier.

1.11.3.3 This Device Manager/Plant Controller device provides proxying services to present the data from one or more of the Equipment Supplier's equipment either as a single BACnet Interface Device or a series of BACnet Interface Devices within this device manager/plant controller.

1.11.3.4 The device may come pre-programmed from the Equipment Supplier or additional programming or configuration is required by the Equipment Supplier to fulfill the Work requirements.

1.11.3.5 There are Work requirements by Division 25 BAS Contractor and the Equipment Supplier. The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.

1.11.3.6 Devices that do not meet all of these requirements are considered to be a Built-Up BACnet Interface Device. See 25 00 13 ~~1.09~~ **1.10** above for Work requirements.

1.11.3.6.1 Any exceptions to these responsibilities as defined in the BACnet Single Line Diagram and Responsibility Matrix are shown in Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive.

1.11.4 The following applies to all the Object Lists provided in this Specification:

1.11.4.1 Mapped Object List Column: Unless otherwise stated, this is the name to be provided in the BACnet Interface Device that follows the Lake Count naming convention specified in 25 05 53

1.11.4.2 Read/Write Column: This is to be determined by the Equipment Supplier.

1.11.4.3 Supply Device Column: The object is to be supplied by the Equipment Supplier.

1.11.4.4 Install Device Column: The object is to be installed by the Equipment Supplier.

1.11.4.5 Power Device Column: The object is to be powered by the Equipment Supplier.

1.11.4.6 Wire Device Column: The object is to be wired by the Equipment Supplier.

1.11.4.7 Pgm Device Column: The object is to be programmed by the Equipment Supplier.

1.11.4.8 Alarmable Column: All objects are considered to be Alarmable.

1.11.4.9 Alarm Limits Column: This is to be determined by the Equipment Supplier.

1.11.4.10 Alarm Type Column: This is to be determined by the Equipment Supplier.

1.11.4.11 Graphics Column: This is to be done by Division 25 BAS Contractor.

1.11.4.12 Trend Column: This is to be done by Division 25 BAS Contractor.

1.11.4.13 Com'd Column: This box will be checked by the Lake County BAS Consultant with the object is commissioned.

1.11.4.14 Units Column: This is to be determined by the Equipment Supplier.

1.11.4.15 Description Column: This is to be determined by the Equipment Supplier.

1.11.4.15.1 Where an Object List does not show these columns, the Division 25 BAS Contractor and all Equipment Suppliers shall assume that the responsibilities listed in these columns still apply to that Object List.

1.11.5 Division 25 BAS Contractor is responsible for controlling this device that includes:

- 1.11.5.1 mapping BACnet Objects in the BACnet Interface Device to Division 25 BAS Contractor supplied BACnet/IP device. ~~See 25 00 11 1.11 for details.~~ **See Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive for Division 25 BAS Contractor Work responsibilities.**
- 1.11.5.2 providing a BACnet network connection to the Plant Controller BACnet Interface Device only if the Device is a BACnet MS/TP device.
- 1.11.5.3 creating a setpoint, enable/disable signal to control the device if the Equipment Supplier's device contains writeable points.
- 1.11.5.4 scheduling the device.
- 1.11.5.5 monitoring the device to receive alarms and events.
- 1.11.5.6 creating trends.
- 1.11.5.7 Division 25 BAS Contractor is responsible for providing an account and a password at the Front End to the Equipment Supplier of any BACnet MS/TP device that is connected to the Division 25 BAS Contractor's BACnet MS/TP network(s) so the Equipment Supplier can view and change parameters of objects for that device.

1.11.5.7.1 Access is restricted to the graphics, trends, alarms and schedules created for these device(s) only that are provided in the Work.

1.11.5.7.2 Division 25 BAS Contractor shall provide an audit log of any transactions for review by the Owner.

1.11.5.8 All Equipment Suppliers responsible for providing BACnet Interfaces in the Work shall provide up to 5 accounts and passwords to Owner for their BACnet Interface Devices. The Owner shall provide the access rights for each account.

1.11.5.9 Division 26 is responsible for power wiring to the device.

1.12 All Trades Responsibilities for the Local Area Network BACnet Interface Device Type

1.12.1 The BACnet Single Line Diagram and Responsibility Matrix define the responsibilities for all Trades in the Work for this BACnet Interface Device Type.

1.12.2 This device consists of more than two BACnet Interface Devices to the on-board packaged controls provided by the Equipment Supplier.

1.12.3 This BACnet Interface Device Type presumes that:

1.12.3.1 There is no additional Work by Division 25 BAS Contractor or other Divisions other than making a network connection to the devices and for providing controls services through the network only.

1.12.3.2 There are no power wiring, control wiring nor installation requirements by any other Division as the devices come pre-installed in the Equipment Supplier's equipment or the device is installed and mounted into the Equipment Supplier's equipment by the Division responsible for providing the device and the equipment.

1.12.3.3 The device may come pre-programmed from the Equipment Supplier or additional programming or configuration is required by the Equipment Supplier to fulfill the Work requirements.

1.12.3.4 Division 25 BAS Contractor is not responsible for providing any external equipment nor any additional BAS devices to make the device operational.

1.12.3.5 Devices that do not meet all of these requirements are considered to be a Built-Up BACnet Interface Device. See 25 00 13 ~~1.09~~ **1.10** above for Work requirements.

1.12.3.5.1 Any exceptions to these responsibilities as defined in the BACnet Single Line Diagram and Responsibility Matrix are shown in Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive..

1.12.4 The following applies to all the Object Lists provided in this Specification:

1.12.4.1 Mapped Object List Column: Unless otherwise stated, this is the name to be provided in the BACnet Interface Device that follows the Lake Count naming convention specified in 25 05 53.

1.12.4.2 Read/Write Column: This is to be determined by the Equipment Supplier.

- 1.12.4.3 Supply Device Column: The object is to be supplied by the Equipment Supplier.
- 1.12.4.4 Install Device Column: The object is to be installed by the Equipment Supplier.
- 1.12.4.5 Power Device Column: The object is to be powered by the Equipment Supplier.
- 1.12.4.6 Wire Device Column: The object is to be wired by the Equipment Supplier.
- 1.12.4.7 Pgm Device Column: The object is to be programmed by the Equipment Supplier.
- 1.12.4.8 Alarmable Column: All objects are considered to be Alarmable.
- 1.12.4.9 Alarm Limits Column: This is to be determined by the Equipment Supplier.
- 1.12.4.10 Alarm Type Column: This is to be determined by the Equipment Supplier.
- 1.12.4.11 Graphics Column: This is to be done by Division 25 BAS Contractor.
- 1.12.4.12 Trend Column: This is to be done by Division 25 BAS Contractor.
- 1.12.4.13 Com'd Column: This box will be checked by the Lake County BAS Consultant with the object is commissioned.
- 1.12.4.14 Units Column: This is to be determined by the Equipment Supplier.
- 1.12.4.15 Description Column: This is to be determined by the Equipment Supplier.
- 1.12.4.15.1 Where an Object List does not show these columns, the Division 25 BAS Contractor and all Equipment Suppliers shall assume that the responsibilities listed in these columns still apply to that Object List.

1.12.5 Division 25 BAS Contractor is responsible for controlling this device that includes:

- 1.12.5.1 mapping selected BACnet Objects in the BACnet Interface Device to the Division 25 BAS Contractor supplied BACnet/IP device. ~~See 25-00-11 1.11 for details.~~ See Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive for Division 25 BAS Contractor Work responsibilities.
- 1.12.5.2 providing a BACnet network connection to the device
- 1.12.5.3 creating a setpoint, enable/disable signal and a shed signal
- 1.12.5.4 scheduling the device.
- 1.12.5.5 monitoring the device to receive alarms and events.
- 1.12.5.6 creating trends.
- 1.12.5.7 Division 25 BAS Contractor is responsible for providing an account and a password at the Front End to the Equipment Supplier of any BACnet MS/TP device that is connected to the Division 25 BAS Contractor's BACnet MS/TP network(s) so the Equipment Supplier can view and change parameters of objects for that device.
 - 1.12.5.7.1 Access is restricted to the graphics, trends, alarms and schedules created for these device(s) only that are provided in the Work.
 - 1.12.5.7.2 Division 25 BAS Contractor shall provide an audit log of any transactions for review by the Owner.
- 1.12.5.8 All Equipment Suppliers responsible for providing BACnet Interfaces in the Work shall provide up to 5 accounts and passwords to Owner for their BACnet Interface Devices. The Owner shall provide the access rights for each account.
- 1.12.5.9 Division 26 is responsible for power wiring to the device.

1.13 All Trades Responsibilities for the Single On-board BACnet Interface Device Type

- 1.13.1 The BACnet Single Line Diagram and Responsibility Matrix define the responsibilities for all Trades in the Work for this BACnet Interface Device Type.
- 1.13.2 This is a single BACnet Interface Device to the on-board packaged controls provided by the Equipment Supplier. The device may arrive to the job site attached to the equipment or is shipped loose and then mounted to the equipment by the Equipment Supplier.
- 1.13.3 This BACnet Interface Device Type presumes that:
 - 1.13.3.1 There are no power wiring, control wiring nor installation requirements by any other Division as the device comes pre-installed in the Equipment Supplier's equipment or the device is installed and mounted into the Equipment Supplier's equipment by the Division responsible for providing the device and the equipment.
 - 1.13.3.2 The device may come pre-programmed from the Equipment Supplier or additional programming or configuration is required by the Equipment Supplier to fulfill the Work requirements.

- 1.13.3.3 Division 25 BAS Contractor is not responsible for providing any external equipment nor any additional BAS devices to make the device operational.
- 1.13.3.4 BACnet Interface Devices that are a single device but generate multiple virtual BACnet devices are considered Single Onboard BACnet Interface Devices providing they meet all of the other requirements listed in 25 00 13 1.13.
- 1.13.3.5 Devices that do not meet all of these requirements are considered as one of the other Interface Device options listed herein.
 - 1.13.3.5.1 Any exceptions to these responsibilities as defined in the BACnet Single Line Diagram and Responsibility Matrix are shown in Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive..
- 1.13.4 The following applies to all the Object Lists provided in this Specification:
 - 1.13.4.1 Mapped Object List Column: Unless otherwise stated, this is the name to be provided in the BACnet Interface Device that follows the Lake Count naming convention specified in 25 05 53.
 - 1.13.4.2 Read/Write Column: This is to be determined by the Equipment Supplier.
 - 1.13.4.3 Supply Device Column: The object is to be supplied by the Equipment Supplier.
 - 1.13.4.4 Install Device Column: The object is to be installed by the Equipment Supplier.
 - 1.13.4.5 Power Device Column: The object is to be powered by the Equipment Supplier.
 - 1.13.4.6 Wire Device Column: The object is to be wired by the Equipment Supplier.
 - 1.13.4.7 Pgm Device Column: The object is to be programmed by the Equipment Supplier.
 - 1.13.4.8 Alarmable Column: All objects are considered to be Alarmable.
 - 1.13.4.9 Alarm Limits Column: This is to be determined by the Equipment Supplier.
 - 1.13.4.10 Alarm Type Column: This is to be determined by the Equipment Supplier.
 - 1.13.4.11 Graphics Column: This is to be done by Division 25 BAS Contractor.
 - 1.13.4.12 Trend Column: This is to be done by Division 25 BAS Contractor.
 - 1.13.4.13 Com'd Column: This box will be checked by the Lake County BAS Consultant with the object is commissioned.
 - 1.13.4.14 Units Column: This is to be determined by the Equipment Supplier.
 - 1.13.4.15 Description Column: This is to be determined by the Equipment Supplier.
 - 1.13.4.15.1 Where an Object List does not show these columns, the Division 25 BAS Contractor and all Equipment Suppliers shall assume that the responsibilities listed in these columns still apply to that Object List.
- 1.13.5 Division 25 BAS Contractor is responsible for controlling this device that includes:
 - 1.13.5.1 mapping selected BACnet Objects in the BACnet Interface Device to the Division 25 BAS Contractor supplied BACnet/IP device. ~~See 25 00 11 1.11 for details.~~ **See Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive for Division 25 BAS Contractor Work responsibilities.**
 - 1.13.5.2 providing a BACnet network connection to the device if the device is a BACnet MS/TP device.
 - 1.13.5.3 creating a setpoint, enable/disable signal to control the device if the Equipment Supplier's device contains writeable points.
 - 1.13.5.4 scheduling the device.
 - 1.13.5.5 monitoring the device's points so that alarms can be created.
 - 1.13.5.6 creating trends.
 - 1.13.5.7 Division 25 BAS Contractor is responsible for providing an account and a password at the Front End to the Equipment Supplier of any BACnet MS/TP device that is connected to the Division 25 BAS Contractor's BACnet MS/TP network(s) so the Equipment Supplier can view and change parameters of objects for that device.
 - 1.13.5.7.1 Access is restricted to the graphics, trends, alarms and schedules created for these device(s) only that are provided in the Work.
 - 1.13.5.7.2 Division 25 BAS Contractor shall provide an audit log of any transactions for review by the Owner.
 - 1.13.5.8 All Equipment Suppliers responsible for providing BACnet Interfaces in the Work shall provide up to 5 accounts and passwords to Owner for their BACnet Interface Devices. The Owner shall provide the access rights for each account.

1.13.5.9 Division 26 is responsible for power wiring to the device.

1.14 All Trades Responsibilities for Equipment fitted with Stick Built Controls

1.14.1 The BACnet Single Line Diagram and Responsibility Matrix define the responsibilities for all Trades in the Work for this BACnet Interface Device Type.

1.14.2 This BACnet Interface Device Type presumes that the Equipment Supplier's equipment comes with no on-board controls or if on-board controls are provided, the equipment controls do not support a connection for a BACnet Interface Device by one of the options listed in this Division.:

1.14.2.1 Division 25 BAS Contractor is responsible for:

1.14.2.1.1 supplying and installing sensors, transducers, etc. for the Stick-Built points;

1.14.2.1.2 providing low voltage wiring from the power drop to the panel,

1.14.2.1.3 providing the line to low voltage transformer.

1.14.2.2 Division 25 BAS Contractor is responsible for controlling the device including:

1.14.2.2.1 mapping the BACnet Objects in the BACnet Interface Device,

1.14.2.2.2 making a network connection to the devices.

1.14.2.2.3 creating a setpoint, enable/disable signal and a shed signal

1.14.2.2.4 scheduling the device.

1.14.2.2.5 monitoring the device to receive alarms and events.

1.14.2.2.6 creating trends.

1.14.2.3 The Equipment Supplier is responsible for:

1.14.2.3.1 delivering the device to site,

1.14.2.3.2 verifying that the controls provided by Division 25 BAS Contractor are operational.

1.14.2.3.3 installing any factory supplied controls or external devices.

1.14.2.3.4 if outlined in the Contract Documents, for starting up, testing and commissioning the device once Division 25 BAS Contractor has installed the controls.

1.14.2.4 Division 26 is responsible for power wiring to the device.

1.14.3 Devices that do not meet all of these requirements are considered by the Lake County BAS Consultant as one of the other Interface Device options listed herein.

1.15 Devices shown on Plans and Specifications in the Division that specifies Supplier's equipment

1.15.1 This table in the BACnet Single Line Diagram and Responsibility Matrix does not include networkable BACnet Interface Device Types defined in this section.

1.15.2 This table defines the responsibilities for Equipment Suppliers who are responsible for providing internal or external controls including but not restricted to sensors and other related devices (e. g., valves, dampers) with the equipment they are responsible for providing in the Work, including but not restricted to the following:

1.15.2.1 Constant Speed Pumps.

1.15.2.2 Air-to-Air Heat Exchangers.

1.16 All Trades Responsibilities for Equipment fitted with Auxiliary Contacts

1.16.1 Not required in the Work.

1.16.1.1 Division 26 is only responsible for power wiring to the device if the auxiliary contact requires power that is additional to the single point of connection to the device.

1.17 Work By Others

1.17.1 The demarcation of work and responsibilities between Division 25 BAS Contractor and other Divisions shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix attached as part of Schedule 3.

1.18 All Trades Responsibilities for Commissioning

1.18.1 Provide a complete commissioning and performance test in the presence of the Owner(s) per Section 25 08 00 and 25 08 03. The commissioning forms in 25 08 00 only need to be completed for hardware

not software points provided by Division 25 BAS Contractor or others in the Work. The Lake County BAS Consultant will create customized forms for each BACnet Interface Device to test and commission approximately 10% of the software points in the Equipment Supplier's BACnet Interface Device.

- 1.18.1.1 Interconnections to and commissioning the connections to the BAS devices supplied and installed by Division 25 BAS Contractor.
- 1.18.1.2 Allow for on-site time to co-ordinate this Work with other Trades
- 1.18.1.3 Assisting the Division 23, 26 and Division 25 BAS Contractors with start-up of devices under BAS control.
- 1.18.2 Division 25 BAS Contractor shall provide a written guarantee to the Owner, consistent with the project-specific General Conditions, stating that the Work provided under this Section is guaranteed against faulty material and workmanship for a period of one (1) year after Final Completion.
- 1.18.3 Division 25 BAS Contractor is responsible for working with other Trades (particularly Mechanical and Electrical) to co-ordinate Work and to resolve construction problems. Co-ordinate the interconnections to and commissioning of the connections to BACnet-based controllers integrated into equipment supplied by other Divisions. Allow for on-site time to co-ordinate this Work with other Trades.
- 1.18.4 Division 25 BAS Contractor is responsible for co-ordination Work to run controls in trenches provided by other Divisions.
- 1.18.5 Division 25 BAS Contractor is responsible for providing the necessary staff and equipment so the BAS shall be ready for the projected start-up date shown in the Contract Documents.
- 1.19 **All Trades Responsibilities for UL 864 UUKL Commissioning responsibilities.**
 - 1.19.1 See Section 25 08 03.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 00 33 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – SUBMITTAL PROCEDURES

1 - GENERAL

1.01 Related Sections

- 1.01.1 Division 01 - Submittal Procedures
- 1.01.2 Division 01 - Closeout Submittals
- 1.01.3 Division 01 - Demonstration and Training

1.02 Administrative

- 1.02.1 Submit to Owner Submittals listed for review. During construction, Submittals may include the following:
 - 1.02.1.1 Contract schedule
 - 1.02.1.2 Submittal schedule
 - 1.02.1.3 Shop Drawings, product data, and samples
 - 1.02.1.4 Test reports
 - 1.02.1.5 Materials and equipment substitution requests
 - 1.02.1.6 Permits and Certifications
 - 1.02.1.7 Calculations
 - 1.02.1.8 Qualifications of installers
- 1.02.2 Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default shall be allowed.
- 1.02.3 Do not proceed with Work affected by Submittal until review is complete.
- 1.02.4 Present Shop Drawings, product data, samples and mock-ups in English units.
- 1.02.5 Where items or information is not produced in English units, converted values are acceptable.
- 1.02.6 Review Submittals prior to submission to Owner. This review represents that the Division 25 BAS Contractor has determined and verified materials, field measurements, and field construction criteria related thereto, or will do so, and has checked and co-ordinated the information contained within such Submittals with the requirements of the Work and of the Contract Documents.. Submittals not stamped, signed, dated and identified as to specific project shall be returned without being examined and considered rejected.
- 1.02.7 Notify Owner, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- 1.02.8 Division 25 BAS Contractor's responsibility for errors and omissions in Submission is not relieved by Owner's review of Submittals.
- 1.02.9 Division 25 BAS Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Owner's review.
- 1.02.10 Keep one reviewed copy of each Submittal on site.

1.03 Shop Drawings and Product Data

- 1.03.1 The term "Shop Drawings" means Drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Division 25 BAS Contractor to illustrate details of a portion of Work. Do not assume applicable catalogues are available in the Owner's Office. Maintenance and Operating Manuals alone are not suitable Submittals as Shop Drawings.
- 1.03.2 Take full responsibility for securing and verifying field dimensions. In instances where fabrication must proceed prior to field dimensions being available, use all available Drawings and product data for dimensional information. Guarantee that dimensions shall be worked to and ensure that other Trades are aware of these dimensions and shall comply with them.
- 1.03.3 Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Division under which adjacent items will be supplied and installed. Indicate cross references to design Drawings and Specifications. Clearly show Division of responsibility. No item, equipment or description of Work shall be indicated to be supplied or Work to be done "By Others" or "By Purchaser". Any item, equipment or description of Work shown on Shop Drawings shall form part of the Agreement between the Division 25 BAS Contractor and the Owner, unless specifically noted to the contrary.

- 1.03.4 Clearly mark each sheet of printed Submittal material (e.g., using arrows, underlining or circling) to show particular sizes, types, model numbers, ratings, pressure drops, capacities, performance and factory available options actually being proposed. Cross out non-applicable material. Note specified features on the Submittal. Note on the Submittal specified requirements such as special tank linings, pump seals, materials or painting.

1.04 Submittals

- 1.04.1 Submit Shop Drawings for equipment having long ordering times within ten (10) days of Contract award to expedite delivery of this equipment. Other than this exception, piecemeal Submittal of Shop Drawings is not accepted. Submit Shop Drawings in a timely manner for all equipment so that the Total Completion of the Work can be completed by the deadline specified in the Contract Documents. While the Owner shall review the Drawings in a timely manner, Division 25 BAS Contractor shall allow a minimum of fourteen (14) working days for review by the Owner.
- 1.04.2 Accompany Submittals with Transmittal Letter, in duplicate, containing:
- 1.04.2.1 Date
 - 1.04.2.2 Project title and number
 - 1.04.2.3 Division 25 BAS Contractor's name and address
 - 1.04.2.4 Identification and quantity of each Shop Drawing, product data and sample
 - 1.04.2.5 Other pertinent data
- 1.04.3 Submittals shall include:
- 1.04.3.1 Date and revision dates
 - 1.04.3.2 Project title and number
 - 1.04.3.3 Name and address of:
 - 1.04.3.3.1 Mechanical and Electrical Contractors and their associated Subcontractors
 - 1.04.3.3.2 Supplier
 - 1.04.3.3.3 Manufacturer
 - 1.04.3.3.4 Division 25 BAS Contractor's stamp, signed by Division 25 BAS Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents
 - 1.04.3.3.5 Details of appropriate portions of Work as applicable:
 - 1.04.3.3.5.1 Fabrication
 - 1.04.3.3.5.2 Layout, showing dimensions, including identified field dimensions, and clearances
 - 1.04.3.3.5.3 Setting or erection details
 - 1.04.3.3.5.4 Capacities
 - 1.04.3.3.5.5 Performance characteristics
 - 1.04.3.3.5.6 Standards
 - 1.04.3.3.5.7 Operating weight
 - 1.04.3.3.5.8 Wiring diagrams
 - 1.04.3.3.5.9 Single line and schematic diagrams
 - 1.04.3.3.5.10 Relationship to adjacent work
- 1.04.4 Submit three (3) digital copies of Shop Drawings in AutoCAD™ format on 11" X 17" size Drawings. Hard copy shall not be accepted. The minimum font size on the Drawings shall be ten (10) point. Failure to meet this minimum requirement will result in the Shop Drawings package being returned for re-submission.
- 1.04.5 After Owner's review, distribute copies.
- 1.04.6 Delete information not applicable to project.
- 1.04.7 Supplement standard information to provide details applicable to project.
- 1.04.8 Shop Drawings shall be required by the Owner for all systems, equipment, devices, products and connections to the control system required to fulfill the terms and conditions of the Contract Documents. The Owner shall ensure that the quality and level of completeness and detail on the Shop Drawings are satisfactory to him. The Shop Drawings shall contain the following information as a minimum:
 - 1.04.8.1 Network Architecture Block Diagrams Showing Device Layout

- 1.04.8.1.1 A block diagram of the complete system architecture, physical layout and location of equipment in the building and BAS device Input/Output (I/O) point termination schematics. Provide system point capacity and expansion limits including the device type, location and size of memory, and location of all spare points. Organise submission on a device-by-device basis.
- 1.04.8.1.2 Show the layout of the devices on the floor plans for each building.
- 1.04.8.1.3 Provide a Shop Drawing of the network layout with the device locations labelled.
- 1.04.8.1.4 Detail the wireless text message communications connection requirements.
- 1.04.8.1.5 Schematic Drawings of each system listed in Schedule 1 – Hardware object list and the Control Sequences, showing all connected device locations, model numbers, scales and operating ranges, settings, setpoints, reset schedules, fail safe positions, input/output point numbers and related names, and all wiring and air piping layouts. Organise submission on a system-by-system basis.
- 1.04.8.1.6 Schematic Drawings of points, field devices and junction/pull boxes located outside the BAS devices. Show these points, devices and boxes on building floor plans.
- 1.04.8.1.7 Proposed line voltage power connections including breaker panel number, breaker number and type, and amperage.
- 1.04.8.2 Hardware Input/Output Object List
 - 1.04.8.2.1 Provide a hardware and software points/variables list to comply with the all requirements of Schedule 1 – Hardware object list and the Control Sequences, complete with a description of the purpose of the point, sorted in alphabetical order.
 - 1.04.8.2.2 Provide a complete database for all system points detailed in Schedule 1 – Hardware object list, including point names, point descriptors, alarm messages, menu penetration, Operator access, colour graphics, custom system reports as defined elsewhere in this Specification and operating schedule one (1) per system or independent control zone).
 - 1.04.8.2.3 Division 25 BAS Contractor shall list the quantity and type of input and output objects and field devices on a per device basis in the Hardware Input/Output Object List provided at the end of this Section. Division 25 BAS Contractors may use their own Object List providing the required information is provided. Include the requirements for any Spare Points identified in Table 1 and the Points Lists found in the 25 09 nn sections where “nn” represents all the stick built sections.
- 1.04.8.3 Project Work Plan
 - 1.04.8.3.1 The Project Work Plan shall include information on the following:
 - 1.04.8.3.1.1 Scope and objectives of the project
 - 1.04.8.3.1.2 Deliverables the project will produce
 - 1.04.8.3.1.3 Process which shall be employed to produce those deliverables
 - 1.04.8.3.1.4 Time frame and milestones for the production of the deliverable (see below)
 - 1.04.8.3.1.5 Organization and staffing which will be established
 - 1.04.8.3.1.6 Responsibilities of those involved
 - 1.04.8.3.1.7 Work steps to be undertaken
 - 1.04.8.3.2 Provide additional details of where Work requires temporary interruption of mechanical and other services described in the Contract Documents.
 - 1.04.8.3.3 Complete the following projected Work schedule showing completion dates (weeks after Contract Award Date):

Contract Award date.....	Week- 0
Complete Controls Specification Submittals by.....	Week- _____
Submit Security Clearance Forms for staff assigned to Work by.....	Week- _____
Submit Hardware (Hardware Input/Output Object List, floor plan layout, device layout)	
Shop Drawings for review by.....	Week- _____
Submit Software (programming) Shop Drawings for review by.....	Week- _____
Submit Software (alarm and event object list and definitions) Shop Drawings for review by	Week- _____
Submit Software (trendlog) Shop Drawings for review by	Week- _____
Submit Software (complete database listing) Shop Drawings for review by	Week- _____
Submit list of required network drops complete with IP addresses to devices, building level WS (if any),building printers (if any) Shop Drawings by	Week- _____
Submit list of required network drops to Server Farm (if any), Server Farm printers (if any) Shop Drawings by.....	Week- _____
Submit ALC Front End design and graphics Shop Drawings by	Week- _____
Submit Firewall Password Request Shop Drawing by	Week- _____
<u>Installation Work Phase:</u>	
Complete rough-in and field wiring by	Week- _____
Install and make device terminations by	Week- _____
Work ready for Owner's Rough-In Review by	Week- _____
Update ALC Front End/Web Server by	Week- _____
Implement BACnet communications on Intranet and any interoperability functions by	Week- _____
<u>Commissioning Work Phase:</u>	
Mechanical has systems ready for Mechanical Static Commissioning by	Week- _____
Complete Controls Hardware Commissioning by	Week- _____
Submit Hardware Commissioning Forms for review by Owner by	Week- _____
System ready for Hardware Commissioning review by	Week- _____
Complete all Front End/Software Work by.....	Week- _____
Submit draft As-Built Controls Drawings for review by Owner by	Week- _____
Provide As-Built Control Drawings by	Week- _____
Submit draft Operating and Maintenance Manuals for review by Owner by	Week- _____
Provide Operating and Maintenance Manuals by.....	Week- _____
System ready for Front End/Software Commissioning review by	Week- _____
System ready for Functional Performance Testing by	Week- _____
<u>Closeout Work Phase:</u>	
Request Controls Substantial Completion (Interim Certificate) by.....	Week- _____
Complete initial equipment training by	Week- _____
Complete final ALC Front End System training by	Week- _____
Request Final Completion Certificate (First Year Warranty Start) by	Week- _____
<u>In-warranty Work Phase:</u>	
Start after sales service by	Week- _____
Complete after sales service by	Week- _____
Complete Month eleven (11) warranty inspection by	Week- _____
Close out Warranty by.....	Week- _____

1.04.8.4 BAS Hardware Supplied

- 1.04.8.4.1 Shop Drawings shall include, but not be limited to Manufacturer's performance data including dimensional Drawings, customer connection Drawings, power circuit diagrams, installation and maintenance manuals, warranty description, ratings, certification agency file numbers and catalogue information. Provide Shop Drawings for all control system hardware, including:
- 1.04.8.4.1.1 Level 1 and Level 3 BAS control device hardware and I/O extender devices
 - 1.04.8.4.1.2 Field equipment
 - 1.04.8.4.1.3 Instrumentation and termination devices
 - 1.04.8.4.1.4 Actuators and Operators

- 1.04.8.4.1.5 Sensors and Transmitters
- 1.04.8.4.1.6 Outdoor air temperature sensor sun shield
- 1.04.8.4.1.7 Space temperature sensor guards
- 1.04.8.4.1.8 Control valves
- 1.04.8.4.1.9 Control dampers
- 1.04.8.4.1.10 VFDs
- 1.04.8.4.1.11 Updates and changes to the existing building SOAP device.
- 1.04.8.5 Level 0 Hardware and Software Supplied
 - 1.04.8.5.1 Shop Drawings shall include:
 - 1.04.8.5.1.1 Upgrades to WebCTRL server VM requirements and software details and configuration complete with all attached peripheral devices, batteries, power supplies, etc. with interconnection diagrams.
 - 1.04.8.5.1.2 Description of all Network Devices and communication interfaces, gateways, repeaters, and connected systems and equipment. Provide details on the network layout, IP addressing, network protocols used, special configuration, etc.
 - 1.04.8.5.1.3 Wireless text message hardware and software details and configuration complete with all attached peripheral devices, batteries, power supplies, etc. with interconnection diagrams
 - 1.04.8.6 Device-By-Device Factory Memory Calculation
 - 1.04.8.6.1 If requested by the Lake County BAS Consultant, provide a factory-authorized memory usage calculation with this submission to justify that this requirement is met on a device-by-device basis.
 - 1.04.8.7 Proposed Programming
 - 1.04.8.7.1 The Submission shall detail the programming for all controlled and monitored equipment, and all documentation required to maintain and operate the control system. The Owner reserves the right to review the programming and require the Division 25 BAS Contractor to change software for systems where field conditions necessitate modification of the Control Sequences.
 - 1.04.8.7.2 Software submissions shall be based on the Control Sequences outlined in the Contract Documents.
 - 1.04.8.7.3 Provide a description of software programs and any additional equipment required to provide a complete and operational system.
 - 1.04.8.7.4 Provide descriptive data and Control Sequences of all operating, user, and application software including a complete Operating and Maintenance Manual, Programmer's Manual and all instruction tailored for this project.
 - 1.04.8.7.5 Alarm logic, limits, delays, classification and message format transmitted by the BAS devices and Front End.
 - 1.04.8.7.6 The Division 25 BAS Contractor may apply to the Owner for an exemption to providing written Control Sequences as one of the documentation deliverables if the software comments, in the opinion of the Owner, are clear enough so as not to warrant the provision of written Control Sequences.
 - 1.04.8.8 Proposed Front End Graphics
 - 1.04.8.8.1 See 25 15 11 and 25 15 11.01 for Graphics requirements.
 - 1.04.8.8.2 Submit samples of all types of graphics for review and approval prior to the start of any Work.
 - 1.04.8.8.3 ALC is responsible for collecting and assembling the background information from Equipment Suppliers in the Work so ALC can create the necessary graphics
 - 1.04.8.9 BACnet Object List

- 1.04.8.9.1 A BACnet Object list based on the Points List and Control Sequences. In addition to standard I/O information, the Object list shall contain the following items to ensure BACnet interoperability:
- 1.04.8.9.1.1 Proposed I/O Names – An I/O point naming convention shall be specified by the Owner in order to clearly identify system points. No BACnet Objects shall be labelled until the proposed I/O Names are approved by the Owner.
 - 1.04.8.9.1.2 BACnet Object Description – This description includes the Object ID and Device ID for each I/O point. The Division 25 BAS Contractor shall ensure that no device ID's are duplicated. Document all non-standard BACnet objects and properties including their structure and data types.
 - 1.04.8.9.1.3 List exceptions to support for optional properties of all standard BACnet objects required to meet the Control Sequences.
 - 1.04.8.9.1.4 List exceptions to support for writable properties required to meet the Control Sequences. If the property is writable, then all data types shall be supported.
 - 1.04.8.9.1.5 Proprietary macro objects which represent equipment such as boilers, AHUs etc.
- 1.04.8.9.2 Objects and their respective property values shall be approved via the Shop Drawing process.
- 1.04.8.10 Spare Parts List
- 1.04.8.10.1 Submit a complete list of spare parts and tools required for regular maintenance.
 - 1.04.8.10.1.1 See Table 1 in 25 00 78.
 - 1.04.8.10.2 Include details on what hardware is being provided to comply with the requirements for spare point capacity identified in Schedule 1 – Hardware object list.
- 1.04.8.11 Inter-Connection to Equipment provided with integrated controls.
- 1.04.8.11.1 Provide information on what hard-wired interlock and interconnects are made between the equipment control system and the BAS.
 - 1.04.8.11.2 Indicate what additional gateways, protocol convertors or BACnet Interface Devices are being used to control mechanical equipment.
- 1.04.8.12 Motorized Dampers Submittal
- 1.04.8.12.1 Provide cutsheets of all dampers and actuators supplied.
 - 1.04.8.12.2 Complete the table below for all dampers and actuators supplied complete with a cross reference to the specific cutsheet information.

MOTORISED DAMPERS								
Qty.	Size ¹	Cutsheet Reference No.	Blade Type ²	Mount Type ³	Actuator Connection ⁴	# of actuators	Orientation ⁵	System/Location

Notes:

1 – Dimensions (width x height)

2 – Blade Type (Opposed Blade [OB]; Parallel Blade [PB])

3 – Mount type (in duct [ID]; Flanged to duct [FD], Round [RD])

4 – Actuator connection (Jackshaft [J], linkage [L], direct mount [D])

5 – Orientation (Vertical [V], Horizontal [H])

1.04.8.13 Motorized Valves Submittal

- 1.04.8.13.1 Provide cutsheets of all valve and actuators supplied.
- 1.04.8.13.2 Complete the table below for all valves and actuators supplied complete with a cross reference to the specific cutsheet information.

MOTORISED VALVES									
Qty.	Size ¹	Cutsheet Reference No.	Config ²	Body Style ³	Cv ⁴	Flow ⁵	ΔP ⁶	Failsafe ⁷	System/Location

Notes:

1 – Flange or Threaded Pipe connection size

2 – Valve Type (2-way/3-way)

3 – Ball [BA], globe [GL], butterfly [BU], Plug [PL]

4 – Final selection to be based on sizing performed by the Division 25 BAS Contractor. Include the sizing equations and the constants used in the selection process.

5 – Rated flow when fully OPEN at design pressure

6 – Pressure drop at design flow with the valve fully actuated OPEN

7 – OPEN/CLOSED (two-way valve), A-AB/B-AB (3-way mixing), AB-A/AB-B (3-way diverting), or fail in position

1.04.8.14 List of Manufacturers

- 1.04.8.14.1 Division 25 BAS Contractor shall submit one copy of a complete List of Manufacturers, with names of Manufacturers of products which shall be used to execute the Work described in the Contract Documents, within two (2) working days of notification of Contract award from Owner. If the List of Manufacturers is not submitted within the two (2) working day timeframe, Division 25 BAS Contractor shall use the product name outlined in each individual clause of the Specification.
- 1.04.8.14.2 Submit Shop Drawings for all items included in the Work that will be provided by the List of Manufacturers.

1.04.8.15 Other items listed throughout the Contract Documents

- 1.04.8.15.1 Identification labelling method, naming conventions used and representative samples of the tags, labels and labelling stencils used. See Section 25 05 **53** for requirements.

- 1.04.9 The required number of Shop Drawings shall be submitted with the Authority Having Jurisdiction approvals where required. Prepare and furnish additional Drawings, details or information in the Shop Drawing submission, where the requirements of the Authority having Jurisdiction varies from the requirements set out in the Contract Documents (Project Manual).

1.05 BAS Shop Drawing Review

- 1.05.1 See Division 01 for Shop Drawing requirements for the Work. The requirements in this clause apply to this Division only.
- 1.05.2 The Owner is responsible for reviewing and approving Submittals, and for maintaining a file of approved Submittals.
- 1.05.3 The review of Shop Drawings by the Owner is for the sole purpose of ascertaining conformance with the general concept. This review shall not mean that the Owner approves the detail design inherent in the Shop Drawings, responsibility for which shall remain with the Division 25 BAS Contractor submitting same, and such review shall not relieve the Division 25 BAS Contractor of responsibility for errors or omissions in the Shop Drawings or of responsibility for meeting all requirements of the construction and Contract Documents. Without restricting the generality of the foregoing, the Division 25 BAS Contractor is responsible for dimensions to be confirmed and correlated at the Place of Work, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of the work of all Contractors, Subcontractors and Equipment Suppliers involved in the Work.
- 1.05.4 Allow ten (10) working days for Owner's review of each Submission.
- 1.05.5 Adjustments made on Shop Drawings by Owner are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Owner prior to proceeding with Work.
- 1.05.6 Make changes in Shop Drawings as Owner may require, consistent with Contract Documents. When resubmitting, notify Owner in writing of revisions other than those requested.
- 1.05.7 If upon review by Owner, no errors or omissions are discovered or if only minor corrections are made, copies shall be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy shall be returned and resubmission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

- 1.05.8 No work shall be undertaken nor shall equipment delivery be accepted until final or partial approval of Shop Drawings has been granted by the Owner.
- 1.05.9 Fabrication of equipment shall not commence until Shop Drawings of such equipment have been reviewed by the Owner.
- 1.05.10 BAS programming or Front End software development and installation shall not commence until Shop Drawings have been reviewed by the Owner.
- 1.05.11 In addition to project identification, date, etc., the form of stamp used by the Owner in Shop Drawings review shall be as follows:

Date _____

This review is to ascertain certain conformance to design concept only and does not imply approval of detail design inherent in the Shop Drawings. Division 25 BAS Contractor remains responsible for all dimensions and site conditions, meeting all contract document requirements and for any errors and/or omissions in the Shop Drawings.

- ☐ Division 25 BAS Contractor Review Done ☐ Y ☐ N
- ☐ Reviewed/No Letter Attached
- ☐ Reviewed as Modified on Shop Drawing Document
- ☐ Revise and Re-submit as per Attached Letter/Memo
- ☐ Not Reviewed
- ☐ Reviewed as per Attached Letter/Memo

- 1.05.12 This stamp or sticker shall be applied by the Owner to the Shop Drawings.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

[illegible]

End of Section

25 00 42 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – REFERENCES

1 - GENERAL

1.01 General

- 1.01.1 Terminology used in this Specification is intended to be generic in nature and consistent with meanings that have been defined through general use and/or accepted Trade practices.
- 1.01.2 BACnet as used in this Specification shall refer implicitly to ASHRAE 135-2024 and approved Addenda unless otherwise noted.
- 1.01.3 The abbreviations, acronyms, definitions and reference standards shall apply to all parts of the Division 25 BAS Contractor Specification.

1.02 Abbreviations and Acronyms

- 1.02.1 AI – Analog Input
- 1.02.2 AHU – Air Handling Unit
- 1.02.3 ANSI – American National Standards Institute
- 1.02.4 AO – Analog Output
- 1.02.5 ASCII – American Standard Code for Information Interchange
- 1.02.6 ASHRAE – American Society of Heating, Refrigerating, and Air Conditioning Engineers
- 1.02.7 ASME – American Society of Mechanical Engineers
- 1.02.8 ASTM – American Society for Testing Materials
- 1.02.9 BACnet – Building Automation and Control network
- 1.02.10 BAS – Building Automation System
- 1.02.11 BBMD – BACnet Broadcast Management Device
- 1.02.12 BDT – Broadcast Distribution Table
- 1.02.13 BI – Binary Input
- 1.02.14 BIBBs – BACnet Interoperability Building Blocks
- 1.02.15 BIL – basic impulse insulation level
- 1.02.16 BTL – BACnet Testing Laboratories™
- 1.02.17 BO – Binary Output
- 1.02.18 CISPR – International Special Committee on Radio Interference
- 1.02.19 DDC – Direct Digital Control
- 1.02.20 DOT – Department Of Transportation
- 1.02.21 DVD – Digital Versatile Disc or Digital Video Disc
- 1.02.22 FCC – Federal Communications Commission
- 1.02.23 FSCS – Firefighter’s Smoke Control Station provided by ADi in the Work
- 1.02.24 HVAC – Heating, Ventilation and Air Conditioning
- 1.02.25 I/O – Input/Output
- 1.02.26 ID – Identifier
- 1.02.27 IEC – International Electrotechnical Commission
- 1.02.28 IEEE – Institute of Electrical and Electronic Engineers
- 1.02.29 IP – Internet Protocol
- 1.02.30 ISA – Instrument Society of America
- 1.02.31 LAN – Local Area Network
- 1.02.32 MS/TP – Manager-Subordinate/Token Passing.
- 1.02.33 MAC – Media Access Control
- 1.02.34 MUA – Make-Up Air Handler
- 1.02.35 NBC – National Building Code
- 1.02.36 NEC – National Electrical Code
- 1.02.37 NEIS – National Electrical Installation Standards
- 1.02.38 NEMA – National Electrical Manufacturers Association
- 1.02.39 NIST – National Institute of Standards and Technology
- 1.02.40 NFPA – National Fire Protection Association
- 1.02.41 NSTA – National Safe Transit Association
- 1.02.42 OSI – Open Systems Interconnection
- 1.02.43 OWS – Operator Workstation
- 1.02.44 PICS – BACnet Protocol Implementation Conformance Statement

- 1.02.45 POT – Portable Operator’s Terminal
- 1.02.46 PTP – Point-To-Point (or Peer-To-Peer)
- 1.02.47 RAS – Remote Access Service
- 1.02.48 RTU – Roof Top Unit
- 1.02.49 SAE – Society of Automotive Engineers
- 1.02.50 TAB – Testing And Balancing
- 1.02.51 TAP – Telelocator Alphanumeric Input Protocol.
- 1.02.52 TCP – Transmission Control Protocol
- 1.02.53 UBD – Uniform Building Code
- 1.02.54 UDP – User Datagram Protocol
- 1.02.55 UL – Underwriters Laboratories
- 1.02.56 UMC – Uniform Mechanical Code
- 1.02.57 VPN – Virtual Private Network
- 1.02.58 WAN – Wide Area Network
- 1.02.59 WS –Workstation
- 1.02.60 OWS – Operator Workstation
- 1.02.61 BAS – Building Automation System
- 1.02.62 BAS Device Network – a network of BAS controllers provided in the Work.
- 1.02.63 BACnet Interface Device – A device supplied by Division 25 BAS Contractor or others listed in the Contract Documents. The purpose of the device is to act as a gateway between a BACnet or a non-BACnet protocol device to BACnet MS/TP or to BACnet/IP. The term BACnet Interface Device also refers to Stick-Built and Wired Connection points.
- 1.02.64 Stick-Built Device – This is a device that comes with no controls. Controls are provided by Division 25 BAS Contractor so the device can be controlled to meet the Sequence of Operations in the Contract Documents.
- 1.02.65 Wired Connection Device – This is an auxiliary contact on a piece of equipment to which Division 25 BAS Contractor or others as specified can land a pair of wires on the contacts to pick up a status, alarm or other point.
- 1.02.66 Modbus Device – A device supplied by the Equipment Supplier. The purpose of the device is to provide data using the Modbus RTU protocol so it can be converted to BACnet/IP by a BACnet Interface Device.
- 1.02.67 Basis of Design and Installation for the BACnet Interface Device provided in the Work – A BACnet Interface Device that has been selected as the standard to which other competitive products are evaluated to be considered approved equals in the Contract Documents. It is the responsibility of the provider of the competitive device to demonstrate to the Lake County BAS Consultant that his competitive device is equivalent to the Basis of Design and Installation BACnet Interface Device called up in this Specification.
- 1.02.68 Listed BAS devices and BAS - All BAS devices used in the Work shall be listed to meet the UL 864 UUKL 10th Edition.
 - 1.02.68.1.1 The Automated Logic System is the Basis of Design and Installation for UL 864 UUKL 10th Edition compliance by the BAS.
 - 1.02.68.1.2 See 25 00 11 ~~1.04.1~~ **1.06** for a citation of the relevant documents from Automated Logic that form the Basis of Design and Installation for the BAS and BAS devices.
 - 1.02.68.1.3 It is the responsibility of the provider of the competitive device to demonstrate to the Lake County BAS Consultant that his competitive device is equivalent to the Basis of Design and Installation for the BAS and BAS devices that are called up in this Specification.
- 1.02.69 Equipment Supplier of the BACnet Interface Device(s). References in this Specification to Equipment Supplier, Manufacturer shall mean the Equipment Supplier.
- 1.03 **General Definitions:**
 - 1.03.1 Work – This is provision of products (both hardware and software), goods and services as outlined in this Division 25 Specification and all the Contract Documents.
 - 1.03.2 Place of the Work – This is the Babcox Justice Complex, Waukegan Illinois as shown in the Contract Documents.
 - 1.03.3 Contract Documents – Plans, Specifications and other documents provided by the Owner and the Consultants.

- 1.03.4 General Contractor – This is the firm or entity engaged by the Owner to construct the Work. The General Contractor shall have complete control over the means and methods needed to complete the Work outlined in all the Contract Documents.
- 1.03.5 Mechanical Contractor – The Mechanical Contractor is a Subcontractor to the General Contractor.
- 1.03.6 Division 25 BAS Contractor – This entity is Automated Logic Chicago Branch. The Division 25 BAS Contractor may be engaged as a Subcontractor to the General Contractor, the Mechanical Contractor or the Electrical Contractor.
- 1.03.7 Electrical Contractor – The Electrical Contractor is a Subcontractor to the General Contractor.
- 1.03.8 Subcontractor – This term is used for persons, firms or other entities who are engaged by the General Contractor, the Mechanical Contractor or the Electrical Contractor or any other Contractor engaged to perform Work on this project.
- 1.03.9 Trade – Shall refer to the General Contractor, Mechanical Contractor, Electrical Contractor, all Subcontractors, the Division 25 BAS Contractor, Equipment Suppliers and Manufacturer’s Representatives.
- 1.03.10 Manufacturer’s Representative – This person, firm or entity is engaged by General Contractor, the Mechanical Contractor or the Electrical Contractor to provide equipment including the BACnet Interface Device needed for the Work of this project.
- 1.03.11 Accessible concealed areas – include crawl spaces and other spaces not covered by the “accessible open” definition
- 1.03.12 Accessible open areas – include boiler rooms, mechanical rooms, crawl spaces used for storage and full height, walkable crawl spaces, hallways, offices, areas used by the public or occupants, workshops, etc. Such spaces are also referred to as exposed spaces. The under floor air distribution spaces are considered accessible open areas. T-bar ceiling spaces are considered accessible open areas. A 3 ft. radius around an access hatch in a drywall ceiling or bulkhead is considered an accessible open area.
- 1.03.13 BETA equipment – any component that has not been released by the Manufacturer for general distribution prior to the Owner issuing the Bid. Beta equipment may only be used in the Work with prior written permission of the Owner.
- 1.03.14 Owner, User and Operator – shall refer to Lake County.
- 1.03.15 Lake County BAS Consultant - shall refer to Appin Associates.
- 1.03.16 Consultant or Engineer of Record or Designer of Record – shall refer to Syska Hennessy Group and its subconsultants.
- 1.03.17 Ethernet – A carrier sensing, multiple access with collision detection, network technology defined by ISO/IEC 8802-3.
- 1.03.18 Inaccessible concealed areas – include walls, shafts, or ceiling pipe chases, block walls, drywall ceilings and other areas that do not permit human entry.
- 1.03.19 Internet Protocol (IP) – a protocol that handles the breaking up of data messages into packets (also called datagrams), the routing of the packets from their origin to the destination network and node, and the reassembling of the packets into the data message at the destination. BACnet/IP operates at the Internetwork layer of the TCP/IP model, which is equivalent to the network, layer of the ISO/OSI reference model.
- 1.03.20 Operator, Owner - These terms refer to the person or persons who will own and operate the BAS. Owners and Operators refer to Lake County, its employees and consultants as defined by Lake County at its discretion.
- 1.03.21 Product Data – are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Division 25 BAS Contractor to illustrate materials or equipment for some portion of the Work.
- 1.03.22 Project Manual – These are the Contract Documents for the Work.
- 1.03.23 Provide - Supply, install, connect, document and commission the system to operate to the satisfaction of the Owner.
- 1.03.24 Shall or Must or Will – This word, or the term “required”, means that the specified Work requirements shall be provided as part of the Work requirements. Use of the words Must and Will shall mean the same as Shall.
- 1.03.25 Shall not or Must not or Will not – This phrase means that the specified prohibition(s) will not be accepted in the Work under any circumstances. Use of the words Must not and Will not shall mean the same as Shall not.
- 1.03.26 Samples – are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
- 1.03.27 Shop Drawings or Submittals – are Drawings, diagrams, illustrations schedules, performance charts, control point schematics, BAS equipment and programming and other data specially prepared for the

Work by the Division 25 BAS Contractor or a Subcontractor, Manufacturer, Equipment Supplier or Distributor to illustrate some portion of the Work.

- 1.03.28 Should – This word means that complete compliance with a Specification clause is optional. Valid reasons may exist in particular circumstances in which the Division 25 BAS Contractor wishes to deviate from fully complying with the specification clause(s), however the full implications shall be understood and carefully weighed before choosing to deviate from the Specification.
- 1.03.29 Substantial Completion – This is the date that the Owner considers the Work to be completed sufficient to allow the warranty to start. The Owner shall provide a list of deficiencies to the Division 25 BAS Contractor to be corrected before Total Completion is granted by the Owner.
- 1.03.30 Testing And Balancing (TAB) – means to test, adjust and balance all systems, equipment and devices to perform in accordance with Contract Documents.
- 1.03.31 Total Completion – This is the data that the Owner considers the Work to be totally complete including all deficiencies.
- 1.03.32 Transmission Control Protocol (TCP) – a protocol that enables two (2) hosts to establish a connection and exchange streams of data. TCP handles delivery and order of data streams.
- 1.03.33 Year 2036 compliant – correctly present the date and time, the day of the week, leap years, date calculations, to the year 2036. The date and time to the year 2036 shall be correct after a power failure. This date and time shall be presented without Operator intervention. All hardware and software provided in the Work shall be Year 2036 compliant.
- 1.03.34 Intranet or Enterprise LAN – A privately maintained computer network by the Owner that can only be accessed by persons authorized by the Owner who operates it.

1.04 BAS Definitions

- 1.04.1 Client – An application or device acting as a requestor or consumer of data in networked systems. A client requests a server device for data resident in the server.
- 1.04.2 Color graphics – These are pictorial representations of all mechanical systems, BAS devices and the building floor plans stored on the Front End software that is resident on a server spun up by the Owner as a VM.
- 1.04.3 Downloading – This means transferring programming and/or configuration data from a Level 0 device to a lower level control device. BACnet refers to this operation as writing to a BACnet device using AtomicFileWrite.
- 1.04.4 Extended logging – This is the process of collecting and archiving trend data in excess of two hundred (200) samples on an input, output or software variable, setpoint, etc. to the Front End archiver. The extended logs shall be stored in the Front End software native format or automatically saved in an EXCEL™ (or approved equal) spreadsheet for retrieval by the Operator.
- 1.04.5 Front End – This is the graphical interface software to the BAS device network. The Front End requirements are outlined in Section 25 15 11 and 25 15 11.01.
- 1.04.6 Internetwork – a set of two (2) or more BACnet networks inter-connected by routers. In a BACnet Internetwork, there shall be no more than one (1) message path between any two (2) nodes. The BACnet Internetwork is part of the Owner's Enterprise LAN but is configured as a separate VLAN.
- 1.04.7 Local connection - This shall mean connecting a POT or Service Tool via a cable, directly into a communications port on the device to which communications is being attempted.
- 1.04.8 MS/TP - A type of LAN implementation defined in BACnet that usually uses the EIA-485 signalling standard. To initiate communications on the network, a node will have an electronic "token", which is passed from one (1) node to another around the network. Manager devices are allowed to have the token, whereas Subordinate devices are allowed only to respond to requests from Manager devices. The term Manager/Subordinate is no longer used for BACnet device. This term is still used for Modbus devices.
- 1.04.9 Operator Workstation (OWS) - a desktop computer used to provide direct or remote communications to the BAS.
- 1.04.10 Peer-to-Peer - A network in which messages are passed between nodes that are considered equal peers or BACnet MS/TP Managers on the network.
- 1.04.11 Portable Operators Terminal (POT) - a laptop computer or similar device used to provide direct and/or remote communications to the BAS. The POT may be any device that permits an instance of a Chrome client to run to access the BAS by communicating via Ports 80 and 443 to the Front End server software.
- 1.04.12 Server - In networked systems, a computer, application or device acting as a provider or server of data and/or services
- 1.04.13 Service Tool - a proprietary tool used to provide direct communications to the BAS device network in order to configure, diagnose, read values, etc. during installation and periodically when devices require reconfiguration. The Service Tool is sometimes used in combination with the POT to provide direct

communications to the BAS device network. The Service Tool may use Bluetooth or other wireless communications technology for temporary communications for troubleshooting, configuration and commissioning.

- 1.04.14 Set, command, override or modify - These terms are used interchangeably and refer to the process of taking a hardware or software point out of programmed control and placing it into manual control or a fixed state or value by the Operator.
 - 1.04.15 Software point/variable - These terms are used interchangeably and refer to the software setpoints, limits, virtual points, subroutine arguments, etc. that are used to pass data from device to device or in and out of subroutines. Software points/variables are considered objects in this Specification. BACnet Object Types and points are used interchangeably in this specification. Modbus registers are also considered to be points in this Specification.
 - 1.04.16 Terminal mode - This means accessing the BAS device network via local or remote connection using a computer in VT100 emulation or Windows HyperTerminal (ASCII text) mode.
 - 1.04.17 Transmit/Transmission - This means sending data to servers, WS, POT, BAS device, printer, wireless text message device, etc. via a data communications link (e.g., serial connection, telephone, Ethernet network).
 - 1.04.18 Trending - This is the process of collecting historical data at the device level on an input, output or software variable or setpoint. The terms "history" and "trend log" are used interchangeably in this Specification. There are two (2) types of trends. Logged trends are the accumulation of historical data. Dynamic trends are the real time graphical display of data.
 - 1.04.19 Uploading - This means transferring programming and/or configuration data from the BAS devices to a Level 0 device. BACnet refers to this operation as reading from a BACnet device using AtomicFileRead.
 - 1.04.20 All other definitions shall be based on the following references: Direct Digital Controls for HVAC Systems by T. Hartman (McGraw-Hill, 1993); Direct Digital Control of Building Systems: Theory and Practice by M. Newman (Wiley, 1994) and BAS for HVAC Monitoring and Control course by ASHRAE (ASHRAE, 1995). The Lake County BAS Consultant shall be the final arbiter of all definitions or terms.
- 1.05 BACnet Definitions**
- 1.05.1 BACnet/IP – One (1) of the LAN types defined by BACnet, whose use is specifically suited to IP centric infrastructure. The protocol is fully described in Annex J of the BACnet Specification.
 - 1.05.2 BACnet/NS – This has been deprecated from ANSI/ASHRAE SSPC 135-2024.
 - 1.05.3 BACnet/IT – This has been deprecated from ANSI/ASHRAE SSPC 135-2024.
 - 1.05.4 BACnet/SC – Defines a security architecture for BACnet. BACnet Network Security is a mechanism in ANSI/ASHRAE SSPC 135-2024 for encrypting and authenticating network communications. Use of BACnet/SC devices is not required in the Work.
 - 1.05.5 BACnet/WS – BACnet Web services are a standard way of integrating applications over an IP network. This service is intended to be communication "protocol neutral" in that the defined Web services can be used with any underlying protocol including BACnet, Konnex, Modbus, LON or legacy proprietary protocols. This protocol defines how to read and write the common elements of all building automation and control systems such as values, schedules, trend logs and alarm information using services such as 'getValue' and 'setValue' that use a simple "path" to define the intended data source
 - 1.05.6 BACnet gateway - Devices that use BACnet objects, services and communication protocols to represent data in BACnet format. They translate this data into one or more non-BACnet protocols to BACnet Object Types such as BVs, AVs and MSVs.
 - 1.05.7 BACnet Identifier - BACnet defines three (3) important IDs used to identify BACnet 1) devices, 2) objects, and 3) properties. A Vendor ID defines who manufactured a device. An Object ID identifies an object's type and instance number. A Property ID identifies a property by a code.
 - 1.05.8 BACnet Interoperability Building Blocks (BIBBs) - These are BACnet objects and services grouped together by ANSI/ASHRAE 135-2024 to define interoperable features. These are prescribed in terms of an "A" and a "B" device. Both of these devices are nodes on a BACnet Internetwork. In most cases the "A" device will act as the user of data (client) and the "B" device will be the provider of this data (server). In addition, certain BIBBs may also be predicated on the support of certain, otherwise optional BACnet objects or properties and may place constraints on the allowable values of specific properties or service parameters.
 - 1.05.9 BACnet PICS - A Protocol Implementation Conformance Statement document that details the particular BACnet objects, services and capabilities supported by a type of BACnet device. Every BACnet-compliant device has an associated PICS published by the Manufacturer or Equipment Supplier.
 - 1.05.10 BACnet Testing Laboratories™ (BTL) - A lab operated by BACnet International to test building automation products and certify them as BACnet compliant. Listings of tested products are available at www.bacnetinternational.org.

- 1.05.11 BBMD - BACnet Broadcast Management Devices are used to distribute Broadcast-messages across multiple IP subnets. Only one BBMD shall be active per IP Broadcast Domain, otherwise a “broadcast storm” may occur due to broadcast messages repeating themselves. All BBMDs of a BACnet/IP network shall have the same BDT (Broadcast Distribution Table) configuration. BBMDs are fully described in Annex J of the BACnet Specification.
- 1.05.12 Bridge - A device that connects two LANs or segments of the same LAN at the MAC or Datalink layers. The LANs can be alike or different. A bridge can connect an Ethernet and token-ring network, for example. Unlike routers that operate at the OSI Network and higher layers, bridges forward messages without analyzing or rerouting them.
- 1.05.13 Datalink - a layer defined in the OSI (Open Systems Interconnection) model to add basic packet organization to groupings of octets transmitted using physical layer signalling.
- 1.05.14 Device Profile - A collection of BIBBs that describes the minimum BACnet capabilities of a particular device in order to achieve reliable exchange of information
- 1.05.15 Half-Router - a device that can participate as one (1) partner in a point-to-point (PTP) connection. Two (2) half-routers form an active PTP connection and act as a single router.
- 1.05.16 Instance - a number that uniquely identifies an object within a device or a device on a BACnet Internetwork.
- 1.05.17 Interoperability - the ability of devices to provide objects and services to support BIBBs and other BACnet features in a network visible manner.
- 1.05.18 Local matter - A feature provided in a proprietary matter which does not need to meet the test of BACnet interoperability or network visibility.
- 1.05.19 Media Access Control (MAC) - The combination of physical and datalink layers that together control access to a given medium. In BACnet, each device has a unique MAC Address/Network Number combination that identifies it on the BACnet Internetwork. In BACnet ANSI/ASHRAE Standard 135-2024, the MAC LAN types are: BACnet ARCNET, ~~BACnet Ethernet ISO/IEC 8802-3~~, BACnet/IP, BACnet MS/TP (Manager-Subordinate/token passing) BACnet over LonTalk Foreign Frames, and BACnet PTP (point-to-point).
- 1.05.20 Native BACnet BAS devices - These are Level 1/1A, 2/2A and 3/3A BAS devices that have an embedded BACnet protocol stack. These devices use BACnet objects, services and communication protocols (e.g., MS/TP) directly without use of translation devices or drivers. Only the programming language of the device may be done as a local matter.
- 1.05.21 Native BACnet WS - These are Level 0 computers that use a BACnet protocol stack that is either embedded in the device (in the case of a web appliance or a display device) or in the Front End software. These devices use BACnet objects, services and communication protocols without the use of translation devices or drivers. Graphics, programming and configuration services and tools may be done as a local matter.
- 1.05.22 Network visible - BACnet objects whose properties can be read using BACnet ReadProperty and ReadPropertyMultiple services from another Manufacturer’s BACnet client.
- 1.05.23 Object - a collection of information in a BACnet system described by a group of properties (see ANSI/ASHRAE 135-2024 for full definition). An Object might represent information about a physical input or output, or it may represent a logical grouping of points that perform some function, such as a setpoint. Every Object has an identifier that allows the BACnet system to identify it. An Object is similar to a data point, although it contains additional information other than present value. It is only through its properties that an Object is monitored and controlled. The terms input, output, variable, and points are considered Objects in this Specification. References to the Points List are to the Points Lists found in the 25 09 nn Stick Built sections where “nn” refers to all section numbers listed in the Contract Documents. The term Object shall also mean Object Type.
- 1.05.24 Property (of an Object) - the means by which objects are monitored and controlled. BACnet defines over three hundred (300) properties of Objects. Three (3) properties (Object-identifier, Object-name, and Object-type) shall be present in every object. BACnet also requires that certain Objects support specific additional properties. The type of Object and the type of device in which that Object resides determine which properties are present. Some properties are writable, and others can only be read. The attribute of a point is considered to mean a property of an Object. See ANSI/ASHRAE 135-2024 for a complete description of objects and their properties.
- 1.05.25 Router - A device that connects two (2) or more LANs. Routers are similar to bridges, but provide additional functions, such as message filtering and forwarding based on various criteria.
- 1.05.26 Services - the method by which one (1) BACnet device gets information from another BACnet device, commands a BACnet device to perform certain actions (through its objects and properties, of course), or

- lets other BACnet devices know that something has happened. The only mandatory service required by all BACnet devices is the ReadProperty service. There are a total of thirty nine (39) standard services.
- 1.05.27 UDP - One of the IP family of protocols. UDP is used to convey BACnet/IP messages and is characterized by a "port number" for each protocol. The UDP-Port can take a value between 47808 (BAC0 hex) through 47817 (BAC9 hex).
- 1.05.28 Other definitions as outlined in the ANSI/ASHRAE 135-2024 standard and subsequent Addenda up to Bid Close shall form part of the Specification Documents.

1.06 Reference Standards

- 1.06.1 518 IEEE Guide for the Installation of Electrical Equipment to Minimize Noise Inputs to Controllers from External Sources
- 1.06.2 ANSI/ASHRAE Standard 135-2024: *BACnet - A Data Communications Protocol for Building Automation and Control Networks*, as amended from time to time. Simply referred to as "BACnet" in this document
- 1.06.3 ASTM D999-91
- 1.06.4 ISO/IEC 8802-3 (2000), Information Processing Systems - Local Area Networks - Part 3: Carrier sense multiple access with collision detection (CSMA/DVD) access method and physical layer Specifications.
- 1.06.5 Underwriters Laboratories: Products shall be UL-916-PAZX listed
- 1.06.6 NFPA 70
- 1.06.7 Federal Communications Commission - Part J
- 1.06.8 ASHRAE 15 (latest edition), Mechanical Refrigeration Code
- 1.06.9 UL 508 Standard C22.2 No. 142 for Isolation Voltages
- 1.06.10 IEC 60068-2.1, 2.2, 2.3, 2.6 and 2.27
- 1.06.11 IEC 61000-4.2, 4.3, 4.4, 4.5 and 4.6
- 1.06.12 NSTA Project 1A
- 1.06.13 CISPR 11 (EN 55011)
- 1.06.14 National Electrical Manufacturers Association (NEMA)
- 1.06.15 IA 2.1/IEC 1131, Part 1 Programmable Controllers - General Information
- 1.06.16 IA 2.2/IEC 1131, Part 2 Programmable Controllers - Equipment Requirements and Tests
- 1.06.17 ICS 1 Industrial Control and Systems: General Requirements
- 1.06.18 ICS 6 Industrial Control and Systems: Enclosures
- 1.06.19 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
- 1.06.20 EI 21.1 Instrument Transformers for Revenue Metering (110 kV BIL and less)
- 1.06.21 EI 21.2 Instrument Transformers for Revenue Metering (125 kV BIL through 350 kV BIL)
- 1.06.22 ICS 2-230
- 1.06.23 ICS 3-304-42
- 1.06.24 Institute of Electrical and Electronic Engineers (IEEE)
- 1.06.25 C12.11 Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
- 1.06.26 IEEE Std. 472-1974/ANSI C37.90/90A-1974
- 1.06.27 National Fire Protection Association (NFPA) 70
- 1.06.28 National Electrical Code (NEC)
- 1.06.29 National Electrical Contractors Association (NECA)
- 1.06.30 National Electrical Installation Standards (NEIS)
- 1.06.31 SAE HS-1738, Electrical Standard for Industrial Machinery
- 1.06.32 UL 864 UUKL Standard (10th Edition) for Safety for Control Units and Accessories for Fire Alarm Systems.

1.07 Trademarks

- 1.07.1 AutoCAD® - registered trademark of Autodesk, Inc. in the United States and other countries
- 1.07.2 BACnet® - registered trademark of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- 1.07.3 BTL® - registered trademark of BACnet International
- 1.07.4 Caddy® - a registered trademark of Erico, Inc. of Solon, Ohio
- 1.07.5 Celcon® - registered trademark of Ticona Corporation or its affiliates
- 1.07.6 Core™ - trademark of Intel Corporation in the United States and other countries
- 1.07.7 Excel® - registered trademark of Microsoft Corporation in the United States and other countries
- 1.07.8 Explorer® - registered trademark of Microsoft Corporation in the United States and other countries
- 1.07.9 Intel® - registered trademark of trademark of Intel Corporation in the United States and other countries

- 1.07.10 LEED® - registered trademark of the U.S. Green Building Council
- 1.07.11 LONMARK® - registered trademark of the Echelon Corporation
- 1.07.12 LonTalk® - registered trademark of the Echelon Corporation
- 1.07.13 LONWORKS® - registered trademark of the Echelon Corporation
- 1.07.14 Microsoft® - registered trademark of Microsoft Corporation in the United States and/or other countries
- 1.07.15 Modbus® - registered trademark of Schneider Electric in the United States and other countries
- 1.07.16 Panduit® - registered trademark of Panduit Corporation in the United States and other countries
- 1.07.17 Teflon® - registered trademark of E.I. du Pont de Nemours and Company
- 1.07.18 SnapTrack™ - trademark of Tyco Electronics Corporation
- 1.07.19 Visio® - registered trademark of Microsoft Corporation in the United States and other countries
- 1.07.20 Vista® - registered trademark of Microsoft Corporation in the United States and other countries
- 1.07.21 Windows® - registered trademark of Microsoft Corporation in the United States and other countries
- 1.07.22 Word® - registered trademark of Microsoft Corporation in the United States and other countries
- 1.07.23 Xeon® - registered trademark of trademark of Intel Corporation in the United States and other countries

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 00 75 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – STARTING & ADJUSTING

1 - GENERAL

1.01 Trial Usage and Tests

- 1.01.1 The Owner shall have the privilege of trial usage of mechanical systems or parts thereof for the purpose of testing and learning operational procedures prior to acceptance.
- 1.01.2 Division 25 BAS Contractor shall assist in trial usage for a period of time, as deemed reasonable by the Owner. Supply labor, material and instruments at no extra cost. Division 25 BAS Contractor shall not waive any responsibility because of trial usage. Assistance provided by the Division 25 BAS Contractor during the trial usage period shall not be counted as training time specified elsewhere in the Specification.
- 1.01.3 Trial usage by the Owner shall not be construed as acceptance of the Work by the Owner.
- 1.01.4 Provide the highest level password for BAS to Owner to permit this trial usage to occur.
- 1.01.5 Provide and pay for all testing required on the system components where, in the opinion of the Owner, Manufacturer's ratings or specified performance are not being achieved.

1.02 Division 25 BAS Contractor Work with TAB Division 25 BAS Contractor

- 1.02.1 Division 25 BAS Contractor shall assist the TAB Division Contractor to test and balance all air systems shown in Sections 23 09 00 and 23 05 93.
- 1.02.2 Division 25 BAS Contractor shall assist the TAB Division Contractor to test and balance all water systems shown in Section Sections 23 09 00 and 23 05 93.
- 1.02.3 Division 25 BAS Contractor shall assist the TAB Division Contractor to set up and calibrate all static pressure sensors shown in Sections 23 09 00 and 23 05 93.
- 1.02.4 Division 25 BAS Contractor shall assist the TAB Division Contractor to set up and calibrate all air and water flow meters shown in Sections 23 09 00 and 23 05 93.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 00 77 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – CLOSEOUT PROCEDURES

1 - GENERAL

1.01 Related Sections

- 1.01.1 Division 01 - Submittal Procedures
- 1.01.2 Division 01 - Closeout Submittals
- 1.01.3 Division 01 - Demonstration and Training

1.02 Preliminary Closeout Reviews

- 1.02.1 Before completion of the work, additional Submittals are made by the Division 25 BAS Contractor to the Owner. These Submittals include the following:
 - 1.02.1.1 As-built documents
 - 1.02.1.2 As-built documents
 - 1.02.1.3 Maintenance contracts
 - 1.02.1.4 Warranties and Guarantees
 - 1.02.1.5 Operating and maintenance Documentation

1.03 Final Closeout Reviews

- 1.03.1 Upon completion of the System Start-up, Field Acceptance Testing and Commissioning, the Owner shall sign off and take complete possession of the Work.

1.04 Safety Device Testing

- 1.04.1 Make complete inspection and testing of all safety devices to ensure that safety devices are in complete accordance with Specifications and Manufacturer's recommendations and that the safety devices are connected and operating according to all local regulations. Provide a full description of all safety and test procedures required.
- 1.04.2 On completion of the inspections, supply to Owner letters and/or certificates for their record, confirming that inspections have been completed. Include copies in the Operating and Maintenance Manuals.

1.05 Documentation and Systems Acceptance

- 1.05.1 Provide the following on completion of the Work:
 - 1.05.1.1 Provide an electronic copy of all "As-Built" Drawings
 - 1.05.1.2 Operating and Maintenance Manuals (also include lubricating data for all equipment).
- 1.05.2 If included as part of the Work, provide certificates for:
 - 1.05.2.1 Electrical permits: If taken out by Division 25 BAS Contractor
 - 1.05.2.2 BAS commissioning: As outlined in this Specification
 - 1.05.2.3 Other: If required by code or by Owner
- 1.05.3 Division 25 BAS Contractor shall submit to Owner, suitable document signed by Owner or his representative, confirming:
 - 1.05.3.1 All tests have been witnessed by Owner.
 - 1.05.3.2 Operators have received satisfactory instruction in operation and maintenance of all equipment, systems and safety devices.
 - 1.05.3.3 Operation and Maintenance Manuals and "As-Built" Drawings have been reviewed with and approved by Owner.
- 1.05.4 The Owner reserves the right to recommend that a portion of the contract funds be withheld pending submission of an acceptable record set of "As-Built" Drawings.

1.06 Warranties

- 1.06.1 Division 25 BAS Contractor shall give a warranty for parts and labor on equipment and materials installed and shall select materials and equipment where the Manufacturer gives the same warranty arrangements. Warranty shall commence on the date of the Owner's issuance of the Certificate of Substantial Completion.

- 1.06.2 The Division 25 BAS Contractor shall agree to make good at no additional cost, any equipment that fails to operate due to poor workmanship, manufacturing defect or improper installation. Any repairs shall be made at the convenience of the Owner during normal working hours, unless deemed an emergency.
- 1.06.3 The following items supplied, installed and/or commissioned by the Division 25 BAS Contractor shall be designated as part of the Work and shall be covered by warranty conditions listed in the Specification:
 - 1.06.3.1 BAS hardware and software
 - 1.06.3.2 Non-BAS control devices or hardware
 - 1.06.3.3 Input devices connected to the BAS
 - 1.06.3.4 Output devices and actuators connected to BAS
 - 1.06.3.5 Electrical terminal connections or devices
 - 1.06.3.6 Device mountings and couplings to the building equipment
 - 1.06.3.7 All items covered by Change Order
- 1.06.4 BAS Software and BAS hardware upgrades (for BASs only):
 - 1.06.4.1 The Division 25 BAS Contractor shall also provide all proprietary software and firmware upgrades to all BAS devices issued during the warranty period at no charge to the Owner.
 - 1.06.4.2 Unless the product is being discontinued during the warranty period, these BAS software and BAS hardware upgrade provisions do not include introduction of new product hardware where a full board replacement is required.
- 1.07 **Warranty Closeout**
 - 1.07.1 During the month before the end of the warranty period defined in the Contract Documents, the Owner shall prepare a list of defects identified during the warranty period. The Owner will review the list to determine if the defects are the Division 25 BAS Contractor's responsibility under the Contract Documents.
 - 1.07.2 Division 25 BAS Contractor shall promptly remedy defects due to faulty materials, programming or workmanship that the Owner deems to be the Division 25 BAS Contractor's responsibility under the Contract Documents before the warranty ends. Failure to remedy defects shall make Division 25 BAS Contractor financially responsible to Owner for repairs (materials and labor) by qualified personnel.
 - 1.07.3 Emergency or other repairs of the Work by qualified personnel under direction of Owner shall not nullify warranty.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 00 78 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – CLOSEOUT SUBMITTALS

1 - GENERAL

1.01 Related Sections

- 1.01.1 Division 01 - Submittal Procedures
- 1.01.2 Division 01 - Closeout Submittals
- 1.01.3 Division 01 - Demonstration and Training
- 1.01.4 Division 01 – Operations and Maintenance Manuals

1.02 Completion And Correction List

- 1.02.1 The Owner shall provide a Completion and Correction List (also referred to as a deficiency list) as required to inform the Division 25 BAS Contractor of deficiencies that need to be corrected.

1.03 Controls System Extended Warranty/Maintenance Agreement

- 1.03.1 Not required.

1.04 Requirements for Emergency Service

- 1.04.1 The Division 25 BAS Contractor shall provide emergency service on a twenty four (24) -hours-a-day basis, including weekends and public holidays on the demand of the Owner. This service support shall include all necessary labor and materials to repair or replace any worn and/or malfunctioning equipment as covered under the terms of this Specification. For the purpose of this section, emergencies are defined as any mechanical or control failures for which no temporary solution exists, that threatens comfort, health, life, mechanical system integrity, or safe operation of equipment.
- 1.04.2 Emergency calls during the Warranty period shall be addressed by the Division 25 BAS Contractor within four (4) hours of notification. Note: this four (4) hour response time does not include travel to the site, but normally includes remote computer connection to the site. Service shall be available twenty four (24) hours per day, seven (7) days a week. Provide the Owner with an emergency phone number for contacting service personnel.
- 1.04.3 The service call costs shall only be extra to the Warranty if inspection reveals any defect not directly covered under the terms of the Specification.
- 1.04.4 Only materials used to repair items not covered by the Warranty shall be chargeable as an extra to the Warranty and only if such materials were approved beforehand.

1.05 Documentation Requirements

- 1.05.1 Provide Operations and Maintenance Manuals as described in this section.
- 1.05.2 All documentation shall be site specific, i.e., containing information relevant to the Work only. Work specific documentation can be supplemented with standard or factory documentation.
 - 1.05.2.1 Arrange Submittals in the same sequence as these Specifications and reference at the upper right-hand corner the particular Specification provision for which each Submittal is intended.
- 1.05.3 Digital copies of all documentation for each site shall be supplied electronically.-
- 1.05.4 The electronic document shall be fully indexed. The electronic document shall also contain a comprehensive index in the documentation package.
- 1.05.5 Provide the following:
 - 1.05.5.1 How to use and find information in documentation
 - 1.05.5.2 System operational procedures for all modes of operation including: warm-up, cool-down, occupied, unoccupied, emergency, seasonal change-over, etc.
 - 1.05.5.3 Acceptable tolerances for system adjustment in all operating modes
 - 1.05.5.4 Procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response
- 1.05.6 One complete set of documentation for the Work shall be furnished to the Owner at least three (3) weeks prior to training sessions, and system and equipment tests, and the remaining sets of documentation shall be furnished prior to the commencement of the third training session. Piecemeal Submittal of data is not acceptable and shall not be reviewed by the Owner.
- 1.05.7 The final documentation packages shall include:

- 1.05.7.1 Digital copies of the Control Sequences if the programming is not documented to the Owner's satisfaction
- 1.05.7.2 Flow charts
- 1.05.7.3 Manufacturer's data
- 1.05.7.4 Factory Operating and Maintenance manuals complete with any customization required
- 1.05.7.5 Soft copies of programming and each controller's database (hard copy output of programming is not necessary)
- 1.05.7.6 Provide As-Built information to Mechanical Contractor so that the BIM Model can be updated to show As-Built conditions.
- 1.05.8 Provide clear, concise descriptions of all control sequences in the Working Language. OCL source code shall be fully commented to aid in program debugging if the written sequence is not provided. Copies of Control Sequences shall be in Word™ format.
- 1.05.9 Provide computer generated flow charts of each unique control program if requested to do so by the Owner. At minimum, flow charts will be required for the optimum start routine.
- 1.05.10 Provide Manufacturer's technical data sheets of all hardware and software.
- 1.05.11 Provide all programming and Front End software and any customized documentation for the Work as an indexed pdf.
- 1.05.12 The Certificate of Total Completion shall not be given until all documentation required is satisfactorily provided.
- 1.06 Operating and Maintenance Manual**
 - 1.06.1 Provide information on warranties, certificates, etc. outlined in this Contract in the Operating and Maintenance Manual.
 - 1.06.2 Provide operation and maintenance data for incorporation into Operating and Maintenance Manual specified elsewhere in Specification.
 - 1.06.3 Final copies of the Operation and Maintenance Manual shall be provided to and approved by the Owner before training is given.
 - 1.06.4 Organise Operation and Maintenance Manual as follows:
 - 1.06.4.1 Cover sheet showing project name, Division 25 BAS Contractor name, Owner
 - 1.06.4.2 Table of Contents
 - 1.06.4.3 List of Contractors, Subcontractor(s) and Manufacturer's representatives including name, address and email address and emergency phone number
 - 1.06.4.4 Organise Operation and Maintenance Manual by Specification Section.
 - 1.06.4.5 Place all tests, certificates, permits, training signoffs in the corresponding tab of the consolidated O&M Manual for the Work
 - 1.06.4.6 Complete set of checked Shop Drawings. Include Owner's Shop Drawing letters and any alterations to the Shop Drawings called up by these letters
 - 1.06.5 Operational data:
 - 1.06.5.1 Description of each system and its controls
 - 1.06.5.2 Description of operation of each system at various loads together with reset schedules and seasonal variances
 - 1.06.5.3 Operation instructions for each system and component
 - 1.06.5.4 Description of actions to be taken in event of equipment failure
 - 1.06.5.5 Valves Schedule and flow diagram shall be marked on "As-Built" Drawings
 - 1.06.5.6 Colour coding chart
 - 1.06.6 Maintenance data:
 - 1.06.6.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment
 - 1.06.6.2 Data to include schedules of tasks, frequency, tools required and task time
 - 1.06.7 Performance data:
 - 1.06.7.1 Equipment Manufacturer's performance data sheets with point of operation as left after installation and commissioning is complete
 - 1.06.7.2 Equipment performance verification test results
 - 1.06.7.3 Special performance data as specified elsewhere
 - 1.06.8 Submittal of Operation and Maintenance Manuals for approval:

- 1.06.8.1 Submit a complete digital copy of draft Operation and Maintenance Manual to Owner for approval. Submission of individual data shall not be accepted unless so directed by Owner.
- 1.06.8.2 Make changes as required and re-submit digital copies as directed by Owner.
- 1.06.9 Additional data:
 - 1.06.9.1 Prepare and insert into Operation and Maintenance Manual when need for same becomes apparent during demonstrations and instructions specified above.
 - 1.06.9.2 Include MSDSs for each product supplied on the project (e.g., boiler chemicals).
- 1.07 Operations Manual Requirements**
 - 1.07.1 Provide final version of the Operating and Maintenance Manuals (described in 25 00 78) electronically, each containing all Division 25 BAS Contractor's and Equipment Suppliers' names and telephone numbers, data sheets, valve charts, equipment charts if changes to equipment are made, brochures, operating, maintenance and lubricating instructions as well as number coded wiring diagrams and a complete set of reviewed Shop Drawings prior to providing Demonstration and Training. Present to the Owner for review in ample time for use during Demonstration and Training.
 - 1.07.2 The Division 25 BAS Contractor shall provide at his cost, two (2) digital sets of all the standard Manufacturer's hardware and software programming and Front End manuals for all control system devices, devices and the Front End equipment. The Division 25 BAS Contractor shall provide digital versions of all equipment servicing, Programmer's and Operating and Maintenance Manuals used by factory trained personnel or Division 25 BAS Contractor's staff for the equipment installed.
 - 1.07.3 Division 25 BAS Contractor shall provide all manual updates and Applications Notes relevant to the installation during the warranty period.
 - 1.07.4 The Division 25 BAS Contractor shall also create supplementary operations Manuals to reflect any customization and unusual design of control system and Front End not covered by the standard factory Manuals.
 - 1.07.5 Describe in concise terms in the Working Language, all functional and operational requirements for the system. It shall not require knowledge of binary processor programming, electronic techniques, or control system theory to understand the description.
 - 1.07.6 Include complete guidance and procedures for operation of the system. Provide step-by-step instructions for system start-up, back-up equipment operation and execution of all system functions and operating modes.
 - 1.07.7 Hardware and software functions, interfaces and requirements shall be explicitly detailed for all system components in all system functions and operating modes. Person-machine interactions shall be functionally described.
 - 1.07.8 Document the theory, design, interface requirements, and functions of all software modules and systems for Front End and all BAS devices. This shall include test and verification procedures and detailed description of program requirements and capabilities. Provide all data necessary to permit modification, relocation, or other reprogramming and to permit combination of new and existing software modules to respond to changing system functional requirements without disrupting normal system operation.
- 1.08 Maintenance Manual Requirements**
 - 1.08.1 The Division 25 BAS Contractor shall include all information required to service and maintain all control system and server hardware and software in optimum operating condition.
 - 1.08.2 The Division 25 BAS Contractor shall provide four (4) copies of a site specific, customized digital Maintenance Manual electronically. Division 25 BAS Contractor shall supplement the Manual with standard or factory supplied material.
 - 1.08.3 Provide detailed documentation on:
 - 1.08.3.1 Theory of BAS operation, design philosophy and specific functions of the BAS.
 - 1.08.3.2 Full details of network communications, how data is stored on the network, the function of system gateways to BACnet Interface Devices or node controllers.
 - 1.08.3.3 Operator test or self-test of all system components and computer peripherals during each function and operating mode.
 - 1.08.4 This Manual shall be organized by HVAC or building system and shall as a minimum, detail:
 - 1.08.4.1 Safety precautions
 - 1.08.4.2 Service schedules
 - 1.08.4.3 Preventive maintenance procedures

- 1.08.4.4 Fault diagnosis procedures
- 1.08.4.5 Over-ride control on component failure
- 1.08.4.6 Re-calibration procedures
- 1.08.4.7 Components replacement procedures
- 1.08.4.8 Re-commissioning procedures

1.09 Manufacturer's Technical Data Requirements

- 1.09.1 Submittals for each manufactured item shall contain Manufacturer's equipment Specification sheet, equipment Drawings, schematic diagrams, performance or characteristic curves and catalogue cut sheets. The manufacturer's name, Trade name, catalogue model or number, nameplate data, size, layout dimension, capacity, and any other information necessary to establish contract compliance shall be included.
- 1.09.2 Information shall be submitted for all material, equipment and software the Division 25 BAS Contractor proposes to furnish for accomplishment of the Work.

1.10 Documentation Requirements

- 1.10.1 All documentation shall be site specific, i.e., containing information relevant to the Work.
- 1.10.2 Arrange Submittals in the same sequence as these Specifications and reference the particular Specification provision for which each Submittal is intended.
- 1.10.3 Four (4) copies of all documentation for each site shall be supplied electronically.
- 1.10.4 The electronic document shall be fully indexed. The electronic document shall also contain a comprehensive index in the documentation package.
- 1.10.5 One (1) complete set of documentation for each site shall be furnished to the Owner at least three (3) weeks prior to training sessions, and system and equipment tests, and the remaining sets of documentation shall be furnished prior to the commencement of the third training session. Piecemeal Submittal of data is not acceptable and shall not be reviewed by the Owner.
- 1.10.6 The final documentation packages shall include:
 - 1.10.6.1 Digital copies of the Owner's existing Drawings marked up to show As-Built conditions.
 - 1.10.6.2 The Division 25 BAS Contractor shall provide soft copies of all AutoCAD™ Drawings.
- 1.10.7 The Certificate of Total Completion shall not be given until all documentation required is satisfactorily provided.

1.11 As-Built Drawing Requirements

- 1.11.1 Keep a record set of Drawings on the site at all times recording any changes that occur. Submit these Drawings to the Owner upon completion of the Work. As-builts shall include circuiting and dimensions of cable from walls where buried. The Division 25 BAS Contractor shall assume all costs to have all changes transferred to AutoCAD™ As-Builts in a clear and legible manner.
- 1.11.2 Building layout Drawings shall show all sensor locations, field device junction box and pull box locations, and alarm and monitoring stations. All main conduit runs shall be shown diagrammatically. The size and fill details shall be shown in diagrammatic form and amended to reflect the "As-Built" conditions.
 - 1.11.2.1 Provide original B-size (11" x 17") drawing and soft copies of AutoCAD™ file(s) for all Drawings for the Work.
 - 1.11.2.2 Drawings shall fully illustrate and describe the entire installation, showing location of each of the following:
 - 1.11.2.2.1 All pieces of equipment connected into the system (show as-installed device layout)
 - 1.11.2.2.2 All terminal blocks (show the number of cable(s) or wire pairs between interconnected pieces of equipment, including terminal boards)
 - 1.11.2.2.3 Riser block diagram for each building
 - 1.11.2.2.4 Floor plan for each building
 - 1.11.2.2.5 System plan block diagram
 - 1.11.2.2.6 Zones served by AHUs, boilers, fan coils, refrigeration compressors, etc.
 - 1.11.2.3 Provide an As-Built schematic of circuit piping layouts (hot water, steam, glycol, etc.) complete with the BAS inputs and outputs for the entire building including makeup water connections, hand valves, gauges, drains, etc. Unless piping and valve changes are part of the Work, the Drawing need not show the layout of the piping after it leaves the boiler or mechanical room. Drawing does not have to be to scale.

- 1.11.2.4 Identify details by reference to sheet and detail numbers shown on schematics
 - 1.11.2.5 Provide date of issuance and initials of person(s) preparing schematics
 - 1.11.2.6 List terminal board identification: Provide a directory for all terminal boards describing the following for all points on the board:
 - 1.11.2.6.1 Point number
 - 1.11.2.6.2 Cable or wire code (pair colour, cable or wire number, etc.)
 - 1.11.2.6.3 Equipment name and equipment location connected to the cable or wire pair
 - 1.11.2.7 Submit a Certificate of Inspection from the local Inspection Authority upon completion of Work and include with Operating and Maintenance Manual.
 - 1.11.3 Include copies of device wiring diagrams as they appear in the field.
 - 1.11.4 System block diagrams shall identify all equipment interfaces and modules, including all modification and/or interfacing to the existing electric or electronic systems.
 - 1.11.5 Points List Submittals shall identify points by device, I/O number, type of signal and range, name, connected device (model or catalogue number), and mechanical system.
 - 1.11.6 Control program listings shall contain flow charts for each typical algorithm as well as a complete description of Control Sequences in lay person's terms.
 - 1.11.7 A single line drawing of all power distribution and communications lines to control equipment and Level 0 devices shall be included.
- 1.12 Special Tools and Spare Parts**
- 1.12.1 Provide spare parts, special tools, components, etc. to the Owner according to Table 1. Division 25 BAS Contractor is not required to provide spare parts for sensor and actuators provided by others in the Work.

TABLE 1 : SPECIAL TOOLS & SPARE PARTS

SPARE PART	WHERE REQUIRED
One spare set of fuses	For any equipment provided under the Work.
One spare set of MOVs (if used in the Work) or other lightning protection equipment	For each Binary Output provided under the Work and for each BAS device network connection.
One spare transducer	For each type provided under the Work. Provide module for transducer if required by the design of the board.
One spare sensor	For each type provided under the Work.
One spare non-BAS device (LLS, aquastat, CT, CSR, AFS, endswitch, patch cable)	For each type provided under the Work.
One spare damper actuator	For each model type provided under the Work.
One spare valve body and actuator	For each model and size type provided under the Work.
One spare terminal equipment controller	For each model and size type provided under the Work.
One spare BAS controller board module	The equivalent of two 8 x8 universal input and universal output boards for each controller type provided under the Work. Provide additional to meet the Division 25 BAS Contractor's modules are AI, AO, BI, BO modules so as to be equivalent to universal input/output boards. All spare modules shall have the built-in HOAs and potentiometers.
One spare set of BAS tub or thermostat cover keys	For each key provided under the Work.
One spare set of special tools (thermostat adjustment tool)	For each special tool provided under the Work.

1.13 Access To Spare Parts for BAS Devices

- 1.13.1 Parts stock availability shall be guaranteed for the equipment proposed for a minimum of seven (7) years from the date of Total Completion. Provide a signed letter from an authorized agent of the Control System Manufacturer confirming same.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 00 79 INTEGRATED AUTOMATION – GENERAL REQUIREMENTS – DEMONSTRATION & TRAINING

1 - GENERAL

1.01 Related Sections

- 1.01.1 Division 01 - Submittal Procedures
- 1.01.2 Division 01 - Closeout Submittals
- 1.01.3 Division 01 - Demonstration and Training

1.02 Training Requirements

- 1.02.1 Instruct the Owners in all aspects of the operations of systems and equipment.
- 1.02.2 Provide training to cover operation of the building BAS and the software procedures to allow the Owner's personnel to add, modify, or create points, BAS loops, graphics or energy management programs. The instruction shall consist of both hands-on and classroom training at the project site. Training shall include a "Question Period" at the close of each session.
- 1.02.3 Supply tools, spare parts (if listed in 25 00 78), equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- 1.02.4 Manufacturers shall provide demonstrations and instructions on all equipment and materials.
- 1.02.5 Use final version of Operating and Maintenance Manual, "As-Built" Drawings, audio visual aids, etc. as part of instructional materials. Owner's training shall not start until these documents are completed and shall be completed just prior to the Certificate of Total Completion being granted.
- 1.02.6 Division 25 BAS Contractor commissioning and assistance provided to the Owner during the trial usage period shall not count as training time.
- 1.02.7 Commissioning and time spent with Division 25 BAS Contractor's staff by Owner's personnel shall not substitute for nor count as training. Owner's personnel shall be allowed to participate in the commissioning process.
- 1.02.8 Obtain Owner's acceptance of instruction in writing after instructions to Owner is completed.

1.03 Instructor Qualifications

- 1.03.1 The Division 25 BAS Contractor shall provide competent instructors who shall give full instruction to the Owner's designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and systems specified, with emphasis on:
 - 1.03.1.1 How to use and find information in documentation
 - 1.03.1.2 System operational procedures for all modes of operation including: warm-up, cool-down, emergency, seasonal change-over, occupied, unoccupied, etc.
 - 1.03.1.3 Acceptable tolerances for system adjustment in all operating modes
 - 1.03.1.4 Procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response
 - 1.03.1.5 Troubleshooting procedures to deal with equipment malfunction or failure
- 1.03.2 Arrange and pay for services of Manufacturers' representatives required for instruction on specialized portions of the installation, maintenance and/or operation.
- 1.03.3 Owner shall have the right to approve or reject the instructors based on their qualifications.
- 1.03.4 Division 25 BAS Contractor shall permit the Owner to videotape the training sessions for the Owner's internal use such as training new employees.

1.04 Training Plan

- 1.04.1 Submit the training plan for approval by the Owner thirty (30) days prior to the first scheduled training session. The plan shall cover:
 - 1.04.1.1 Proposed curriculum and teaching methods.
 - 1.04.1.2 Required entering skills. It shall be the responsibility of the Owner to ensure that the trainees have the required entering skills prior to taking the Division 25 BAS Contractor's course.
- 1.04.2 The duration of the training period shall not be less than thirty (30) hours of general instruction, and not less than ten (10) hours of site specific instruction for the Work, and not limited to a consecutive period.

- All training shall take place during normal working hours and shall not exceed seven (7) hours per day. Travel time to sites or place of training shall not be counted as training time.
- 1.04.3 Co-ordinate all sessions with the Owner and/or his representatives. The Owner and/or the Division 25 BAS Contractor shall provide written notification at least three (3) working days prior to cancellation or postponement of the training session.
- 1.04.4 Documentation specified in Section 25 00 78 shall be used as source information for the training sessions.
- 1.04.4.1 Provide a training manual for each trainee, covering in detail the data included in each training program, before training shall commence.
- 1.04.4.2 If the Division 25 BAS Contractor wishes to use visual aids such as video tape, slides, overhead, etc. as a part of the training course fulfilment, these visual aids or copies of them shall be made a part of the documentation package for future reference, refresher or retraining.
- 1.04.4.3 Provide training source material for a minimum of four (4) of the Owner's operations personnel at least four (4) weeks prior to start of session.
- 1.04.5 Training courses shall be presented in the form of four (4) sessions. Each session shall be of equal length.
- 1.04.6 The first session shall occur prior to the start of the system test for Substantial Completion. This course shall all include but not be limited to the following:
- 1.04.6.1 System architecture
- 1.04.6.2 Equipment operation
- 1.04.6.3 Introduction to programming
- 1.04.6.4 System communication protocol
- 1.04.6.5 BACnet overview
- 1.04.6.6 System names
- 1.04.6.7 Report generation
- 1.04.6.8 Maintenance management
- 1.04.6.9 Energy management
- 1.04.6.10 Changing setpoints
- 1.04.6.11 Changing schedules
- 1.04.6.12 Alarm management
- 1.04.7 The second session shall start immediately after the start of Substantial Completion and shall include but not be limited to the following:
- 1.04.7.1 Preventive maintenance of all system components
- 1.04.7.2 Calibration of all sensors and controls
- 1.04.7.3 Programming of system equipment (BAS and Front End)
- 1.04.7.4 Additional system features
- 1.04.7.5 Troubleshooting
- 1.04.7.6 Abnormal and emergency condition procedures
- 1.04.8 The remaining two (2) sessions will occur at two (2) months and four (4) months after the second session. These sessions shall be designed to address the Owner's requirements. Co-ordinate course curriculum with Owner. Material shall cover all of the following subjects:
- 1.04.8.1 OCL programming: editing, saving, reloading, composition and implementation
- 1.04.8.2 Colour Graphic Generation: creation, file management and installation
- 1.04.8.3 Operational Skills: setpoint modification, graphic interrogation, menu manipulation, file interrogation, alarm management, and controller communications
- 1.04.8.4 Front End system: Level 0 hardware and Operator software language functions
- 1.04.8.5 Calibration and preventive maintenance of field equipment
- 1.04.8.6 Troubleshooting
- 1.04.9 All training shall be clearly documented on a daily basis, detailing number of hours of instruction, material covered, trainees' names and instructor(s') name. At the end of each training day, this information shall be authorized by the Owner's designated representative and by the Division 25 BAS Contractor.
- 1.04.10 Upon completion of each session of training, the Division 25 BAS Contractor shall provide the Owner with a written statement, signed by the Owner, indicating that the training outlined by this Specification has been fulfilled to the satisfaction of the Owner.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 05 01 INTEGRATED AUTOMATION – COMMON WORK RESULTS – GENERAL

1 - GENERAL

1.01 General Conditions

- 1.01.1 The Specification shall be read as a whole by all parties concerned. Sectioning of the Specification is for convenience only; each section may contain less or more than the completed Work of any Trade. The Division 25 BAS Contractor is solely responsible to understand the scope of Work, and make clear to other Contractors and Subcontractor(s) the extent of their Work in this Section.
- 1.01.2 Sections of these Specifications are not intended to delegate functions or to delegate Work and supply to any specific Trade. The Work shall include all labor, materials, equipment and tools required for a complete and working installation as described in the Drawings and these Specifications.

1.02 General Requirements

- 1.02.1 Provide all remote sensing points and instruments as indicated and/or required for a fully functional BAS that meets the Specification requirements.
- 1.02.2 All equipment shall be installed according to Manufacturers' instruction by factory trained journeymen.
- 1.02.3 All employees and Subcontractors of the Division 25 BAS Contractor must follow and abide by all rules and regulations set forth by local Workplace Safety and Health authorities.
- 1.02.4 See Section 25 00 11 for more details on general installation requirements.
- 1.02.5 BAS devices shall use English units in calculations, displays, etc. Selection of units on a point by point basis shall be at the Owner's discretion. Verify requirements with Owner before assignment of units.

1.03 Contract Drawings and Site Examination

- 1.03.1 Examine the Mechanical Drawings to ensure that the Work under this Contract can be satisfactorily carried out. Report any discrepancies to the Owner prior to submission of Bid.
- 1.03.2 Any Drawings supplied by the Owner are performance Drawings, are diagrammatic in nature and are intended to convey the scope of Work and to indicate general arrangement and approximate location of apparatus, fixtures and pipe runs. The Drawings do not intend to show architectural and structural details.
- 1.03.3 Do not scale Drawings. Obtain accurate dimensions by site measurement.
- 1.03.4 Not all required offsets, fittings and accessories are shown in the Drawings. Investigate structural and finish conditions affecting this Work and arrange Work accordingly, providing such fittings, valves and accessories required to meet the conditions. Conserve head room and interfere as little as possible with the free use of space. Report any issues of concern to the General Contractor in writing.
- 1.03.5 Examine the site and local conditions, and verify that the supplied equipment is suitable for its intended use in the new construction.
- 1.03.6 Visit and inspect the site of the Work to verify location and elevation of existing services which affect Work of this Contract (water, electrical, sanitary, ductwork, etc.) before proceeding with Work.

1.04 General Installation Requirements

- 1.04.1 Include in the Work all requirements of Manufacturers' devices as shown on the Shop Drawings.
- 1.04.2 Install all equipment and apparatus regarding wiring, maintenance, adjustment or eventual replacement with due allowance therefore.
- 1.04.3 Replace all Work unsatisfactory to the Owner without extra cost.
- 1.04.4 Terminations shall use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- 1.04.5 Leave space clear and install all Work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or materials supplied by other Trades. Verify spaces in which Work shall be installed. Install pipe runs etc., to maintain maximum headroom and clearances, and to conserve space in shaft and ceiling spaces.
- 1.04.6 Ensure that all equipment, fixtures and devices requiring normal maintenance and/or cleaning are mounted such that they are fully serviceable. Provide necessary isolation, access doors, union type fittings and the like to facilitate service work.
- 1.04.7 Protect BAS devices or other equipment from sprinkler damage or from damage when equipment needs to be drained for servicing.

- 1.04.8 Electrical outlets, switches or other electrical equipment shall be moved to any point within a ten (10) foot radius when relocation is requested by the Owner before the Work has been substantially completed, without additional cost.
- 1.04.9 Branch circuit wiring shall be installed with circuits arranged exactly as shown on the Drawings. Cable runs shall be modified to suit the installation.
- 1.04.10 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- 1.04.11 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- 1.04.12 All equipment, installation, and wiring shall comply with acceptable industry Specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
- 1.04.13 All BAS devices, transducers and relays shall be installed in approved enclosures.
- 1.04.14 All field devices shall be properly calibrated and tested for performance and accuracy.
- 1.04.15 Alter the locations of materials and/or equipment that do not necessitate additional material as directed at no additional cost.
- 1.04.16 All hardware, interface and junction boxes shall be installed so they are easily accessible for maintenance. Hardware etc. that is installed in locations the Owner deems to be unsafe or inaccessible shall be relocated at the Division 25 BAS Contractor's expense.
- 1.05 **Integration of Stick Built, Networked and Aux Contact BACnet Interface Devices**
 - 1.05.1 See Sections 25 09 23.21.23 to 25 20 28.31.11 inclusive for Work responsibilities for BACnet Device Integration on equipment provided by others.
- 1.06 **Manufacturers' Instructions**
 - 1.06.1 Unless otherwise indicated in the Drawings and Specifications, install or erect products in accordance with Manufacturers' instructions.
 - 1.06.2 Notify Owner in writing of any conflict between Manufacturers' instructions and Contract Documents. Owner shall designate which document shall be followed.
 - 1.06.3 Improper installation or erection of products due to failure in complying with these requirements authorizes the Owner to require removal and re-installation at no increase in Bid Price.
- 1.07 **Workmanship**
 - 1.07.1 Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Division 25 BAS Contractor shall immediately notify the Owner if required Work is such as to make it impractical to produce required results.
 - 1.07.2 Install equipment, ductwork, conduit, cables and piping in a manner to present a neat appearance and to function properly to the acceptance of the Owner.
 - 1.07.2.1 Install cable runs parallel and perpendicular in chases, behind furring or above ceilings.
 - 1.07.2.2 Install ducts and pipes parallel and perpendicular to building planes.
 - 1.07.2.3 Install piping and ductwork concealed in chases, behind furring or above ceiling.
 - 1.07.2.4 Install exposed system neatly and group to present a neat appearance.
 - 1.07.3 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Owner, whose decision is final and binding on the Division 25 BAS Contractor.
- 1.08 **Standard Of Material**
 - 1.08.1 Control devices of each category to be of same type and manufacturer.
 - 1.08.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration proof, and heat resistant assembly, as required to suite the application.
 - 1.08.3 Provide new material and equipment of first class quality, delivered, erected, connected and finished in every detail and supplied with the acceptance of the Owner. Assume responsibility of ensuring that equipment provided performs as specified.
- 1.09 **Field Quality Control**
 - 1.09.1 All electrical Work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the National, State and Local codes and laws.
- 1.10 **Installation Of Sensors**
 - 1.10.1 Install gauges, thermostats and BAS sensors to permit easy observance and to guarantee proper sensing of all conditions. Shield elements from direct radiation and avoid placing them behind obstructions.

- 1.10.2 Do not use strap-on sensors if sensor is used to control or monitor a device. Strap-on sensors are only permissible where written permission is given by the Owner or where existing boiler controls are being retained.
- 1.10.3 Install sensors in accordance with the Manufacturer's recommendations.
- 1.10.4 Mount sensors rigidly and adequately for the environment within which the sensor operates.
- 1.10.5 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- 1.10.6 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
- 1.10.7 Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip.
- 1.10.8 Low limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m [10 ft.] of sensing element for each 1m² [10 ft²] of coil area.
- 1.10.9 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
- 1.10.10 Wells for temperature sensing devices shall be installed in the piping at elbows to promote proper liquid flow across the entire surface of the well. Well shall not restrict flow area to less than 70% of normal line size flow area.
- 1.10.11 Sensors shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.
- 1.10.12 Install outdoor air temperature sensors on north wall at designated location. Outdoor installation shall be weatherproof construction in NEMA 12 enclosures. These installations shall be protected from solar radiation and wind effects by stainless steel shields.
- 1.10.13 Differential air static pressure:
 - 1.10.13.1 Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a Pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable), or to the location of the duct high-pressure tap and leave open to the plenum.
 - 1.10.13.2 Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a Pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor as described in the Control Sequences Sections.
 - 1.10.13.3 Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover as described in the Control Sequences Sections.
 - 1.10.13.4 The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - 1.10.13.5 All pressure transducers, other than those controlling VAV boxes, shall be located in field device devices, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
- 1.10.14 All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.
- 1.11 **Equipment Power Protection**
 - 1.11.1 Provide power line filtering for all Level 0 equipment and BAS devices either internally or as an external component.
 - 1.11.2 Provide an Uninterruptible Power Supply (UPS) for all BAS devices. Size UPS to maintain power to all BAS devices during the transfer from commercial to generator power. Power all BAS devices from emergency power circuits. Co-ordinate power requirements with Division 26.
 - 1.11.2.1 The UPS shall be a non-switching double conversion online type of UPS that continuously powers all the BAS devices. Switching UPSs are not allowed in the Work.
- 1.12 **Sprinkler Proof Equipment**
 - 1.12.1 All electrical equipment installed in areas where sprinklers are also installed shall be constructed so that exposure to water from the sprinkler heads shall not impair the effectiveness of the BAS equipment.

- 1.12.2 Sprinkler proof or relocate all BAS devices that are within 3 m [10 ft.] of a backflow preventer, sprinkler head or water relief valve.

1.13 BAS Input and Output Point Installation

- 1.13.1 Provide all inputs and outputs to the BAS as filled out by the Division 25 BAS Contractor in the Hardware Input/Output Object List and as required by the Control Sequences.
- 1.13.2 All BAS devices shall be configured so that all primary input, output and control logic for each major piece of equipment described in the Points List shall be resident within a single BAS device to provide network independent, standalone closed loop control. In no instance shall control programs or I/O points for primary systems be distributed over two (2) or more BAS devices without the express written permission of the Owner.

1.14 Non-BAS Equipment Installation

- 1.14.1 Install per Manufacturer's recommendations and Control Sequences.
- 1.14.2 Install Work according to Control Sequences. Provide additional hardware as required to meet the Control Sequences.
- 1.14.3 Division 25 BAS Contractor shall follow Manufacturer's instructions and shall be responsible for the reconnection of all safety devices such as boiler safeties.
- 1.14.4 The Division 25 BAS Contractor shall modify/relocate or arrange for the modification/relocation of existing devices/controls on the AHUs to suit exterior or interior duct insulation. Provide insulation standoffs where required.
- 1.14.5 Commission system to the satisfaction of the Owner following the provisions of Section 25 08 00 and Section 25 08 03. Provide on-site assistance to the Owner during the commissioning process if required to do so by the Owner. Provide eight (8) hours of training to Owner on site on the non-BAS equipment in addition to the training specified elsewhere in this Specification. Provide "As-Built" control Drawings for insertion into the Operating and Maintenance Manual. Provide an electronic copy of all As-Built and Shop Drawings to Owner in editable DWG format. Provide one (1) copy of the final approved version of Control Sequences electronically in editable Word™ format (latest version) to Owner.

1.15 Warranty

- 1.15.1 See Division 01 for details.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

**25 05 05 INTEGRATED AUTOMATION – COMMON WORK RESULTS – DEVICE INTERFACE
INTEGRATION**

1 - GENERAL

1.01 Related Sections

- 1.01.1 Section 01 31 13.13 – BACnet and Other Device Interface Integration
- 1.01.2 Section 23 05 05 – BACnet and Other Device Interface Integration
- 1.01.3 Section 25 00 13 – All Trades Work Responsibilities
- 1.01.4 Section 26 05 05 – BACnet and Other Device Interface Integration
- 1.01.5 Section 28 05 05 – BACnet and Other Device Interface Integration

1.02 General Requirements

- 1.02.1 Division 25 BAS Contractor is responsible for reading all the sections in this Specification as there is Work for this Division 25 BAS Contractor in each section.

2 - PRODUCTS

Not Used

3 - EXECUTION

Not Used

End of Section

25 05 13 INTEGRATED AUTOMATION – COMMON WORK RESULTS – CONDUCTORS & CABLES

1 - GENERAL

1.01 General Conditions

- 1.01.1 Electrical material and installation shall be in accordance with the appropriate requirements of all applicable Sections of the current edition of the National Electrical Code, State and Local codes and regulations and the local Electrical Authority. Refer to Electrical Division for requirements for wiring installation.
- 1.01.2 All IP network cabling Work shall be done by Division 27 in accordance with EIA/TIA 568C.
- 1.01.3 All non-IP network cabling Work shall be done by Division 25 BAS Contractor in accordance with EIA/TIA 568C.
- 1.01.4 All conduit and pathways shall be installed in the Work shall be done accordance with ANSI/TIA/EIA-569B. All Division 25 conduit shall be BLUE. Refer to 25 00 11 for labelling requirements.
- 1.01.5 See Division 26 for additional requirements.
- 1.01.6 Obtain and comply with Manufacturer's installation instructions.

2 - PRODUCTS

Not Used

3 - EXECUTION

3.01 Installation

- 3.01.1 Refer to Division 26.

End of Section

25 05 26 INTEGRATED AUTOMATION – COMMON WORK RESULTS – GROUNDING & BONDING

1 - GENERAL

1.01 General Conditions

- 1.01.1 Electrical material and installation shall be in accordance with the appropriate requirements of all applicable Sections of the current edition of the National Electrical Code, State and Local codes and regulations and the local Electrical Authority. Refer to Electrical Division for requirements for wiring installation.
- 1.01.2 All IP network cabling Work shall be done by Division 27 in accordance with EIA/TIA 568C.
- 1.01.3 All non-IP network cabling Work shall be done by Division 25 BAS Contractor in accordance with EIA/TIA 568C.
- 1.01.4 All conduit and pathways shall be installed in the Work shall be done accordance with ANSI/TIA/EIA-569B. All Division 25 conduit shall be BLUE. Refer to 25 00 11 for labelling requirements.
- 1.01.5 See Division 26 for additional requirements.
- 1.01.6 Obtain and comply with Manufacturer's installation instructions.

2 - PRODUCTS

Not Used

3 - EXECUTION

3.01 Installation

- 3.01.1 Refer to Division 26.

End of Section

25 05 28 INTEGRATED AUTOMATION – COMMON WORK RESULTS – PATHWAYS

1 - GENERAL

1.01 General Conditions

- 1.01.1 Electrical material and installation shall be in accordance with the appropriate requirements of all applicable Sections of the current edition of the National Electrical Code, State and Local codes and regulations and the local Electrical Authority. Refer to Electrical Division for requirements for wiring installation.
- 1.01.2 All IP network cabling Work shall be done by Division 27 in accordance with EIA/TIA 568C.
- 1.01.3 All non-IP network cabling Work shall be done by Division 25 BAS Contractor in accordance with EIA/TIA 568C.
- 1.01.4 All conduit and pathways shall be installed in the Work shall be done accordance with ANSI/TIA/EIA-569B. All Division 25 conduit shall be BLUE. Refer to 25 00 11 for labelling requirements.
- 1.01.5 See Division 26 for additional requirements.
- 1.01.6 Obtain and comply with Manufacturer's installation instructions.

2 - PRODUCTS

Not Used

3 - EXECUTION

3.01 Installation

- 3.01.1 Refer to Division 26.

End of section

25 05 53 INTEGRATED AUTOMATION – COMMON WORK RESULTS – IDENTIFICATION

1 - GENERAL

1.01 General Conditions

- 1.01.1 All devices and equipment, whether installed by the Division 25 BAS Contractor or existing, that is used for monitoring or control by the BAS, shall be clearly identified by a permanently attached label, tag or nameplate as specified below. Locate identification in a conspicuous location.
- 1.01.2 Each inscription shall be in the Working Language, identifying the device type, point number and corresponding zone it controls. All labelling shall be consistent with the naming convention and methods approved by the Owner via the Shop Drawing process.
- 1.01.3 No labelling (hardware and software) shall begin until approved by the Owner.

2 - PRODUCTS

2.01 Labels

- 2.01.1 Labels shall be embossed plastic with 6 mm [$\frac{1}{4}$ in] high letters unless specified otherwise. Allow for an average of twenty-five (25) letters per label.

2.02 Tags

- 2.02.1 Provide brass or lamacoid numbered tags, 32 mm [$1\frac{1}{4}$ in] diameter with stamped numbers secured by brass jack chains, brass "S" hooks or one piece nylon ties around the valve stem on all valves that are controlled by the BAS. Rectangular waterproof luggage style tags are an acceptable alternate. Prepare an approved list detailing the valve location, tag numbers and purpose it serves. Mount one (1) copy of this list in a glazed frame where advised by the Owner and provide additional copies for the Operating and Maintenance Manuals.

2.03 Nameplates

- 2.03.1 Nameplates shall be engraved plastic laminate with bevelled edges, either screwed or riveted in place in accordance with the Contract Documents.
- 2.03.2 Lamacoid shall consist of a 3 mm [$\frac{1}{8}$ in] thick plastic engraving sheet with a white face and a black core.

NAMEPLATE SIZES	DIMENSIONS	LINES	LETTER HEIGHT
Size 1	10 mm x 50 mm	1	3 mm
Size 2	12 mm x 70 mm	1	5 mm
Size 3	12 mm x 70 mm	2	3 mm
Size 4	20 mm x 90 mm	1	8 mm
Size 5	20 mm x 90 mm	2	5 mm
Size 6	25 mm x 100 mm	1	12 mm
Size 7	25 mm x 100 mm	2 lines	6 mm high letters

2.04 Naming Conventions

- 2.04.1 Use device identification that is consistent with the established naming conventions at the Place of Work. Co-ordinate identification of equipment and systems supplied by other Divisions to ensure that identical naming conventions are used.
 - 2.04.1.1 The BAS Device Object Name system network shall support up to a 16 character Object Name consisting only of ASCII printable characters. The convention to be used for all Device Object Names is as follows:
 - 2.04.1.1.1 Object Name format shall be in the form of LCB#-AAAAAANN where "A" designates a CAPITAL alphanumeric character, "a" designates an upper and lower case name and "N" is a digit from 0 to 9.

- 2.04.1.1.2 The LCB# followed by a dash “-” designate the three digit Lake Co Building Number. If less than three digits are used, the front of the Lake County Building Number shall be padded with leading zeroes.
- 2.04.1.1.3 BAS panels that are general purpose controllers shall use the name of the device such as G5, NAE or SC, followed by a two or three digit code for the instance of the device in the facility.
- 2.04.1.1.4 Controllers that are specific to a piece of equipment like a VAV box shall carry the VAV tag and not the BAS Division 25 BAS Contractor’s name.
- 2.04.2 The BAS device system network shall support up to a 40 character Object Name consisting only of ASCII printable characters. The convention to be used for all Object Names is as follows:
 - 2.04.2.1 Object Name format shall be in the form of LCB#-AAAAAANN-SSSSSSNN-aaaaaaaaaaaaaaaa where “A” designates a CAPITAL alphanumeric character, “a” designates an upper and lower case name and “N” is a digit from 0 to 9 Names shall follow the convention of FACILITY-SYSTEM-SUBSYSTEM-Point (FSSP) naming method. The underscore character is not allowed in the FACILITY-SYSTEM-SUBSYSTEM components.
 - 2.04.2.1.1 The LCB# followed by a dash “-” designate the three digit Lake Co Building Number. If less than three digits are used, the front of the Lake County Building Number shall be padded with leading zeroes.
 - 2.04.2.1.2 The next six alphanumeric characters AAAAAA followed by a dash “-”, designate the equipment or system name. No spaces are allowed in the equipment/system name; however the name length may be shortened as required to no less than three alphanumeric characters, such as VAV or AHU.
 - 2.04.2.1.3 The three digits NNN followed by a dash “-” designate the System Number. If less than three digits are used so long as there are not more than 99 devices in the facility. AHUs are normally only two digits whereas VAVs are three digits
 - 2.04.2.1.4 The next set of characters designate the subsystem name and number. An example of this is a VFD that is a component of an AHU.
 - 2.04.2.1.5 The final set alphanumeric characters aaaaaaaaaaaaaa designate the device or sensor connected to that system that is usually the name provided by the BACnet Interface Device from either the Division 25 BAS Contractor or the Equipment Supplier. The name length may be shortened as required. There are no restrictions on the character set so long as the ?, * and other top keyboard row characters are not used. Only Space and underscores are allowed. Part of the name may be the Consultant’s Drawing tag for the device such as MDP for Main Distribution Panel.
 - 2.04.2.1.6 An example of this is “063-AHU01-VFD027-BACnetDeviceName”.
- 2.04.3 This naming convention applies to all objects provided by the Division 25 BAS Contractor as well as to all objects that are mapped from the BACnet devices provided by others in the Work.
- 2.04.4 These object names shall be used in Front End applications such as graphics, reports, and alarms or wherever an object name is appropriate in lieu of the object name property in the remote device. Permit an Operator to display, at any time, the mapping between the object name used on the Front End and the object name property used in the remote BACnet device.
- 2.04.5 The Object Name and the Description may have the same name.
- 2.04.6 If the Division 25 BAS Contractor’s panel does not support a maximum 32 character object name, map all third party object types to a BAS panel that does support this requirement.
- 2.04.7 If the Division 25 BAS Contractor’s panels such as those used for VAV box controllers, have the same names in every panel, the Division 25 BAS Contractor shall add the LCB#-AAAAAANN-SSSSSSNN prefix in front of the panel point names so all points are uniquely identified on the Lake County BACnet internetwork.
 - 2.04.7.1 An example of this is 063-VAV027-DischargeAirTemp.

2.05 Numbering Conventions

- 2.05.1 Device Object Instance Numbers shall have the following components:
 - 2.05.1.1 NNN for the Division 25 BAS Contractor’s ASHRAE BACnet Vendor ID.
 - 2.05.1.2 NNN for the Facility Code assigned by Lake County.
 - 2.05.1.3 NNN for the device instance in the building. The first device is 01 or 001.

2.05.2 BACnet five digit Numbers shall have the following components:

- 2.05.2.1 N for the Division 25 BAS Contractor's identification. Trane is 2. ALC is 4. JCI is 5.
- 2.05.2.2 Other vendors may use their ASHRAE BACnet Vendor ID.
- 2.05.2.3 NN is the two digit Facility Code.
- 2.05.2.4 N or NN is the network instance in the building.
- 2.05.2.5 Since the network number is limited to 5 characters and BACnet Vendor IDs now exceed 1000, the Lake County BAS Consultant reserves the right to alter the network numbers to suit the facility.

2.06 Identification Conventions

- 2.06.1 Co-ordinate with equipment identification systems defined in other Divisions of the Specification.
- 2.06.2 Provide apparatus (including electric motors) with proper nameplates affixed thereto, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase and horsepower of motors and the name of the Manufacturer and his address.
- 2.06.3 Identify all new and reused devices, sensors etc. Use lamacoid plastic plates of an approved size complete with bevelled edges having engraved white 3 mm [1/8 in] letters on black background giving the name of the equipment or equipment service and its number, e.g., "Main Circulating Pump P-1", "Radiation Valve V-1". Fix to equipment using pop rivets or sheet metal screws. Stick-on nameplates of any type are not acceptable under any circumstances.
- 2.06.4 Identify all conduits, cable junction boxes and pull boxes in the colour assigned by the Owner.
- 2.06.5 Identify locations of all control devices installed in the ceiling space on the T-bar or access door directly below it, with a dot or star in the Division 25 BAS Contractor's corporate colours.

2.07 Panel Identification

- 2.07.1 Each control device cabinet shall be identified using a Size six (6) lamacoid label.
- 2.07.2 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics
- 2.07.3 Identify equipment with Size three (3) labels engraved "ASSET INVENTORY No. []". Number as directed by the Owner.
- 2.07.4 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- 2.07.5 Terminal cabinets and pull boxes: indicate system and voltage.
- 2.07.6 Transformers: indicate capacity, primary and secondary voltages.
- 2.07.7 Provide apparatus (including electric motors) with proper nameplates affixed thereto, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase and horsepower of motors and the name of the Manufacturer and his address.
- 2.07.8 Identify all new and reused devices, sensors etc. Use lamacoid plastic plates of an approved size complete with bevelled edges having engraved white 3 mm [1/8 in] letters on black background giving the name of the equipment or equipment service and its number, i.e., "Main Circulating Pump PU-1", "Radiation Valve V-1", "Air Handling Unit AHU-1", "Motor M-1", etc. Fix to equipment using pop rivets or sheet metal screws. Stick-on nameplates of any type are not acceptable under any circumstances.
- 2.07.9 Provide all valves that are new or re-used with brass numbered tags, 16 mm [5/8 in] diameter with stamped numbers secure be chains to the valve. Prepare an approved list detailing the valve location, tag numbers and purpose it serves. Mount one (1) copy of this list in a glazed frame where advised by the Owner and provide additional copies for the Operating and Maintenance Manuals.
- 2.07.10 Stencil on identification approved by Owner complete with flow arrows for all piping installed during the Work.

2.08 Panel Wiring Diagrams

- 2.08.1 Each BAS device shall have a permanent, non-fading, "As-Built" interconnection wiring diagram of the complete field installed system, with properly identified device model and catalogue number of each system component and device and list of the meaning of the alarm and other lights.
- 2.08.2 Clearly identify all I/O address numbers and associated BAS point name on each input and output.
- 2.08.3 The diagram shall be sealed by plastic laminate and affixed to the inside of the field device.
- 2.08.4 All device and junction box terminal strips shall be fully labelled to identify wiring connections.

2.09 **Warning Labels**

- 2.09.1 Warning labels shall use white lettering on a red background on a Size 7 Nameplate.
2.09.2 Affix permanent warning labels to equipment that can be automatically started by the control system.
Warning labels shall read as follows:

CAUTION
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "OFF" position before servicing.

- 2.09.3 Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects. Warning labels shall read as follows:

CAUTION
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3 - EXECUTION

Not Used

End of section

25 06 00 INTEGRATED AUTOMATION – SCHEDULES

SCHEDULE 1 – HARDWARE OBJECT LIST

This Schedule has been provided for the convenience of the Division 25 BAS Contractor. It is not intended to show all the required points, since the Division 25 BAS Contractor's programming and control panel capabilities may require additional points to implement the Control Sequences. The Division 25 BAS Contractor shall review the Control Sequences and add any points necessary to fulfil these requirements.

See the Sections 25 09 23.21.23 to 25 20 28.31.11 sections for references to the Hardware objects to be provided by Division 25 BAS Contractor. The locations and quantities of points are shown on the Drawings.

SCHEDULE 2 – ROOM HVAC DEVICE MATRIX

Not required for this Bid.

**SCHEDULE 3 – BACNET SINGLE LINE DIAGRAM AND
RESPONSIBILITY MATRIX (APPLIES TO ALL TRADES)**

The Schedule is attached as a separate item in the Contract Documents.

SCHEDULE 4 – OBJECT NAME ABBREVIATION CONVENTIONS

To be provided to the Division 25 BAS Contractor prior to the Controls Co-ordination meeting referred to in this Division 25 Specification.

End of Section

25 08 00 INTEGRATED AUTOMATION – CONTROLS COMMISSIONING

1 - GENERAL

1.01 Summary

1.01.1 Section Includes:

1.01.1.1 Methods and procedures for start-up, verification and commissioning of all control system components and systems and includes:

- 1.01.1.1.1 Start-up testing and verification of systems
- 1.01.1.1.2 Check out demonstration or proper operation of components
- 1.01.1.1.3 On-site operational tests

1.01.1.2 Related Sections

- 1.01.1.2.1 Section 01 33 00 – Submittal Procedures
- 1.01.1.2.2 Section 01 78 23 – Operations and Maintenance Data
- 1.01.1.2.3 Section 01 79 00 – Demonstration and Training

1.02 Design Requirements

- 1.02.1 Confirm with Owner that Design Criteria and Design Intents are still applicable.
- 1.02.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.03 Submittals

- 1.03.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- 1.03.2 Final Report: submit report to Owner.
 - 1.03.2.1 Include measurements, final settings and certified test results.
 - 1.03.2.2 Bear signature of commissioning technician and supervisor
 - 1.03.2.3 Report format to be approved by Owner before commissioning is started.
 - 1.03.2.4 Revise “As-Built” documentation, commissioning reports to reflect changes, adjustments and modifications to the control systems as set during commissioning and submit to Owner in accordance with Section 25 00 78.
 - 1.03.2.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.04 Closeout Submittals

- 1.04.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Owner before Interim Acceptance in accordance with Section 25 00 78.

1.05 Commissioning

- 1.05.1 Do commissioning in accordance with Section 25 08 00 **and Section 25 08 03.**
- 1.05.2 Carry out commissioning under direction of Owner and in presence of Owner [and Commissioning Manager].
- 1.05.3 Inform, and obtain approval from, Owner in writing at least fourteen (14) days prior to commissioning or each test. Indicate:
 - 1.05.3.1 Location and part of system to be tested or commissioned.
 - 1.05.3.2 Testing/commissioning procedures, anticipated results.
 - 1.05.3.3 Names of testing/commissioning personnel.
 - 1.05.3.4 Correct deficiencies, re test in presence of Owner until satisfactory performance is obtained.
 - 1.05.3.5 Acceptance of tests shall not relieve Division 25 BAS Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
 - 1.05.3.6 Load system with project software.
 - 1.05.3.7 Perform tests as required.

1.06 Completion Of Commissioning

- 1.06.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Owner.

1.07 Issuance Of Final Certificate of Completion

- 1.07.1 Final Certificate of Completion shall not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

2 - PRODUCTS

2.01 Equipment

- 2.01.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- 2.01.2 Instrumentation accuracy tolerances shall be an order of magnitude higher than equipment or system being tested.
- 2.01.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than two (2) months prior to tests.
- 2.01.4 Testing locations to be approved, readily accessible and accurately reflect readings read by the control system sensors.

3 - EXECUTION

3.01 Procedures and Requirements

- 3.01.1 The Division 25 BAS Contractor is responsible for commissioning all new and existing points integrated into the Work.
- 3.01.2 Through the commissioning process, the Division 25 BAS Contractor shall, to the satisfaction of the Owner:
 - 3.01.2.1 Verify the installation, operation and functional performance of BASs hardware and software under the appropriate seasonal conditions, for compliance with design intent and the Contract Documents.
 - 3.01.2.2 Document the data generated by tests and inspections.
 - 3.01.2.3 Verify accuracy and logical organization of Operation and Maintenance Manuals, As-Built Drawings, spare parts, special tools and documentation.
- 3.01.3 A complete static and dynamic commissioning test shall be performed for all hardware and software points at each site, all BAS devices and for all Level 0 devices by the Division 25 BAS Contractor.
 - 3.01.3.1 Static tests: Commissioning tests shall consist of a full range of static tests carried out to verify that all hardware points, software, devices, transducers, all Level 0 devices and other components, function in accordance with the Specifications.
 - 3.01.3.2 Dynamic tests: System performance shall be checked under dynamic conditions which simulate varying load and operating modes, including pre-conditioning, start-up, normal operating, emergency and fail-safe modes, shut-down interlocks and lock-outs defined in the Control Sequences.
- 3.01.4 The Division 25 BAS Contractor shall provide all commissioning test equipment required.
- 3.01.5 The Owner shall be given written notice at least seven (7) days in advance of the dates of all tests. Detail the locations and parts of system(s) being tested, the test procedures proposed and the anticipated results.
- 3.01.6 Acceptance of test procedures outlined in detail in Section 25 08 00 by the Owner shall not relieve the Division 25 BAS Contractor of responsibility for the complete system meeting the requirements of these Specifications after installation.
- 3.01.7 Final acceptance tests shall be performed for individual site(s) and for the BAS as a whole.
 - 3.01.7.1 Upon complete installation of the BAS, the Division 25 BAS Contractor shall start up the system and perform all necessary testing and run diagnostics to ensure proper operation.
 - 3.01.7.2 An acceptance test in the presence of the Owner(s) and/or Lake County BAS Consultant shall be performed.
 - 3.01.7.3 Upon successful completion of these tests and receipt of all documentation, training, etc., the system parts will be accepted for Total Completion and placed under warranty.

- 3.01.8 All testing shall be completed at least fourteen (14) days before system turnover. If any check or test cannot be accomplished for seasonal reasons, lack of occupancy, or for other reasons, this fact shall be noted along with an indication of when the test will be rescheduled.

3.02 Static Commissioning Input and Output Hardware

- 3.02.1 The Division 25 BAS Contractor shall complete the appropriate Commissioning Sheet (see end of this Section) for each hardware point that is added or modified as part of the Work. These Commissioning Sheets shall be completed during the Division 25 BAS Contractor's own testing and verification procedure that is done prior to the request for a Final Inspection. The completed Commissioning Sheets shall then be returned to the Owner for review and approval. The Owner will repeat a random sample (20% minimum) of the tests during the Owner's commissioning procedure to corroborate their accuracy. The Division 25 BAS Contractor shall be present on site with test equipment to repeat a random sample of the commissioning tests. The test procedures shall include the following Work required to complete the Test Sheets:

3.02.1.1 Binary Input (BI) Commissioning Sheet:

- 3.02.1.1.1 BI status shall be verified at the Front End (provided by ALC), local BAS display device and POT for ON status and OFF status.
- 3.02.1.1.2 All binary alarm inputs shall be proven using actual conditions where possible or be jumpered for testing with approval by the Owner at the field device to test for correct notification at the POT and server.

3.02.1.2 Analog Input (AI) Commissioning Sheet:

- 3.02.1.2.1 All temperature sensors shall be verified by conducting an equivalence test using a digital hand-held meter with equal or better accuracy.
- 3.02.1.2.2 Selected temperature sensors chosen by the Owner shall be verified by spraying with a "cold-spray" or other means to ensure response and to test the low temperature alarm condition.
- 3.02.1.2.3 All pressure sensing devices and analog output feedback shall be verified using a device with equal or better accuracy to ensure correct calibration. Calibration must be per Manufacturers' recommendations and to the Owner's satisfaction.
- 3.02.1.2.4 All humidity sensing devices must be verified using a hygrometer with equal or better accuracy to ensure correct calibration. Calibration shall be per Manufacturer's recommendations and to the Owner's satisfaction.
- 3.02.1.2.5 All CTs shall be set to accurately reflect motor status.
- 3.02.1.2.6 All other sensing devices shall be verified using an appropriate device with equal accuracy or better to ensure correct calibration. Calibration shall be per Manufacturer's recommendations and to the Owner's satisfaction.
- 3.02.1.2.7 Adjust span on feedback points so the analog input matches the end device output.

3.02.1.3 Binary Output (BO) Commissioning Sheet:

- 3.02.1.3.1 Status shall be verified at the equipment location. Verification at the Front End (provided by ALC) shall be completed for ON status, OFF status, software DISABLE indicator and OVERRIDDEN indicator.

3.02.1.4 Analog Output (AO) Commissioning Sheet:

- 3.02.1.4.1 AOs shall be tested by sending a command from the POT and server to incrementally stroke the field device from full CLOSED to full OPEN and measuring the signal at the field device. The increments of the test shall be no larger than 10% of output span.
- 3.02.1.4.2 The AO feedback requirement shall also be tested by failing the field device and verifying that the alarm registers.
- 3.02.1.4.3 Each output shall be exercised over the full output capability of the device.
- 3.02.1.4.4 Field device hysteresis shall be measured at a minimum of three (3) output levels for each direction of travel. Output increments shall not exceed 2% of span for this test.

- 3.02.2 Instead of completing the hardware characteristics of each point on the forms, Division 25 BAS Contractor may provide a list and a cutsheet of the sensors, transducers, etc. used in the Work with a cross

reference number on the Commissioning Sheets. For example space temperature sensors are Device A and only the words Device A need to be written on the forms in the appropriate location.

3.03 Static Commissioning BAS Software

- 3.03.1 The Owner shall review the final versions of all BAS software to ensure that the software complies with the Control Sequences in every respect. The Division 25 BAS Contractor shall provide assistance and technical manuals as required.
- 3.03.2 Division 25 BAS Contractor shall allocate sufficient time to review the BAS software with the Owner and shall provide the necessary documentation or other information as required to enable the Owner to conduct a thorough review of the software.
- 3.03.3 The Division 25 BAS Contractor shall provide an electronic copy of the database of each controller. The file(s) can be ASCII .PRN files or in Word or WordPerfect format. Provide software to read the database if required.

3.04 Static Commissioning BAS Device Network and Level 0 Devices

- 3.04.1 Each BAS device shall be checked for compliance with standalone and fail-safe requirements, proper grounding and other features. All features listed in Section 25 13 16 shall be checked and verified by the Division 25 BAS Contractor in the presence of the Owner. Devices that do not pass the standalone tests shall be replaced at no cost to the Owner. In this context, “standalone” means that the device, with the network cable disconnected, shall accurately maintain reference time, continue trending data, maintain communications with any devices connected to it and control the equipment connected to the device.

3.05 Static Commissioning BACnet Interface Devices

- 3.05.1 Each BAS device shall be checked for compliance with standalone and fail-safe requirements, proper grounding and other features. All features listed shall be checked and verified by the Division 25 BAS Contractor in the presence of the Owner. Devices that do not pass the standalone tests shall be replaced at no cost to the Owner. In this context, “standalone” means that the device, with the network cable disconnected, shall accurately maintain reference time, continue trending data, maintain communications with any devices connected to it and control the equipment connected to the device.
- 3.05.2 Prior to full operation, a complete commissioning test shall be performed in the presence of the Owner. The demonstration, having satisfactorily met previously approved Submittals, shall, with the Owner’s approval, allow commissioning of the Front End (provided by ALC).

3.06 Dynamic Commissioning The Work As A Whole

- 3.06.1 With all points enabled and automatically controlled, all systems and associated programs shall operate for seven (7) consecutive days on history/trend logs to verify all types of conditions that occurred in the period.
- 3.06.2 All history/trend logs shall be set up by ALC and shall be submitted to the Owner for review and approval.
- 3.06.3 The Division 25 BAS Contractor shall provide a minimum of seven (7) days’ worth of trend data to verify that the following functions:
 - 3.06.3.1 Optimum start/stop data showing that preheat, purge and precool functions.
 - 3.06.3.2 Reset schedules for setpoints.
 - 3.06.3.3 The coast function.
 - 3.06.3.4 Free cooling during the occupied cycle.
 - 3.06.3.5 Control loop stability.
 - 3.06.3.6 Division 25 BAS Contractor shall provide trend data at intervals and duration specified by the Owner at the start of the dynamic commissioning process to determine that the above Control Sequences functions perform to his satisfaction.
- 3.06.4 This condition of the commissioning process is met when all alarms and system values are appropriate for the defined Control Sequences.
- 3.06.5 The Owner may request that the Division 25 BAS Contractor provide the testing described in 25 13 16 3.04.1 as part of the dynamic commissioning process.
- 3.06.6 Verify Year 2036 Compliance. All equipment provided in the Work shall be tested to meet Year 2036 compliance.

PROJECT NAME: Replacement Project _____ POINT TYPE – BI	
COMMISSIONING COMPLETED BY (Print Name): _____	
Point Name <u>NNN-MMM-</u> Address _____	
Description _____	
COMMISSIONING ITEM	REV'D
Labels: Label attached to termination wire ☐ Yes ☐ No Labels contains: ☐ point name ☐ Address	
Field device conforms to cutsheet # _____ (provide cutsheet or describe below) List Units of Measurement for point (A, ppm) _____. Device operating range from _____ to _____ (e.g., differential pressure) Cut-in value set to _____ (e.g., PIL switch cut in – distance from top of pit). Cut-out value set to _____ (e.g., PIL switch cut out – distance from top of pit).	
Verify alarm condition (Check one): ____ Alarm BI: Trip alarm to check that alarm registers (e.g., sump pump, CO, flood, filter, pressure UPS). ____ Status BI: Check current switch to verify the amperage value is appropriate for the BI trip point and that the BI status trips when the motor starts. Verify that proof follows binary output command (e.g., fan status). ____ Other BI: Describe _____.	
Alarm delay time limit set in software: _____ (e.g., 120 s delay between input transitions).	
Runtime: Runtime set up ☐ Yes ☐ No. Runtime alarm trips at ____ Hours. Runtime Log Maintenance Alarm complete with message text and runtime total is included in the programming Submittal ☐ Yes ☐ No	
Other Hardware Input or Output proof interlock points: Describe Hardware interlock _____. Describe Hardware interlock _____.	
POINT PROGRAMMING, GRAPHICS, TRENDING AND DOCUMENTATION	REV'D
Programming: Point programming completed per Control Sequences ☐ Yes ☐ No Units defined correctly in programming ☐ Yes ☐ No Alarm programming: Soft copy of the status alarm complete with message text and point status is included in the programming Submittal ☐ Yes ☐ No. <i>Software simulation for alarm creation is not acceptable.</i>	
Graphics (Point on Front End) (stroke out device if not applicable):: Floor plan graphic ☐ Yes ☐ No Equipment graphic ☐ Yes ☐ No Panel graphic ☐ Yes ☐ No	
Trends: Point trend data in panel ☐ Yes ☐ No Point trend data in Front End ☐ Yes ☐ No 144 thirty minute samples set up in panel ☐ Yes ☐ No Trend data point name, if different than original point name to provide average _____ OR _____ (N/A)	
Documentation: Point on Shop Drawings: Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No Point in Control Sequences ☐ Yes ☐ No or Point programming properly documented ☐ Yes ☐ No Field device on Shop Drawings: Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No Field Device cutsheet in O&M manual ☐ Yes ☐ No Confirm Bill of Materials description ☐ Yes ☐ No	
Training: Point function and operation covered during the training courses ☐ Yes ☐ No Client initials _____	
Additional Comments: 	

OWNER'S SIGNATURE _____

AUTHORISED DIVISION 25 BAS CONTRACTOR'S SIGNATURE _____

AUTHORISED LAKE COUNTY BAS CONSULTANT'S SIGNATURE _____

DATE _____

DATE _____

DATE _____

PROJECT NAME: Replacement Project _____ POINT TYPE – AI											
COMMISSIONING COMPLETED BY (Print Name): _____.											
Point Name <u>NNN-MMM-</u> Address _____.											
Description _____.											
COMMISSIONING ITEM											REV'D
Labels: Label attached to termination wire ☐ Yes ☐ No Labels contains: ☐ point name ☐ Address											
Field device conforms to cutsheet # _____ (provide cutsheet or describe below)											
List Units of Measurement for point (A, ppm) _____.											
Device operating range from _____ to _____ (e.g., differential pressure from .1" w. c. to 4" w. c.).											
Verify alarm condition:											
High Alarm limit set to _____ (e.g., alarm may be fixed, reset by season or differential from setpoint).											
Low Alarm limit set to _____ (e.g., alarm may be fixed, reset by season or differential from setpoint).											
Alarm delay time limit set in software: _____ (e.g., 120 s in alarm condition).											
Other Hardware Input or Output proof interlock points:											
Describe Hardware interlock _____.											
Describe Hardware interlock _____.											
ANALOG INPUT TESTING											REV'D
Measured value											
Sensor reading											
Test sensor over entire expected operating range in equal increments. Test hysteresis at extremes and midpoint. Provide at least one day's worth of data for each relative humidity and CO ₂ sensor using a data logger and a trend log for the same period. Use testing equipment with accuracy of at least twice that specified for sensor.											
POINT PROGRAMMING, GRAPHICS, TRENDING AND DOCUMENTATION											REV'D
Programming: Point programming completed per Control Sequences ☐ Yes ☐ No											
Units defined correctly in programming ☐ Yes ☐ No											
Alarm programming: Soft copy of the status alarm complete with message text and point status is included in the programming Submittal ☐ Yes ☐ No. <i>Software simulation for alarm creation is not acceptable.</i>											
Graphics (Point on Front End) (stroke out device if not applicable):											
Floor plan graphic ☐ Yes ☐ No Equipment graphic ☐ Yes ☐ No Panel graphic ☐ Yes ☐ No											
Trends: Point trend data in panel ☐ Yes ☐ No Point trend data in Front End ☐ Yes ☐ No											
144 thirty minute samples set up in panel ☐ Yes ☐ No											
Trend data point name, if different than original point name to provide average _____ OR ____ (N/A)											
Documentation:											
Point on Shop Drawings:											
Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No											
Point in Control Sequences ☐ Yes ☐ No or Point programming properly documented ☐ Yes ☐ No											
Field device on Shop Drawings:											
Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No											
Field Device cutsheet in O&M manual ☐ Yes ☐ No Confirm Bill of Materials description ☐ Yes ☐ No											
Training: Point function and operation covered during the training courses ☐ Yes ☐ No Client initials _____.											
Additional Comments:											

OWNER'S SIGNATURE _____

DATE _____

AUTHORISED DIVISION 25 BAS CONTRACTOR'S SIGNATURE _____

DATE _____

AUTHORISED LAKE COUNTY BAS CONSULTANT'S SIGNATURE _____

DATE _____

PROJECT NAME: Replacement Project _____ POINT TYPE – BO	
COMMISSIONING COMPLETED BY (Print Name): _____.	
Point Name <u>NNN-MMM-</u> Address _____	
Description _____	
COMMISSIONING ITEM	REV'D
Labels: Label attached to termination wire ☐ Yes ☐ No Labels contains: ☐ point name ☐ Address	
Field device conforms to cutsheet # _____ (provide cutsheet or if directly connected to device terminals write "direct connect").	
End device action: ☐ direct acting ☐ reverse acting	
Verify operating conditions: Fail Safe position _____ (e.g., position to which device will fail under loss of control and power). Normal position _____ (e.g., position at which device is set under normal conditions). Able to command point ON and OFF when HOA in Auto position ☐ Yes ☐ No Not able to command point ON or OFF when HOA in Hand position ☐ Yes ☐ No Not able to command point ON and OFF when HOA in OFF position ☐ Yes ☐ No Able to control output via HOA during power loss in panel ☐ Yes ☐ No Hard wired interlocks prevent control by HOA and point commands ☐ Yes ☐ No	
Runtime: Runtime set up ☐ Yes ☐ No. Runtime alarm trips at _____ Hours. Runtime Log Maintenance Alarm complete with message text and runtime total is included in the programming Submittal ☐ Yes ☐ No.	
Other Hardware Input or Output proof interlock points: Describe Hardware interlock _____ Describe Hardware interlock _____	
POINT PROGRAMMING, GRAPHICS, TRENDING AND DOCUMENTATION	REV'D
Programming: Point programming completed per Control Sequences ☐ Yes ☐ No Units defined correctly in programming ☐ Yes ☐ No	
Graphics (Point on Front End) (stroke out device if not applicable): Floor plan graphic ☐ Yes ☐ No Equipment graphic ☐ Yes ☐ No Panel graphic ☐ Yes ☐ No	
Trends: Point trend data in panel ☐ Yes ☐ No Point trend data in Front End ☐ Yes ☐ No 144 thirty minute samples set up in panel ☐ Yes ☐ No Trend data point name, if different than original point name to provide average _____ OR _____ (N/A)	
Documentation: Point on Shop Drawings: Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No Point in Control Sequences ☐ Yes ☐ No or Point programming properly documented ☐ Yes ☐ No Optimum Start/Stop and Schedules in Control Sequences ☐ Yes ☐ No Field device on Shop Drawings: Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No Field Device cutsheet in O&M manual ☐ Yes ☐ No Confirm Bill of Materials description ☐ Yes ☐ No	
Training: Point function and operation covered during the training courses ☐ Yes ☐ No Client initials _____.	
Additional Comments:	

OWNER'S SIGNATURE _____

AUTHORISED DIVISION 25 BAS CONTRACTOR'S SIGNATURE _____

AUTHORISED LAKE COUNTY BAS CONSULTANT'S SIGNATURE _____

DATE _____

DATE _____

DATE _____

PROJECT NAME: Replacement Project _____ POINT TYPE – AO	
COMMISSIONING COMPLETED BY (Print Name): _____.	
Point Name <u>NNN-MMM-</u>	Address _____.
Description _____.	
COMMISSIONING ITEM	REV'D
Labels: Label attached to termination wire ☐ Yes ☐ No Labels contains: ☐ point name ☐ Address	
Field device conforms to cutsheet # _____ (provide cutsheet or describe below) List Units of Measurement for point (volts, mA) _____. Output point operating range from _____ to _____ (e.g., 0.0 V to 10.0 V). Transducer operating range from _____ to _____ (e.g., pressure output). End Device operating range from _____ to _____ (e.g., pressure output). <i>(Ignore reference to transducer if device is directly driven from BAS panel).</i> End Device action: ☐ direct acting ☐ reverse acting Field transducer installed ☐ Yes ☐ No Field device has a manual controller installed ☐ Yes ☐ No	
Verify operating conditions: Fail Safe position _____ (i.e., position to which device will fail under loss of control and power). Normal position _____ (i.e., position at which device is set under normal conditions). Able to command point when Potentiometer in Auto position ☐ Yes ☐ No Control point from Potentiometer in Auto position with panel powered ☐ Yes ☐ No Control point from Potentiometer in Auto position with panel not powered ☐ Yes ☐ No Not able to command point when Potentiometer in Manual position ☐ Yes ☐ No	
Other Hardware Input or Output proof interlock points: Describe Hardware interlock _____. Describe Hardware interlock _____.	
POINT PROGRAMMING, GRAPHICS, TRENDING AND DOCUMENTATION	REV'D
Programming: Point programming completed per Control Sequences ☐ Yes ☐ No Units defined correctly in programming ☐ Yes ☐ No	
Graphics (Point on Front End) (stroke out device if not applicable): Floor plan graphic ☐ Yes ☐ No Equipment graphic ☐ Yes ☐ No Panel graphic ☐ Yes ☐ No	
Trends: Point trend data in panel ☐ Yes ☐ No Point trend data in Front End ☐ Yes ☐ No 144 thirty minute samples set up in panel ☐ Yes ☐ No Trend data point name, if different than original point name to provide average _____ OR ____ (N/A)	
Documentation: Point on Shop Drawings: Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No Point in Control Sequences ☐ Yes ☐ No or Point programming properly documented ☐ Yes ☐ No Reset Schedule in Control Sequences ☐ Yes ☐ No Field device on Shop Drawings: Equipment plan ☐ Yes ☐ No Floor plan ☐ Yes ☐ No Panel layout ☐ Yes ☐ No Field Device cutsheet in O&M manual ☐ Yes ☐ No Confirm Bill of Materials description ☐ Yes ☐ No	
Training: Point function and operation covered during the training courses ☐ Yes ☐ No Client initials _____.	
Additional Comments:	

OWNER'S SIGNATURE _____

AUTHORISED DIVISION 25 BAS CONTRACTOR'S SIGNATURE _____

AUTHORISED LAKE COUNTY BAS CONSULTANT'S SIGNATURE _____

DATE _____

DATE _____

DATE _____

PROJECT NAME: Replacement Project _____ POINT TYPE – AO		
COMMISSIONING COMPLETED BY (<i>Print Name</i>): _____		
Point Name <u>NNN-MMM-</u>	Address _____	Description _____

INCREMENTAL OUTPUT POINT TESTING: (Note: testing includes measuring hysteresis effects)														
Set Point to these values	0%	10%	0%	20%	30%	40%	50%	60%	50%	70%	80%	90%	100%	90%
Trans Input (V_{DC} , mA, pulses)														
Trans Output (psi, Ω , pulses)														
End Device Position (measured % on shaft – use felt marker)														

Point output at which modulation starts _____ Point output at which modulation stops _____
 Transducer output at which modulation starts _____ Transducer output at which modulation stops _____.

Test point output and potentiometer control by incrementing output to values shown in the top row of each table. Accurately record all data in cells as laid out. Ignore transducer input line if outputted directly from device. Note units used in each case.

POTENTIOMETER OVERRIDE TESTING: (Note: testing includes measuring hysteresis effects)									
Set Pot to these approx. values	0%	10%	0%	25%	50%	75%	50%	100%	75%
Trans Output (psi, Ω , pulses)									
End Device Position (% on shaft)									
End Device Position (% on shaft)									

Write *DOES NOT WORK WITH POWER OFF* through the last two (2) lines of the table if potentiometer does not work with the power off.

Additional Comments:

OWNER'S SIGNATURE _____
 AUTHORISED DIVISION 25 BAS CONTRACTOR'S SIGNATURE _____
 AUTHORISED LAKE COUNTY BAS CONSULTANT'S SIGNATURE _____

DATE _____
 DATE _____
 DATE _____

End of section

25 08 03 INTEGRATED AUTOMATION – BAS UL 864 UUKL COMMISSIONING

1 - GENERAL

1.01 Application

- 1.01.1 This Section applies to controls supplied and installed by Division 25 BAS Contractor

1.02 Summary

- 1.02.1 Section includes:

- 1.02.1.1 Building commissioning activities and documentation to meet the specified requirements, including:

- 1.02.1.1.1 Automated Logic is the Basis of Design and Installation for UL 864 UUKL compliance by the BAS.

- 1.02.1.1.2 See 25 00 11 ~~4-01-1~~ **1.06** for a citation of the relevant documents from Automated Logic that form the Basis of Design and Installation for the BAS.

- 1.02.2 The Owner, Lake County BAS Consultant, Architect, Engineers and Commissioning Authority are not responsible for construction means, methods, job safety and sub-Trade/Equipment Supplier management functions related to the commissioning Work.

- 1.02.2.1 The Owner may appoint a Commissioning Authority or may act as the Commissioning Authority.

- 1.02.2.2 Commissioning Authority shall follow all job site safety rules set by the Division 25 BAS Contractor. The Commissioning Authority shall provide his own safety equipment (hard hat, safety shoes) while on site.

- 1.02.3 Unless otherwise stated, references to Division 25 BAS Contractor in this section shall be interpreted to include the Mechanical and Electrical Contractors, acting as Subcontractors to the General Contractor. Mechanical and Electrical Contractors shall include the Work of this section in their scope of Work.

- 1.02.4 Related Sections:

- 1.02.4.1 01 91 13 – Commissioning

- 1.02.4.2 Unless otherwise specified, the Electrical Contractor shall prepare the Electrical Commissioning Binder following the layout and procedures as outlined in the Mechanical Commissioning Section 01 91 13.

- 1.02.5 Unless permitted by the Commissioning Authority, all documentation provided by the all Division 25 BAS Contractors and Subcontractors to meet the requirements of this section, shall be electronic. All electronic documents submitted shall be text searchable and fully indexed. Fax, paper copies and scans of paper copies shall not be accepted.

1.03 Definitions

- 1.03.1 Authority Having Jurisdiction (AHJ): The AHJ is the City of Waukegan Fire Department.

- 1.03.2 Basis of Design and Installation: The Basis of Design and Installation is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the Design Intent. The Basis of Design and Installation describes the systems, components, conditions and methods chosen to meet the intent.

- 1.03.3 Commissioning: Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the Owner's requirements. Commissioning during the construction, acceptance, and warranty phases is intended to achieve the following specific objectives:

- 1.03.3.1 Verify and document that equipment is installed and started per Manufacturer's recommendations; industry accepted minimum standards, and the Contract Documents.

- 1.03.3.2 Verify and document that equipment and systems receive complete operational checkout by installing Division 25 BAS Contractor.

- 1.03.3.3 Verify and document equipment and system performance (as compared to Design Intent).

- 1.03.3.4 Verify the completeness of Operations and Maintenance manuals.

- 1.03.3.5 Ensure that the Owner's operating personnel are adequately trained on the operation and maintenance of building equipment.

- 1.03.4 Commissioning Plan: An overall plan that provides the structure, schedule and coordination planning for the commissioning process.
- 1.03.5 Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents, does not perform properly or is not complying with the Design Intent.
- 1.03.6 Design Intent/Owner's Project Requirements: A dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the Owner. It is initially the outcome of the programming and conceptual design phases.
- 1.03.7 Functional Performance Test: Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outdoor air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The Division 25 BAS Contractor shall submit controls system programming in accordance with the specified sequences of operation for review and comment by the Commissioning Authority and Design Consultant. During commissioning, the Division 25 BAS Contractor will demonstrate to the Commissioning Authority the functional performance of the system in accordance with the final reviewed Submittals. Functional Performance Tests are performed after pre-functional checklists and startups are complete.
- 1.03.8 Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- 1.03.9 Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- 1.03.10 Non-Compliance: See Deficiency List generated by Lake County BAS Consultant.
- 1.03.11 Non-Conformance: See Deficiency List generated by Lake County BAS Consultant.
- 1.03.12 Pre-functional Checklist/Equipment Startup Report: A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the Commissioning Authority to the Division 25 BAS Contractor. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor). The word "pre-functional" refers to before functional testing. Pre-functional checklists augment and are combined with the Manufacturer's start-up checklist.
- 1.03.13 The warranty period for entire project, including equipment components begins at Final Completion and extends for at least one (1) year, unless specifically noted otherwise in the Contract Documents and accepted Submittals.

1.04 Coordination of Commissioning Services

- 1.04.1 Commissioning Authority shall provide overall coordination and management of the commissioning program as specified herein.
- 1.04.2 Division 25 BAS Contractor is responsible for providing all commissioning services per the Contract Documents. Commissioning Authority shall witness the commissioning tests. Commissioning Authority is not responsible for exercising equipment that is under warranty.
- 1.04.3 The commissioning process does not reduce the responsibility of the designers for the design of the Work. The process does not reduce the responsibility for installing Division 25 BAS Contractors to provide a finished and fully functioning product.
- 1.04.4 Commissioning Team: The Commissioning Team includes the Owner, General Contractor, the Division 25 BAS Contractor, Simplex and the Lake County BAS Consultant. The Commissioning Team's activities may be observed by the AHJ.
- 1.04.5 General Contractor shall verify that any systems to be commissioned shall be in operation for at least thirty (30) calendar days before the Commissioning Authority starts formal commissioning procedures.
- 1.04.6 Unless otherwise directed, Division 25 BAS Contractor shall complete all commissioning procedures prior to granting Substantial Completion. The exceptions are as follows:
 - 1.04.6.1 Completion and distribution of the final Commissioning Report
 - 1.04.6.2 Completion of deferred/seasonal commissioning
 - 1.04.6.3 BAS commissioning activities

1.04.6.4 Any Owner training required by the commissioning process

1.05 Documents Review by Lake County BAS Consultant

1.05.1 The Lake County BAS Consultant shall provide the following reports:

1.05.1.1 Review the Division 25 BAS Contractor Submittals for conformance to the BAS UL 864 UUKL commissioning requirements only.

1.05.2 Provide copies of these reports to Commissioning Authority for inclusion in the Commissioning Binder.

1.06 Submittal Review By Commissioning Authority

1.06.1 The Commissioning Authority shall review the Mechanical and Electrical Contractor Shop Drawings for conformance to Design Intent only.

1.06.2 The Commissioning Authority shall provide an electronic copy of the Submittal Review to the Lake County BAS Consultant.

1.06.3 Mechanical and Electrical Contractors shall retain a copy of all reviewed Shop Drawings for integration into the Commissioning Binder.

1.07 Commissioning Plan and Commissioning Schedule

1.07.1 Upon Contract award, the Commissioning Authority shall schedule, co-ordinate and facilitate a Commissioning scoping meeting to accomplish the following:

1.07.1.1 Review each building system to be commissioned, including its intended operation, commissioning requirements, and completion and start-up schedules.

1.07.1.2 Identify how commissioning activities will be integrated into the general construction and Trade activities.

1.07.1.3 Establish the scope of Work, tasks, schedules, deliverables, and responsibilities for implementation of the Commissioning Plan.

1.07.1.4 Commissioning Team members, General Contractor and the Mechanical and Electrical Contractors shall attend this meeting.

1.07.2 Based on this meeting, the Division 25 BAS Contractor shall prepare the Commissioning Plan and Commissioning Schedule and submit to the Commissioning Authority for review prior to implementation by the Division 25 BAS Contractor and his Subcontractors.

1.07.3 The Division 25 BAS Contractor and his Subcontractors shall allow sufficient time to review the plan and to provide comments.

1.07.4 The Division 25 BAS Contractor shall update the Commissioning Plan and Schedule as necessary during the Work to reflect the progress on the components and systems and submit to the Commissioning Authority for review.

1.07.5 The Commissioning Authority shall distribute these electronically. Recipients are responsible for printing their own copies.

1.08 Start-Up/Pre-Functional Checklists/Equipment Startup Reports/Functional Performance Test Forms

1.08.1 Mechanical:

1.08.1.1 There is a set of Mechanical commissioning forms provided in the Contract Documents. The Commissioning Authority shall prepare additional forms as required to prove out the Design Intent.

1.08.1.2 The Mechanical Contractor is responsible for completing these forms. The Commissioning Authority shall provide these forms in PDF format.

1.08.2 Electrical:

1.08.2.1 The Electrical commissioning requirements are outlined in the Contract Documents. The Commissioning Authority shall prepare additional forms as required to prove out the Design Intent based on this list.

1.08.2.2 The Electrical Contractor is responsible for completing these forms. The Commissioning Authority shall provide these forms in PDF format.

1.09 Deficiency Report and Resolution Record

1.09.1 The Commissioning Authority shall document items of non-compliance in materials, installation or operation during the commissioning process.

- 1.09.2 The Commissioning Authority shall document the results from start-up/pre-functional checklists, functional performance testing, and short-term diagnostic monitoring. Include details of the components or systems found to be non-compliant with the Drawings and Specifications. Identify adjustments and alterations required to correct the system operation, and identify who is responsible for making the corrective changes.
- 1.09.3 The Commissioning Authority shall address non-conformance and deficiencies observed immediately, in terms of notification to responsible parties, and providing recommended actions to correct deficiencies.
 - 1.09.3.1 Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Authority. In such cases the deficiency and resolution shall be documented on the procedure form.
 - 1.09.3.2 For identified deficiencies:
 - 1.09.3.2.1 If there is no dispute on the deficiency and the responsibility to correct it:
 - 1.09.3.2.1.1 The Commissioning Authority documents the deficiency and the adjustments or alterations required to correct it. The Division 25 BAS Contractor corrects the deficiency and notifies the Commissioning Authority that the equipment is ready to be retested.
 - 1.09.3.2.1.2 The Commissioning Authority reschedules the test and the test is repeated.
 - 1.09.3.2.2 If there is a dispute about a deficiency or who is responsible:
 - 1.09.3.2.2.1 The deficiency is documented on the non-compliance form and a copy given to the Commissioning Authority.
 - 1.09.3.2.2.2 Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Division 25 BAS Contractor shall have responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by Owner and/or Designate(s) shall have responsibility for providing design revision.
 - 1.09.3.2.2.3 The Commissioning Authority documents the resolution process.
 - 1.09.3.2.2.4 Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the Commissioning Authority that the equipment is ready to be retested. The Commissioning Authority reschedules the test and the test is repeated until satisfactory performance is achieved.
- 1.09.4 Costs for retesting the same BACnet point and/or device more than two (2) times shall be charged to the Division 25 BAS Contractor.
- 1.09.5 Update as necessary during the Work to reflect the progress on the components and systems.
- 1.09.6 The Commissioning Authority shall distribute this report electronically. Recipients are responsible for printing their own copies.
- 1.10 **Recommissioning Manual**
 - 1.10.1 This applies to the weekly testing required by the AHJ or by UL 864 UUKL 10th Edition Code requirements.
- 1.11 **One Year Commissioning Review**
 - 1.11.1 Not required.
- 1.12 **Final Commissioning Report**
 - 1.12.1 The Commissioning Authority shall compile a final Commissioning Report. Summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process. Indicate the actual performance of the building systems in reference to the Design Intent and contract documents. Include completed pre-functional inspection checklists, functional performance testing records, diagnostic monitoring results, identified deficiencies, recommendations, and a summary of commissioning activities.
 - 1.12.1.1 The Commissioning Authority shall distribute this report electronically. Recipients are responsible for printing their own copies.
- 1.13 **Deferred/Seasonal Testing**
 - 1.13.1 Not required.

2 - PRODUCTS

2.01 Test Equipment

- 2.01.1 Unless otherwise specified, all test equipment shall be provided by the Division 25 BAS Contractor. See Section 01 91 13 or Commissioning Specification for other requirements.

3 - EXECUTION

3.01 Commissioning Binder

- 3.01.1 Mechanical Contractor shall prepare the Commissioning Binder based on the direction from the Commissioning Authority. Mechanical Contractor is referred to this Section and for details on preparing this binder. The Table of Contents is as follows:
- 3.01.1.1 Submittal Review by Commissioning Authority
 - 3.01.1.2 Basis of Design and Installation and Design Intent Documents by Design Team including Sequence of Operations
 - 3.01.1.3 Fire Alarm zone testing procedures
 - 3.01.1.4 Completed Test Forms in this section
 - 3.01.1.5 Deficiency Report and Resolution Record
 - 3.01.1.6 Final Commissioning Report
- 3.01.2 Electrical Contractor shall prepare the Commissioning Binder based on the direction from the Commissioning Authority. Electrical shall prepare the Electrical Commissioning Binder in the same format as the Mechanical Commissioning Binder.
- 3.01.3 General Contractor shall provide one (1) printed copy of the Commissioning Binder to the Owner.

Division 25 BAS UL 864 UUKL Compliance Form for ALC 10th Edition BASs

Compliance Survey for UL 864 UUKL Smoke Control Listing

Date of Survey	
Division 25 BAS Contractor Authorized Representative	
Project Title	

UL Compliance Required By:

☒ Building Codes as interpreted by AHJ

☒ Contract Documents

Applicable Building Codes and Standards

Division 25 BAS Contractor Providing and Verifying Information

Initials	Full Name

General Requirements Checklist for UL Smoke Control Listing

General requirements for UL 864 UUKL 10th Edition Smoke Control Listing compliance. If the requirement was verified, mark **Y** (Yes) or **N** (No) for compliance and initialize. If the requirement is not applicable, mark **NA** and initial.

UL 864 UUKL 10th Edition Smoke Control Listing Requirements	Y/N or NA	Verifier's Initials
If a system upgrade was performed, the controllers have been labeled with the correct software revision.		
The wiring guidelines for transient and surge protection have been followed as outlined in this document the <i>Part Number UUKL - WebCTRL SCS (Rev. 10)</i> .		
ALC and the documents cited are the Basis of Design and Installation for this Work by the Division 25 BAS Contractor		
Communication links between buildings are fiber-optic cable or copper cable buried in a conduit separate from power wiring.		
Each binary output object used for pressurization and exhaust control is configured with positive feedback.		
The feedback input monitors the associated controlled equipment status (for example, both open and closed, on and off).		
For smoke control dampers, there may be a pair of feedback binary inputs for two damper end switches.		
Any mismatch of a command and status of the binary output occurring longer than the allowed response time must create a trouble light indication at the FSCS.		
A positive indication of airflow is evident for all fans.		
Non UL Listed control equipment is isolated from the UL Listed network.		
See BACnet Single Line Diagram in Schedule 3.		
The Owner is responsible for Weekly Testing of dedicated stairwell pressurization fans application is used on all dedicated smoke control systems. The Division 25 BAS Contractor has instructed the Owner's staff in the testing procedures.		
Automatic smoke control sequences take precedence over HVAC automatic and manual commands. Manual FSCS takes precedence over all else.		
Automatic activation of any smoke control sequence of operation has priority over any non-smoke control manual commands and any automatic environmental control strategy, when an auto smoke control sequence is initiated. High and low temperature protection devices and return and exhaust air-duct smoke detectors are bypassed.		
Response time for individual smoke control fans to reach commanded state is no more than 60 seconds.		
Response time for individual smoke control dampers to reach commanded state is no more than 75 seconds.		
Fire alarm system manual pull stations do not initiate automatic smoke control sequences. Smoke detectors are used to initiate a smoke control strategy only. <i>Part Number UUKL - WebCTRL SCS (Rev. 10)</i>		
All field controllers that monitor or control smoke control equipment are UL Listed.		
Electrical disconnects, overloads, duct static pressure limits, and supply air duct smoke detectors are not overridden by manual or automatic smoke control strategies.		
BAS and Fire Alarm system zones as shown in the Contract Documents tested and are in compliance with the Consultant's Sequence of Operations.		

Firefighter's Smoke Control Station (FSCS) Requirements Checklist for UL Smoke Control Listing

Requirements for UL 864 UUKL 10th Edition Smoke Control Listing compliance for FSCSs where required. If the requirement was verified, mark **Y** (Yes) or **N** (No) for compliance and initialize. If the requirement is not applicable, mark **NA** and initialize.

FSCS Requirements for UL 864 UUKL 10th Edition Listing	Y/N or NA	Verifier's Initials
FSCS is UL Listed and provides manual control of the smoke control system, a UL Listed annunciator panel is used as FSCS. The device shall be provided by ADi and shall be an Modbus RTU device. ALC shall provide a Modbus RTU to BACnet MS/TP gateway that is 10 th Edition listed. ALC shall map all Modbus registers provided by ADi to BACnet objects. Network this gateway device on a dedicated MS/TP network back to the Second Floor Mechanical Room in a location shown on the Contract Documents..		
Custom annunciator FSCS is connected to a UL Listed Smoke Control engine through the MS/TP network. FSCS provides positive indication of the operation of all smoke control equipment (for example, both open and closed, on and off).		
FSCS provides audible and visible trouble indication when any smoke control equipment does not respond to automatic or manual commands.		
FSCS simultaneously displays the status of all smoke control systems dampers, fans. FSCS has manual control over all smoke control systems		
FSCS can override (partially or in full) any operation in progress, including programmed actions, non-smoke control manual overrides.		
FSCS has highest priority over all smoke control systems.		
FSCS indicates the actual status (not the command status) of systems and equipment used for smoke control. This includes the current position of each damper used in an active smoke control sequence and the status of airflow status of every fan.		
FSCS activates an audible signal if the operation proof sensor (binary feedback point) failed to provide positive feedback that fan or damper reached its intended position.		
Only one FSCS on the UL list system is used for smoke control applications unless approved by the AHJ.		
FSCS manual activation or deactivation of any smoke control device has priority over any automatic smoke or environmental sequence of operation.		
Any return air duct smoke detectors in duct work of each HVAC fan system used for smoke control exhaust or purge only reports an alarm condition to the FSCS or fire alarm annunciator located at the FSCS and does not stop the fan.		
Annunciation at the FSCS to indicate smoke control equipment change of state is no more than 10 seconds after reaching commanded state.		
Fire Alarm system zones as shown in the Contract Documents tested and are in compliance with the Consultant's Sequence of Operation and operates to the satisfaction of the AHJ.		

Wiring Requirements Checklist for UL Smoke Control Listing

Requirements for UL 864 UUKL 10th Edition Smoke Control Listing compliance for Smoke Control Wiring. If the requirement was verified, mark **Y** (Yes) or **N** (No) for compliance and initialize. If the requirement is not applicable, mark **NA** and initial.

[illegible]

Application Programming Requirements for UL Smoke Control Listing

Requirement for UL 864 UUKL 10th Edition Smoke Control compliance for Smoke Control Application Programming.
If the requirement was verified, mark **Y** (Yes) or **N** (No) for compliance and initial.

[illegible]

Alterations to the standard smoke control applications that were required by local, state or federal codes and requirements. Initial each item after verification.

Alterations to the Standard Smoke Control Applications	Verifier's Initials

The information contained within this compliance checklist is verified and accepted to be true as indicated by the signatures in the table below

Date of Acceptance	
Project Title	
Automated Logic Corporation BAS Representative responsible for the UL 864 UUKL design Work (signature)	
Owner	
Lake County BAS Consultant	
Authority Having Jurisdiction	

End of section

25 09 23.21.23 INTEGRATED AUTOMATION – STICK BUILT – HYDRONIC PUMPS – CONSTANT SPEED
(ALL TYPES)

1 - GENERAL

1.01 Controls Coordination Meeting

- 1.01.1 Division 25 BAS Contractor shall meet with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment with a hardwired interface device that is being connected to the Intranet at the Place of the Work to co-ordinate details of the interface connection between their product(s) and the Intranet.
- 1.01.2 The Owner or his designated representative shall be present at this meeting.
- 1.01.3 Submittals for these products shall not be approved prior to the completion of this meeting.

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the stick built equipment to be integrated with the BAS device network in the Work per the list above.

2 - PRODUCTS

2.01 General

- 2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Sections 23 09 00 and 23 05 93.
- 2.01.2 Division 25 BAS Contractor shall provide the following hardwired objects shown in this Specification section and shall make these points available in the BACnet/IP device. There is no BACnet Interface Device for this device.
- 2.01.3 Provide the following points at a minimum. Refer to Contract Drawings for Points Lists showing additional points and Sequence of Operations for locations and quantities.
 - 2.01.3.1 Division 25 BAS Contractor shall provide stop/start and status for each pump.
 - 2.01.3.2 Division 25 BAS Contractor shall provide a starter equal to Franklin BAS-1P to allow for HOA control.
 - 2.01.3.3 Division 25 BAS Contractor shall provide a current transducer to read amps. All wiring shall be in blue conduit. Refer to 25 00 11 for labelling requirements. See Drawings for locations and quantities. When there is a call for the device to run and the amp reading is zero for two (2) minutes (user settable), generate an alarm at the Front End. Division 25 BAS Contractor shall use the current transducer to calculate kW and kWh. Report this kW and kWh data as points on this graphic.
- 2.01.4 Division 25 BAS Contractor shall create graphics per 25 15 11 and 25 15 11.01 for this device.

3 - EXECUTION

3.01 Device Installation and Commissioning:

- 3.01.1 See BACnet Single Line Diagram and Responsibility Matrix for Work responsibilities. The BACnet Single Line Diagram and Responsibility Matrix apply to all Trades.
- 3.01.2 Division 25 BAS Contractor and the Supplier shall jointly test and commission the hardwired objects, following the provision of 25 08 00. Division 25 BAS Contractor is responsible for completing all forms shown in 25 08 00.
- 3.01.3 Electrical Contractor shall provide the following:
 - 3.01.3.1 Provide power and wire the Division 25 supplied starter for the device. Refer to Electrical for Work requirements.
 - 3.01.3.2 Instruct Division 25 BAS Contractor on the point of connection for control of the device.

End of section

**25 09 23.72.00 INTEGRATED AUTOMATION – STICK BUILT – AIR TO AIR ENERGY RECOVERY
EQUIPMENT (ALL TYPES)**

1 - GENERAL

1.01 Controls Coordination Meeting

- 1.01.1 Division 25 BAS Contractor who is providing the stick-built controls for this device shall meet with Division 23 and the Equipment Supplier who are responsible for supplying equipment with a hardwired interface device that is being connected to Division 25 BAS Contractor's network at the Place of the Work to co-ordinate details of the interface connection to this equipment.
- 1.01.2 The Owner or his designated representative shall be present at this meeting.
- 1.01.3 Submittals for these products shall not be approved prior to the completion of this meeting.

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the stick built equipment to be integrated with the BAS device network in the Work.

2 - PRODUCTS

2.01 General

- 2.01.1 This system is instrumented as part of the AHUs found in 25 09 23.73.13.
- 2.01.2 Division 25 BAS Contractor shall provide the hardwired objects shown in Division 23 and shall make these points available in the BACnet/IP device. There is no BACnet Interface Device for this device.
- 2.01.3 Division 25 BAS Contractor shall create graphics per 25 15 11 and 25 15 11.01 for this device.

3 - EXECUTION

3.01 Device Installation and Commissioning

- 3.01.1 See BACnet Single Line Diagram and Responsibility Matrix for Work responsibilities. The BACnet Single Line Diagram and Responsibility Matrix applies to all Trades.
- 3.01.2 Division 25 BAS Contractor and Owner shall jointly test and commission the hardwired objects following the provision of 25 08 00. Division 25 BAS Contractor is responsible for completing all forms shown in 25 08 00.
- 3.01.3 Electrical Contractor shall provide the following:
 - 3.01.3.1 There is no BAS related Work required for this device.

3.02 Device Installation and Commissioning:

- 3.02.1 See BACnet Single Line Diagram and Responsibility Matrix for Work responsibilities. The BACnet Single Line Diagram and Responsibility Matrix applies to all Trades.
- 3.02.2 The Division 25 BAS Contractor who is providing this BACnet Interface Device and the Supplier shall jointly test and commission the hardwired objects following the provision of 25 08 00. Division 25 BAS Contractor is responsible for completing all forms shown in 25 08 00.
- 3.02.3 Division 25 BAS Contractor shall allow for the Air-to-Air Recovery Unit to be a BACnet MS/TP device or a stick built device. If Division 23 provides a stick built device, Division 25 BAS Contractor shall provide hardwired, field mounted inputs and outputs as shown on the Mechanical Documents.
- 3.02.4 Electrical Contractor shall provide the following:
 - 3.02.4.1 Provide power for any controls requiring power.

End of section

**25 13 16 INTEGRATED AUTOMATION – CONTROL & MONITORING NETWORK – INTEGRATION
PANELS/DEVICES**

1 - GENERAL

1.01 Application

1.01.1 This Section applies to controls supplied and installed by Division 25 BAS Contractor.

1.02 General Conditions

- 1.02.1 All materials and equipment used shall be standard components, regularly manufactured for this and/or similar systems. No materials or equipment shall be custom designed especially for this project, nor shall this equipment be "BETA" equipment unless expressly approved by the Owner (BETA provisions for BACnet features are waived).
- 1.02.2 Division 25 BAS Contractors shall read the BACnet sections of the Specification in conjunction with the non-BACnet sections to determine the scope of the BACnet Work requirements
- 1.02.3 The terms "BAS panels" or "panels" and "device" are used interchangeably. The term "device" applies to a BAS panel that is a native BACnet panel that uses BACnet objects and services. The term "device" is also used to describe computers or other equipment provided in the Work that use BACnet objects and services. The terms Building Automation System (BAS) and Direct Digital Control system (DDC) are used interchangeably in this Specification.

2 - PRODUCTS

2.01 BAS Device Network - Definition of Levels

2.01.1 The four (4) levels of control devices in the BAS architecture shall be defined as follows.

2.01.1.1 Level 0:

- 2.01.1.1.1 This level includes Servers, Workstations (WS) and Portable Operator Terminals (POT) complete with Front End and other software specified herein, all associated peripheral devices such as the alarm printer, graphics printer, display devices, and all associated communications devices.
- 2.01.1.1.2 The following protocols are considered acceptable network communications protocols. See Section 25 13 16 3.06 for protocols that are allowed in the Work for Level 0 devices:
- 2.01.1.1.2.1 BACnet/IP
- 2.01.1.1.3 Application of the Level 0 device definition to BACnet device profiles
- 2.01.1.1.3.1 BACnet B-OWS devices are considered Level 0 devices if they support BACnet objects and services listed in the Specification for this device.
- 2.01.1.1.3.2 BACnet B-AWS devices are considered Level 0 devices if they support BACnet objects and services listed in the Specification for this device.
- 2.01.1.1.3.3 BACnet B-BC devices that function as Web servers and which provide for programming tools on board the device for programming the device itself plus any devices connected to it are considered Level 0 devices. This Specification outlines where B-BC devices may be used as Level 0 devices in the Work. BACnet B-BC devices shall not be used in the Work as Level 0 devices without written permission of the Owner.

2.01.1.2 Level 1:

- 2.01.1.2.1 This level includes all BAS devices that communicate on a network using peer-to-peer protocols such as contention, token passing or token interrupt. The definition of peer-to-peer is found in the references listed in 25 00 42 1.04.20 ~~10~~ **10**. The Owner will not consider equipment peer-to-peer unless the equipment meets all the referenced definitions.

- 2.01.1.2.2 The following protocols are considered acceptable peer-to-peer network communications protocols: See Section 25 13 16 3.06 for protocols that are allowed in the Work for Level 1/1A devices:
 - 2.01.1.2.2.1 BACnet MS/TP where the devices operate as Manager devices.
- 2.01.1.2.3 Level 1 devices may also perform the functions of routers, protocol convertors, network interface devices. This last device is also called a “node controller”, “network extender device” or “area controller”. Multiple layers of Level 1 device networks connected via these devices shall be considered a Level 1 device provided the top level device and all the devices below this device meet all of the criteria listed above for Level 1 devices.
- 2.01.1.2.4 Level 1 devices provide the master communications control for connected networks of Level 1A, 2/2A and 3/3A BAS devices.
- 2.01.1.2.5 Level 1 devices shall meet all the following minimum requirements:
 - 2.01.1.2.5.1 Meet the memory requirements for programming, trending and alarming as outlined in 25 13 16 2.18.
 - 2.01.1.2.5.2 Meet the local data display requirements per Section 25 13 16 3.06.3.13.
 - 2.01.1.2.5.3 Meet the point processing software language requirements of 25 13 16 2.12.
 - 2.01.1.2.5.3.1 Devices that exclusively use canned, application specific, or template style programming shall be considered Level 3 or 3A devices.
 - 2.01.1.2.5.4 All other peer-to-peer devices that do not meet all these minimum requirements shall be considered Level 1A devices in the Specification Documents.
- 2.01.1.2.6 Application of the Level 1 device definition to BACnet device profiles.
 - 2.01.1.2.6.1 Application to BACnet B-BC devices:
 - 2.01.1.2.6.1.1 BACnet B-BC devices are considered Level 1 devices if they support BACnet objects and services listed in the Specification for this device.
 - 2.01.1.2.6.1.2 BACnet B-BC devices residing as Manager devices on a BACnet Manager Subordinate/Token Passing (MS/TP) LAN are considered Level 1 devices if they meet all the criteria listed herein.
 - 2.01.1.2.6.1.3 BACnet B-BC devices may act as system routers, protocol convertors, and network interface devices. These devices are also referred to as “node controllers”, “network extender devices” or “area controllers”. They shall be considered Level 1 devices if they meet all the criteria listed herein. The same requirements apply to the B-BC devices connected to these devices.
 - 2.01.1.2.6.1.4 BACnet B-BC devices that perform the function of Subordinate proxy devices shall be considered Level 1 devices if they meet all the criteria listed herein.
 - 2.01.1.2.6.1.5 BACnet B-BC devices shall also provide both client and server functionality in order to be a Level 1 device.
 - 2.01.1.2.6.2 Application to BACnet B-AAC devices:
 - 2.01.1.2.6.2.1 BACnet B-AAC devices are considered Level 1A devices if they support BACnet objects and services listed in the Specification for this device.
 - 2.01.1.2.6.2.2 BACnet B-AAC devices shall meet all requirements for the Level 1A devices listed herein.
 - 2.01.1.2.6.3 Application to BACnet B-ASC devices:
 - 2.01.1.2.6.3.1 These devices are considered Level 3 or 3A devices.
- 2.01.1.3 Level 2:
 - 2.01.1.3.1 This level shall include all BAS devices that rely on a Level 1/1A BAS device for exchange of information with all other BAS devices.
 - 2.01.1.3.1.1 Level 2 BAS devices communicate with Level 1/1A BAS devices using a request/response or poll/poll response protocol. The definition of request/response

or poll/poll response protocol is found in the references listed in clause 25 00 42 1.04.20.

2.01.1.3.1.2 Level 2 devices shall operate in a standalone mode using the last known values passed to them by the Level 1/1A devices to which they are connected.

2.01.1.3.1.3 Level 2/2A devices may be devices that use a proprietary or a legacy protocol. The Owner will not consider equipment as request/response or poll/poll response unless the equipment meets all the referenced definitions for Level 2 devices.

2.01.1.3.2 The following protocols are considered acceptable poll/poll response network communications protocols. See Section 25 13 16 3.06 for protocols that are allowed in the Work for Level 2/2A devices:

2.01.1.3.2.1 BACnet MS/TP where the devices operate as Subordinate devices

2.01.1.3.2.2 BACnet/PTP where the devices operate as Subordinate devices (these devices may also act as gateways to other proprietary devices)

2.01.1.3.2.3 LonTalk devices that provide a poll response to a master device

2.01.1.3.2.4 Proprietary or legacy protocols (such as those that use EIA-485 as the Physical Layer) where the devices operate as Subordinate devices

2.01.1.3.3 Level 2 devices shall meet all the following minimum requirements:

2.01.1.3.3.1 Meet the memory requirements for programming, trending and alarming as outlined in Section 25 13 16 2.16 and 25 13 16 2.08.5.

2.01.1.3.3.2 Meet the local data display requirements per Section 25 13 16 3.06.3.13.

2.01.1.3.3.3 Meet the point processing software language requirements of Section 25 13 16 2.12.

2.01.1.3.3.4 Use the same programming language as the Level 1 device.

2.01.1.3.3.5 Respond to the master Level 1/1A controller that manages communications for all Level 2 devices on the same Level 2 network. Note that this definition applies to network protocols like BACnet MS/TP that permits Manager and Subordinate devices on the same network.

2.01.1.3.3.6 Use the same communications software as the Level 1 devices for POT to BAS device communications.

2.01.1.3.3.7 Any other Level 2 devices that do not meet all these minimum requirements shall be considered Level 2A devices in the Specification Documents.

2.01.1.3.4 Application of the Level 2 device definition to BACnet device profiles.

2.01.1.3.4.1 Application to BACnet B-BC devices:

2.01.1.3.4.1.1 BACnet B-BC devices are not considered Level 2 devices as they are Manager devices.

2.01.1.3.4.2 Application to BACnet B-ASC devices:

2.01.1.3.4.2.1 BACnet B-ASC devices are considered Level 2 devices if they support BACnet objects and services listed in the Specification for this device.

2.01.1.3.4.2.2 BACnet B-ASC devices residing as Subordinate devices on a BACnet Manager Subordinate/Token Passing (MS/TP) LAN are considered Level 1 devices if they meet all the criteria listed herein.

2.01.1.3.4.2.3 BACnet B-ASC devices that respond to requests for information from node controllers.

2.01.1.3.4.2.4 Level 2 and 2A devices shall provide server functions only. They may optionally support client functions.

2.01.1.3.4.3 Application to BACnet B-ASC devices:

2.01.1.3.4.3.1 These devices are considered Level 3 or 3A devices.

2.01.1.4 Level 3:

2.01.1.4.1 This level shall include all BAS devices that rely on higher level devices, gateways or servers for exchange of information with all other BAS devices. Level 3 BAS devices

- communicate with the higher level BAS devices using a peer-to-peer protocol or a non-peer-to-peer protocol.
- 2.01.1.4.2 Level 3/3A devices do not use the same programming language as the Level 1/1A and 2/2A devices. They are referred to as Application Specific Controllers (ASCs) in this Specification and normally have “canned” programming routines or use a configuration menu as the programming method.
- 2.01.1.4.3 Level 3 devices are Application Specific Controllers (ASCs) that support dynamic device binding. Level 3A devices Application Specific Controllers (ASCs) that support manual device binding.
- 2.01.1.4.4 Terminal device controllers (e. g., VAV boxes) that are fully programmable with the same programming language as the Level 1 devices shall be considered Level 1, 1A, 2 or 2A devices, depending on how these devices meet the other criteria listed herein.
- 2.01.1.4.5 The following protocols are considered acceptable peer-to-peer network communications protocols: See Section 25 13 16 3.06 for protocols that are allowed in the Work for Level 3 devices:
- 2.01.1.4.5.1 BACnet MS/TP where the devices operate as Manager devices.
- 2.01.1.4.5.2 LonTalk where the devices operate as Manager devices.
- 2.01.1.4.5.3 Proprietary or legacy protocols (such as those that use EIA-485 as the Physical Layer) where the devices operate as Manager devices.
- 2.01.1.4.5.4 Proprietary or legacy protocols (such as EIA-485) or the LonWorks protocols where the devices operate as Manager or Subordinate devices.
- 2.01.1.4.6 The following protocols are considered acceptable peer-to-peer network communications protocols: See Section 25 13 16 3.06 for protocols that are allowed in the Work for Level 3A devices:
- 2.01.1.4.6.1 BACnet MS/TP where the devices operate as Subordinate devices
- 2.01.1.4.6.2 LonTalk where the devices operate as Subordinate devices
- 2.01.1.4.6.3 Proprietary or legacy protocols (such as those that use EIA-485 as the Physical Layer) where the devices operate as Subordinate devices
- 2.01.1.4.7 Application of the Level 3 device definition to BACnet device profiles.
- 2.01.1.4.7.1 Application to BACnet B-BC devices:
- 2.01.1.4.7.1.1 BACnet B-BC devices are considered Level 3 devices if they are not fully programmable , but support dynamic device binding.
- 2.01.1.4.7.2 Application to BACnet B-AAC devices:
- 2.01.1.4.7.2.1 BACnet B-ASC devices are considered Level 3 devices if they are not fully programmable, but support dynamic device binding.
- 2.01.1.4.7.3 Application to BACnet B-ASC devices:
- 2.01.1.4.7.3.1 BACnet B-ASC devices are considered Level 3 devices if they support BACnet objects and services listed in the Specification for this device.
- 2.01.1.4.7.4 Definition of Level 3A devices:
- 2.01.1.4.7.4.1 BACnet B-ASC devices residing as Subordinate devices on a BACnet Manager Subordinate/Token Passing (MS/TP) LAN are considered Level 3A devices.
- 2.01.1.4.7.4.2 BACnet B-ASC devices that do not support dynamic device and object binding are considered Level 3A devices.
- 2.01.1.4.7.5 Application to BACnet B-SA and B-SS devices:
- 2.01.1.4.7.5.1 BACnet B-SA and B-SS devices are considered Level 3 devices or 3A devices depending on their support for dynamic device binding.
- 2.01.1.4.8 All BAS devices shall come with a pre-wired connector or port for connection of a POT so the Operator can perform the following:

- 2.01.1.4.8.1 The BAS architecture shall permit the POT to be connected to any device and have access to the entire network. See 25 13 16 2.03.1.3.1 for additional details.
- 2.01.1.4.8.2 The Operator shall only require one (1) communications software package on the POT to connect directly to the network. Devices that require a different software package than that required for a Level 1 device shall be considered Level 1A or Level 2A devices and shall be subject to limitations on use that is described elsewhere in this Specification.
- 2.01.1.4.8.3 The BAS architecture shall permit the POT to be locally connected for Operator readout of all system variables, override control and adjustment of all control parameters and other functions defined in this section of the Specification.

2.02 BAS Device Network – Support for BACnet

- 2.02.1 All BAS devices provided by the Division 25 BAS Contractor in the Work shall support all mandatory and shall support all optional properties of all objects and all services as defined as BACnet Interoperability Building Blocks (BIBBs) as listed in the ASHRAE 135-2024. This includes any Addenda issued up to the time of Bid, or as, required to comply with the Sequences of Operation.
 - 2.02.1.1 The following clauses apply as a project specific condition:
 - 2.02.1.1.1 All optional properties of all standard BACnet objects required to meet the Sequence of Operations shall be supported.
 - 2.02.1.1.2 All properties that must be writable to meet the Sequence of Operations shall be writable. If the property is writable, then all data types shall be supported.
 - 2.02.1.1.3 All forms of a BACnet service required to meet the Sequence of Operations shall be supported.
- 2.02.2 Support the following BACnet Engineering Units:
 - 2.02.2.1 Level 0 devices shall support all BACnet Engineering Units required in the Work to meet the Sequence of Operations.
 - 2.02.2.2 Level 1/1A BAS devices shall support all BACnet Engineering Units required in the Work to meet the Sequence of Operations.
 - 2.02.2.3 Level 2/2A BAS devices need not support BACnet Engineering Units required in the Work providing the data can be mapped into the Level 0 computers to meet the Sequence of Operations.
 - 2.02.2.4 Level 3/3A BAS devices need not support BACnet Engineering Units required in the Work providing the data can be mapped into the Level 0 computers to meet the Sequence of Operations.
- 2.02.3 BACnet features may be tested per the provisions of the network test throughput described elsewhere in this Specification.
 - 2.02.3.1 The Owner reserves the right to test the network performance using a network protocol “sniffer”. The Division 25 BAS Contractor shall co-operate with the Owner by providing password access to the network, a physical connection and the time of qualified personnel to review the results.
- 2.02.4 Provide the following BACnet features and services:
 - 2.02.4.1 The Division 25 BAS Contractor’s BAS equipment shall support BACnet over IP as defined in Annex J of the BACnet standard.
 - 2.02.4.2 A time master shall be provided. The format of the time synchronization messages shall be to local time. UTC support is not necessary. This function may be done in a Level 0 device.
 - 2.02.4.3 Use the appropriate character set to comply with the Working Language requirements of the Specification.
 - 2.02.4.4 Level 0 computers and devices shall support all sixteen (16) command priorities per Table 2.

2.02.4.4.1 Structure the command priorities as shown in Table 2 below:

TABLE 2 : SPECIFIED BACNET COMMAND PRIORITIES TO BE USED IN THE WORK

Priority Level	Application	Priority Level	Application
1	Manual-Life Safety (Used by Firefighter's Smoke Control Station).	9	Reserved for control over BACnet Interface Devices provided by Equipment Suppliers in this Specification. (Do not use without prior written permission of Owner).
2	Automatic-Life Safety (Used by UUKL 864 Listing BAS hardware only).	10	Reserved for devices that only support this Priority Level for Manual Operator control.
3	Reserved for Owner's Administrator Override Control.	11	Available (Do not use without prior written permission of Owner).
4	Available (Do not use without prior written permission of Owner).	12	Reserved for Division 25 BAS to control Air Terminal Unit Standby Setpoints to meet CA Title 24 requirements as outlined in this Specification.
5	Critical Equipment Control Reserved for Future Demand Response Control (Not part of the Work).	13	Division 25 BAS Contractor may use this Priority Level for specific sequences. Provide justification for use via the Submittal process.
6	Minimum On/Off Reserved for Future Demand Response Control.	14	Division 25 BAS Contractor may use this Priority Level for specific sequences. Provide justification for use via the Submittal process.
7	Lighting Override Control (Reserved for BACnet Interface Devices other than the Division 25 BAS).	15	Division 25 BAS Contractor may use this Priority Level for specific sequences. Provide justification for use via the Submittal process.
8	Manual Operator (Used by Owner for non-Administrator Rights accounts).	16	Normal Division 25 BAS Program Control

- 2.02.4.4.2 Support the following command priorities:
 - 2.02.4.4.2.1 Level 1/1A BAS devices containing commandable object properties shall accept ALL sixteen (16) command priorities. Priority 6 is prohibited for any use other than minimum on/off time. Its use is restricted to binary outputs.
 - 2.02.4.4.2.2 Level 0 and 1/1A devices that act as clients that can initiate writes to these properties shall support the use of ANY priority including priority 6.
 - 2.02.4.4.2.3 Level 2/2A devices shall support priorities 8 and 10 at minimum.
 - 2.02.4.4.2.4 Level 3/3A devices shall support priorities 8 and 10 at minimum.
 - 2.02.4.4.2.5 All hardware outputs that are writable shall be commandable. All setpoints called up in the Sequence of Operations shall be commandable.
 - 2.02.4.4.2.6 Where a BACnet device performs the functions of a gateway as defined in this Specification, support the Priority_Array properties of objects to provide network visible command priorities. Safeties for starting and stopping fans, boilers and other equipment shall be provided in the Division 25 BAS Contractor's BAS programming language as a local matter.
- 2.02.4.5 See 25 05 53 2.04 for the BACnet Interface Device and point naming conventions, Device Object instance numbers and BACnet network numbers.-
 - 2.02.4.5.1 These object names shall be used in Front End applications such as graphics, reports, and alarms or wherever an object name is appropriate in lieu of the object name property in the remote device. Permit an Operator to display, at any time, the mapping between the object name used on the Front End and the object name property used in the remote BACnet device.
- 2.02.4.6 Set the Description following the object description naming conventions specified elsewhere. The Description shall be minimum sixty four (64) ASCII printable characters.

- 2.02.5 Data sharing BIBBs: These BIBBs outline the BACnet objects and services required to interoperably perform the data sharing functions enumerated in Annex K for the BACnet devices defined in this Specification. All BAS devices provided in the Work by the Division 25 BAS Contractor shall support all BIBBs that are called up in this Specification.
- 2.02.5.1 Support a network connection to permit the Operator to read and display the value of any property, including all required and supported optional properties, of every object of every networked device when the Operator is directly connected to the device via a serial or wireless connection.
- 2.02.5.1.1 This feature shall support all of the following features:
- 2.02.5.1.1.1 Be available on at least one Level 1/1A and 3/3A device
 - 2.02.5.1.1.2 Be password protected
 - 2.02.5.1.1.3 Can be restricted by an administrator using a Level 0 device that is remotely connected
 - 2.02.5.1.1.4 All operating setpoints and parameters in the device must be available for modification via BACnet services
- 2.02.5.2 Changes of value of globally shared data (up to forty (40) points) on the BACnet Internetwork shall be distributed by any Level 1/1A device using UnconfirmedCOVNotifications. Utilise the COVU service for this purpose. Global information shall be shared at a minimum of once a minute and upon a change of value of $\pm 10\%$ (Operator definable).
- 2.02.6 Alarm and Event BIBBs: These BIBBs outline the BACnet objects and services required to interoperably perform the Alarm and Event functions enumerated in Annex K for the BACnet devices defined in this Specification. The Alarm and Event Priority Classification shall follow the BACnet Standard (fully described in Annex M). All BAS devices provided in the Work by the Division 25 BAS Contractor shall support all BIBBs that are called up in this Specification.
- 2.02.6.1 Provide intrinsic or algorithmic alarming services using one of the methods listed below:
- 2.02.6.1.1 Use intrinsic reporting wherever there is conditional alarming required (e.g., high and low alarm limits and time delays). Alarm logic, limits and delays shall be approved by the Shop Drawing process.
 - 2.02.6.1.2 Use algorithmic alarming for all other alarms defined in the Sequences of Operation (e.g., suppress HVAC coil pump alarm when $OAT > 0\text{ C } [32\text{ F}]$). Create these Alarms using the Event Enrollment object that cannot be met by intrinsic alarming. Support dynamic creation and deletion of Event Enrollment objects as needed to comply with the Sequences of Operation. Alarm logic, limits and delays shall be approved by the Shop Drawing process.
- 2.02.6.2 Meet the following requirements for the Alarm and Event BIBB:
- 2.02.6.2.1 Permit the Operator to modify the alarm parameters dynamically for all standard BACnet event types.
 - 2.02.6.2.2 Permit the Operator to change alarm routing for each alarm including the destination for each type of alarm and alarm priority, the day of week and time of day, and the type of transition involved (TO-OFFNORMAL, TO-NORMAL and so on).
 - 2.02.6.2.3 All alarms required by the Sequence of Operation shall be created using BACnet objects and services. Use intrinsic reporting or algorithmic reporting to generate these time delay type of alarms. Create Notification Class objects to satisfy the alarming reporting requirements. Set Recipient_List to report to the server. Allow for two (2) additional entries in the Recipient_List. Send alarms to their appropriate Recipient_List recipients using the Notification Class object as needed to comply with the Sequences of Operation.
 - 2.02.6.2.3.1 Use BVs to generate runtimes and transition counts. Provide alarms as described in the Sequences of Operation Sections. These alarms can be done through intrinsic reporting. See the Alarm Class Table for reporting and acknowledgment requirements.

- 2.02.6.2.3.2 Use the Alarm Class Table and the Sequences in the Sequences of Operation Sections to generate the Recipient_List. Use the Event Enrollment Object to access alarms and events.
- 2.02.6.2.3.3 Use the Alarm Class Table and the Sequences in the Sequences of Operation Sections to set alarm priorities for those objects where alarming is required by the Sequences of Operation. The Owner will assign priority numbers to match the alarm priorities shown in the Alarm Class Table.
- 2.02.6.2.3.4 Support the Message Text parameter for Event Notifications. Message texts shall be supported by the Level 0 device and the Level 1 device Message text shall be two hundred (200) characters minimum.
- 2.02.6.2.3.5 Report all network communications faults described in Section 25 13 16 as BACnet alarms. The establishment of what constitutes a network communications fault is a local matter.
- 2.02.6.2.3.6 Report all restart sequences described in Sections 25 13 16 as BACnet alarms.
- 2.02.6.2.3.7 Support the acknowledgement of alarms by using the Level 0 Front End software as outlined in Section 25 15 11.
- 2.02.6.2.3.8 Use BAS programming (done as a local matter) to set the In_Alarm status flag BO such as AHU1.FAN $\neq$ AHU1.STATUS after one hundred and twenty (120) seconds.
- 2.02.6.2.3.9 Generate an alarm to show all BOs that have been overridden ON or OFF for more than seventy two (72) hours (Operator definable).
- 2.02.6.2.3.10 Support COV reporting as detailed below:
 - 2.02.6.2.3.10.1 Analog, Binary, and Multi-state Input, Output, and Value, and the Loop shall support COV reporting.
 - 2.02.6.2.3.10.2 Level 0 Front End software shall support subscriptions to COV notifications for all object types that support COV notification.
 - 2.02.6.2.3.10.3 COV notification shall be supported at the Level 0 Front End software (e. g., for updating real-time graphic displays).
- 2.02.6.3 Support the audit trail function using Event Enrollment objects. Pass the audit trail data to the Server using Notification Class objects. Note that each Notification Class object shall have space for two (2) more entries in the Recipient_List. Support the sorting and selecting of alarms and events by class, date, time, etc. by using the Level 0 Front End software.
- 2.02.6.4 Wireless text message service may be done as a local matter.
- 2.02.6.5 For wireless text message alarms, provide an entry in the Recipient_List to tell the Front End software that a wireless text message alarm has occurred. Transmit this alarm per the Sequences of Operation Sections.
- 2.02.7 Scheduling BIBB: These BIBBs outline the BACnet objects and services required to interoperably perform the scheduling functions enumerated in Annex K for the BACnet devices defined in this Specification. All BAS devices provided in the Work by the Division 25 BAS Contractor shall support all BIBBs that are called up in this Specification.
 - 2.02.7.1 Meet the following requirements for the Scheduling BIBBs:
 - 2.02.7.1.1 Permit the Operator to create, delete and modify schedule and Calendar objects in a Level 1/1A device using a Level 0 device. If OCD is not supported but the devices contain pre-created Calendar and Schedule objects that can be edited using Level 0 Front End software, this is considered equivalent to OCD.
 - 2.02.7.1.2 Support at minimum three (3) ON/OFF times on a daily basis.
 - 2.02.7.1.3 Support at minimum twenty five (25) date entries for the annual schedule using the Calendar object.
 - 2.02.7.1.4 Support editing of Schedule and Calendar objects in BACnet/IP device.
 - 2.02.7.1.5 Specify each action that shall take place based on date and time of day. This shall include each Start/Stop operation and each change of operating setpoint and parameter based on operating mode, (e. g., night set-back, vacation and holiday operation, special event operation, etc.).
 - 2.02.7.1.6 The creation and deletion of schedules shall cause the creation of an Event Enrollment object which in turn shall cause the generation of a Notification Class object telling those server(s) on the Recipient_List that the Log object has been created or deleted. Write this

data to the server audit trail specified elsewhere. This feature can be provided in a proprietary manner.

- 2.02.7.1.7 Provide for the following coding structure in the Present_Value property to permit interoperable scheduling on the BACnet Internetwork:

- 2.02.7.1.7.1 1: ON (for devices such as fans)
- 2.02.7.1.7.2 2: OFF (for devices such as fans)
- 2.02.7.1.7.3 3: optimum start enable
- 2.02.7.1.7.4 4: optimum stop enable
- 2.02.7.1.7.5 5: night purge
- 2.02.7.1.7.6 6: night setback/setup
- 2.02.7.1.7.7 7: occupied
- 2.02.7.1.7.8 8: unoccupied
- 2.02.7.1.7.9 Support a next transition property to permit optimum start

- 2.02.7.2 Meet the following requirements for the Calendar object:

- 2.02.7.2.1 Devices that provide scheduling capability shall also provide at least one (1) Calendar object with a capacity of at least twenty (20) entries. Permit the Operator to view the Calendar object and make modifications from any BACnet server on the Internetwork.
- 2.02.7.2.2 The Calendar object's Date_List property shall be writable using BACnet services.

- 2.02.8 Trending BIBBs: These BIBBs outline the BACnet objects and services required to interoperably perform the trending functions enumerated in Annex K for the BACnet devices defined in this Specification. All BAS devices provided in the Work by the Division 25 BAS Contractor shall support all BIBBs that are called up in this Specification.

- 2.02.8.1 Meet the following requirements for the Trending BIBBs:

- 2.02.8.1.1 Permit the Operator to create, delete and modify Trendlog and Trendlog Multiple objects in a Level 1/1A device using a Level 0 device. If OCD is not supported but the devices contain pre-created Trendlog and Trendlog Multiple objects that can be edited using Level 0 Front End software, this is considered equivalent to OCD. All trend data shall be passed as Log records to server(s) in the Recipient_List. Set up logs for all input, output and setpoint objects in BACnet/IP devices.
- 2.02.8.1.1.1 The Level 0 Front End software shall support the creation and deletion of multiple Log objects using wildcard capabilities or other mechanism. This mechanism can be provided as a local matter.
- 2.02.8.1.1.2 Names shall follow the object naming conventions specified elsewhere so objects can be accessed via the wildcarding capabilities of the Front End.
- 2.02.8.1.2 Set the Log_DeviceObjectProperty to permit logging. Set the Log_Enable property to TRUE to begin logging for each Log object.
- 2.02.8.1.3 The creation and deletion of log records shall cause the creation of an Event Enrollment object which in turn shall cause the generation of a Notification Class object telling those server(s) on the Recipient_List that the Log object has been created or deleted. Write this data to the server audit trail specified elsewhere. This feature may be provided in a proprietary manner.
- 2.02.8.1.4 The Start_Time and Stop_Time shall be supported but these properties need not be completed as the logging is designed to be continuous at the device only (i.e., record N+1 will overwrite the first record). Set the Stop_When_Full property to FALSE on all Log objects so the log can overwrite the first entry when Buffer_Size is exceeded. Provide training to the Operator on using these Start_Time and Stop_Time properties to permit troubleshooting.
- 2.02.8.1.5 The Division 25 BAS Contractor shall log the Present_Value of the object's property per Section 25 13 16. The Operator shall have the option of logging other properties of objects as required but such logs of other properties need not be set up by the Division 25 BAS Contractor.
- 2.02.8.1.6 Set all Log_Intervals of all Log objects to thirty (30) minutes per Section 25 13 16.

- 2.02.8.1.7 The Operator shall have the option of logging the average, maximum, minimum or last instantaneous value over the Log_Interval. The average, maximum or minimum may be implemented via a proprietary process. The Owner prefers that the average, maximum or minimum values be done via BACnet (e. g., an Analog Input object is set up by the Division 25 BAS Contractor to calculate OAT.AVG. The Log is then set up to trend OAT.AVG).
- 2.02.8.1.8 The Division 25 BAS Contractor shall allow for at least ten percent (10%) of the Log objects to be logged via COV subscription. Set the COV_Resubscription_Interval to thirty (30) minutes for these Log objects. The Owner shall provide a list of these Log objects to the Division 25 BAS Contractor.
- 2.02.8.1.9 Set all Buffer_Sizes of all Log objects to one hundred and forty four (144). Set the Notification_Threshold to thirty three percent (33%) of the Buffer_Size for those Log objects designated for extended trending (e. g., utility meter data) in this Specification. Log data from the BAS devices shall be automatically uploaded to the server(s) on the Notification Class object Recipient_List during the time when the network is not busy (i.e., at 0200 hours) or when the Buffer-Ready notification is given.
- 2.02.8.1.10 Provide access to the Records_Since_Notification, Previous_Notify_Time and Current_Notify_Time properties of the Log object so the Operator can troubleshoot logging problems.
- 2.02.8.1.11 Support the Notification-Class property.
- 2.02.8.1.12 Support the Event_Enable property so the Operator can troubleshoot logging problems.
- 2.02.8.1.13 Trending requirements apply to all objects provided in all BACnet Interface Devices provided by others in the Work Trending will be done by the Division 25 BAS Contractor.
- 2.02.8.2 All log data shall be stored in a comma delimited format for parsing by a spreadsheet program such as Microsoft Excel. Log records shall be stored in a consistent manner at all server(s) listed on the Recipient_List so data from different the Division 25 BAS Contractor's BASs can be analysed by the Operator without translation or manipulation. The SQL reporting requirements described in Section 25 15 11 that use log data need not be provided via BACnet.
- 2.02.8.3 Access to the Log_DeviceObjectProperty and the Log_Enable property properties shall be password protected so only selected Operators shall be able to enable and disable logging. Access to the Record_Count shall be password protected so only selected Operators shall be able to delete the log records. The audit trail provisions described above apply to this property. This function may be done in a proprietary manner as a vendor proprietary extension to BACnet.
- 2.02.9 Device and Network Management BIBBs: These BIBBs outline the BACnet objects and services required to interoperably perform the device and network management functions enumerated in Annex K for the BACnet devices defined in this Specification. The network management BIBBs prescribe the BACnet capabilities required to interoperably perform network management functions. All BAS devices provided in the Work by the Division 25 BAS Contractor shall support all BIBBs that are called up in this Specification.
 - 2.02.9.1 Using the Level 0 Front End software, the Operator shall be able to:
 - 2.02.9.1.1 Meet the following requirements for the Device and Network Management BIBBs:
 - 2.02.9.1.1.1 Display at any time the operational status of any device on the BACnet Internetwork.
 - 2.02.9.1.1.2 Display at any time any property of any BACnet object.
 - 2.02.9.1.1.3 Display property values of objects grouped by object type, object location and building system.
 - 2.02.9.1.1.4 Direct a field device to stop transmitting event or alarm notifications until a subsequent command to resume transmissions is received.
 - 2.02.9.1.1.5 Set the time and date in any device on the network that supports time-of-day functionality.
 - 2.02.9.1.1.6 Issue re-initialization commands to any device that supports remote re-initialization.
 - 2.02.9.1.1.7 Backup and restore all BACnet devices (Level 1/1A controllers) on the network.
 - 2.02.9.1.1.8 Command for the establishment or termination of a connection to a remote BACnet network.
 - 2.02.9.1.1.9 Display and modify the routing table entries in all BACnet half-routers and routers in the Work.

- 2.02.9.1.2 For network and device communication faults, the proprietary BAS programming language or Event Enrollment objects shall cause one or more of the BV Status_Flags to generate an alarm condition. Device network communication faults shall be treated as critical alarms.
- 2.02.9.1.3 Support uploading and downloading of BAS device programming described in Section 25 13 16 using the Program, the File object or other BACnet objects/services.
- 2.02.9.1.4 The Out_Of_Service property shall be writable using BACnet services for the Program object.

2.03 BAS Device Network – BACnet Internetwork Communications Requirements

- 2.03.1 All devices provided in the Work shall operate on the BACnet Internetwork. See Section 25 13 16 3.06 for allowable devices and protocols in the Work.
 - 2.03.1.1 These devices shall have a communications port for connections with the Operator interfaces (e. g., server, POT), which is described in detail elsewhere in this Specification.
 - 2.03.1.2 Where permitted by Section 25 13 16 3.06, devices may use:
 - 2.03.1.2.1 BACnet MS/TP.
 - 2.03.1.2.2 ~~BACnet Ethernet~~ **BACnet Ethernet is no longer allowed.**
 - 2.03.1.2.3 BACnet/IP or BACnet/WS is permissible only if the device supports one (1) of the other protocols as a separate IP network drop may not be available or permitted by the Owner for security reasons.
 - 2.03.1.3 Communications services over the BACnet Internetwork shall result in value-passing that is transparent to the BACnet Internetwork architecture as follows:
 - 2.03.1.3.1 Connection of a POT to any one (1) Level 1/1A and Level 2 BAS device on the Internetwork shall allow the Operator to interface with all other devices as if that interface were locally connected to the other devices. Data, status information, reports, system software, custom programs, etc., for all devices shall be available for viewing and editing from any one (1) device on the Internetwork.
 - 2.03.1.3.2 All database values (i.e., points, software variable, custom program variables) of any one (1) device shall be readable by any other device on the Internetwork. This value passing shall be automatically performed by a device when a reference to an object name not located in that device is entered into the device's database. An Operator/installer shall not be required to set up any communications services to perform Internetwork value passing.
 - 2.03.1.4 The time clocks in all devices shall be automatically synchronized daily via the Internetwork. An Operator change to the time clock in any device shall be automatically broadcast to all devices on the Internetwork.

2.04 BAS Device Network – Data Communications/Network Requirements

- 2.04.1 Each BAS device shall perform all specified control functions in a completely independent, stand-alone manner.
- 2.04.2 The BAS devices shall communicate with each other on an Internetwork, sharing point information and control instructions completely independent of the Front End.
- 2.04.3 The Level 0 Front End software shall transparently access all BAS device information.
- 2.04.4 The BAS communications network architecture shall transparently allow exchange of data and execution of programs across individual networks without the presence of a host processor or Front End (Level 0) computer.
- 2.04.5 The network shall permit POT to BAS device communications.
- 2.04.6 Where required by the project-specific conditions of the Work, at least one (1) device in each BAS in each building shall simultaneously, and continuously without any time limit, support:
 - 2.04.6.1 A local alarm printer plugged into a BAS device or server
 - 2.04.6.2 Communication by local, LAN or WAN connection from the server
 - 2.04.6.3 Communication by local, LAN or WAN connection from the POT
- 2.04.7 There shall be a continuous update of input and output values and programming.
 - 2.04.7.1 All connected points shall be configurable to be updated at a maximum interval rate of once per second.

- 2.04.7.2 If the device data scan rate is slower than once per second, the device shall buffer this data so that it is available for trending by the Operator.
- 2.04.7.3 BAS devices shall be able to execute BAS PID control loops at a selectable frequency of at least once per second. Devices shall scan and update the process value and output generated by this calculation at twice this same frequency.
- 2.04.8 Global data shall be available for use by any BAS device on the network(s) as inputs or outputs to its resident control programs.
- 2.04.8.1 Any Level 1/1A device pass global data from at least forty (40) objects (e. g., OAT) using UnconfirmedCOVNotifications.
- 2.04.9 Level 1/1A BAS devices shall have the following data communications/network error recovery/fault protection features:
 - 2.04.9.1 Single or multiple Level 1/1A BAS device failures shall not cause loss of communications between the remaining functional Level 1/1A BAS devices.
 - 2.04.9.2 As a peer device on a BACnet network, each Level 1/1A BAS device shall have equal rights for data transfer and shall report in its predetermined time slot. Devices using BACnet MS/TP are deemed to meet this requirement
 - 2.04.9.3 No single Level 1/1A BAS device shall be statically assigned as the communications master for the Level 1/1A network, but each device on the network shall be able to dynamically take over the function of network monitor to ensure that loss of any single device will not cause total network failure.
 - 2.04.9.4 All data transmissions must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgements shall immediately force a data re-transmission:
 - 2.04.9.5 All devices provided in the Work shall have built in communications and device fault detection.
 - 2.04.9.5.1 BACnet devices have this capability as this is a requirement in the standard. The Level 0 Front End software shall proactively supervise all Level 1/1A devices by periodic polling of their Device object System_Status properties. Failure to reply to a ReadProperty request, or the receipt of an error, or a status other than OPERATIONAL shall constitute a communications or BAS device failure. It shall be recognized as such by the network, and shall the Level 0 Front End software shall generate and alarm. The alarm shall be recorded on the Level 0 Front End alarm log.
 - 2.04.9.5.2 Where other protocols are specified in Section 25 13 16 3.06, devices shall meet this requirement, which are as follows:
 - 2.04.9.5.2.1 Level 1/1A BAS devices with no data to transmit must send an "I'm OK" message each communications or scan cycle. Lack of an "I'm OK" message after successive retries shall constitute a communications or BAS device failure, be recognized as such by the network, and shall generate and alarm. The alarm shall be recorded on the Level 0 Front End software alarm log.
 - 2.04.9.5.2.2 Provide each BAS device with a communications watchdog to ensure that an individual BAS device cannot permanently "occupy" the communications network. If a BAS device is determined to be "babbling". A babbling node is a situation where a node sends out small packets in an infinite loop in order to check for some information such as status reports or to identify themselves (see Anomaly Detection in IP Networks Marina Thottan and Chuanyi Ji TRANSACTIONS ON SIGNAL PROCESSING, VOL. 51, NO. 8, AUGUST 2003") Such nodes shall be automatically shut down and a flag set to annunciate this fact. Activation of this flag shall be treated as a critical alarm.
 - 2.04.9.5.2.3 Error recovery and communication initialization routines shall be completely distributed (i.e., each connected BAS device resident on each network).
 - 2.04.9.6 All devices shall provide access to a communications variable or "point" that can be used for alarming network and device communications faults.
 - 2.04.9.6.1 BACnet devices shall support the COMMUNICATION_FAILURE enumeration for objects that have a Reliability property.

- 2.04.10 For reliability, maintainability, and performance, communications networks using MS/TP shall be extendable to twelve hundred (1,200) meters without active links, hubs, or repeaters. Active devices required to extend network transmission cables over 1,200 m [4000 ft.] long shall be totally transparent.
- 2.04.11 All network communications shall have a minimum transmission speed of 38.4 kbps.
- 2.04.12 Each device level shall support the following minimum number of BAS devices of that level.
 - 2.04.12.1 Level 1/1A devices using Ethernet 255
 - 2.04.12.2 Level 3/3A devices using MS/TP 100
- 2.05 **Level 1 Ancillary Devices – Display of Device Data Locally**
 - 2.05.1 Local display of device inputs, outputs and variables shall be located within one (1) meter of the Level 1/1A devices listed in 25 00 11. The following arrangements are acceptable:
 - 2.05.1.1 An LCD screen and keypad (or touch sensitive screen) to view and manipulate all device variables, inputs and outputs. At least eight (8) values shall be displayable per local display. The LCD screen may be an MS/TP device built specifically for this purpose.
 - 2.05.1.2 An integrated LCD screen and keypad (or touch sensitive screen) at every device to display and manipulate the variables, inputs or outputs of that device.
 - 2.05.1.3 A Service Tool or palmtop computer that can plug into each Level 1/1A device on the network (or other options as proposed by the Division 25 BAS Contractor) to display and manipulate the variables, inputs or outputs of that device. A POT is not an acceptable alternative to provide this function. The device may be a third party tool or OEM device that is sold and supported by Division 25 BAS Contractor's Supplier.
 - 2.05.2 The device or devices:
 - 2.05.2.1 Shall permit the Operator to view point status and to command points OFF and ON or to a specific value
 - 2.05.2.2 Shall display the point names complete with units. Devices that display only the point value shall not be used in the Work.
 - 2.05.2.3 May be powered from the device to which they are connected.
 - 2.05.2.4 Shall have a screen that is backlit to enhance readability.
- 2.06 **Level 1/1A, 2/2A and 3 BAS Devices Network – Remote Communications/Alarming**
 - 2.06.1 Provide the following remote communications features when the Server is connected directly to the BAS devices or when the POT is remotely connected to the BAS devices:
 - 2.06.1.1 Alarm and data file transfers handled via secure remote connection shall not interfere with local BAS/Front End communications, nor shall local BAS/Front End communications prevent receiving incoming calls.
 - 2.06.1.2 The Division 25 BAS Contractor shall assume that connection to one (1) or more remote sites will be accomplished via secure connection. The secure connection will be provided by the Owner.
 - 2.06.2 The BAS devices shall connect to the server to:
 - 2.06.2.1 Report all critical and non-critical alarms.
 - 2.06.2.2 Download trend and historical information for archiving.
 - 2.06.2.3 Automatically restore programming by retrieving BAS data from the hard disk in the server.
 - 2.06.2.4 Provide this connection regardless of whether the server is locally connected on the network or accessed remotely via WAN.
 - 2.06.3 The BAS shall transmit critical alarms to the designated Level 0 computer. The message shall conform to alarm requirements described elsewhere in this Specification. All critical alarms shall be echoed to the local alarm printer at the time the alarms occurred.
 - 2.06.4 If the Level 0 computer is remotely connected to the BAS, alarm transmissions shall be programmed to be made according to three (3) distinct time and day schedules, with each schedule permitting up to five (5) Operators being notified in rotation until a positive acknowledgement is received. In scheduling the transmissions, the Division 25 BAS Contractor shall give due consideration to the potential for other buildings being connected in future to prevent overlapping communications activity.
 - 2.06.5 During non-office hours (Operator definable), the BAS devices shall filter and shall set priorities for all alarms to minimise the initiation of alarm transmission to the POT.
 - 2.06.5.1 Critical alarms during this time shall be sent to the POT.

- 2.06.5.2 All alarms occurring during normal office hours (Operator definable) shall be transmitted to the WS.
- 2.06.5.3 All alarms shall be echoed to the local alarm printer at the time the alarms occurred.
- 2.06.5.4 The alarm arrangements for the third time and day schedule shall be Operator definable. See 23 09 00 for a description of the equipment schedules and the Sequences of Operation Section for Project-specific requirements.
- 2.06.6 The Operator shall be able to set a time delay interval before the same alarm is reported again to reduce the number of alarms. The alarm shall repeat at the time delay interval until it is acknowledged by the Operator.
- 2.06.7 Level 3/3A devices need not support alarming if alarms can be generated in higher level devices.
- 2.07 **Level 1/1A BAS Devices Network – Failure Mode Requirements**
 - 2.07.1 All Level 1/1A BAS devices shall be able to operate completely stand alone.
 - 2.07.1.1 In the event of any BAS device failure, all other BAS devices shall utilize the last known values from the failed BAS device or revert to default values for their Sequences of Operation.
 - 2.07.1.2 Selection of last known or default values shall be at the discretion of the Operator.
 - 2.07.2 A designated Level 1/1A BAS device must automatically synchronize all Level 1/1A BAS device clocks throughout the network(s).
 - 2.07.2.1 The network(s) must automatically recognize the failure of the designated clock synchronizing Level 1/1A BAS device and immediately re-assign another Level 1/1A BAS device to assume this responsibility. This feature may be provided in a proprietary manner.
 - 2.07.3 In the event of the loss of normal power to the BAS devices only, there shall be an orderly shutdown of all BAS devices to prevent the loss of database or operating system software.
 - 2.07.3.1 This orderly shutdown shall be Operator programmable.
 - 2.07.3.1.1 Upon a loss of power, an alarm shall be transmitted to all locations.
 - 2.07.3.1.2 Provide a point that monitors the AC power if an internal powerout flag is not available.
 - 2.07.3.1.3 Upon resumption of AC power, the system shall be powered back up as defined by the Operator.
 - 2.07.3.2 Upon restoration of normal power, the BAS devices shall automatically resume full operation without manual intervention.
 - 2.07.3.3 There shall then be an orderly equipment start-up sequence. Transmit successful completion of start-up sequence as a critical alarm.
 - 2.07.4 Shall BAS device memory be lost for any reason, the Operator shall be able to reload the BAS device programming via:
 - 2.07.4.1 A secure connection through the Internet or WAN
 - 2.07.4.2 Local POT connection to a BAS device
 - 2.07.4.3 The LAN from an Level 0 computer
 - 2.07.5 Shall any Level 1/1A BAS device's memory become corrupted or altered for any reason, the BAS device shall automatically initiate a connection with the Front End, and instruct it to retrieve and reload the necessary programming to restart those devices that have corrupted or altered memory. This feature shall be provided as follows:
 - 2.07.5.1 The BAS shall be able to detect differences between the version of software in any device and the version in the Front End
 - 2.07.5.2 The differences (e. g., date of revision, file size) shall be reported to the Operator who shall then have the option of choosing which is the correct version and then make the changes accordingly
 - 2.07.5.3 The Level 0 Front End software shall not automatically assume which is the correct version
 - 2.07.5.4 The Level 0 Front End software shall not automatically begin the process of uploading or downloading unless the Operator has permitted these operations to take place.
 - 2.07.5.5 Level 2/2A and Level 3/3A devices need not support this feature.
 - 2.07.6 All BAS devices shall continuously perform self-diagnostics, communication diagnosis, power supply diagnosis and diagnosis of all ancillary equipment.

- 2.07.6.1 All BAS devices shall provide both local and remote annunciation of any detected component failures, low device battery level or repeated failure to establish communication.
- 2.07.6.2 Indication of the diagnostic results shall:
 - 2.07.6.2.1 Be provided at the Front End.
 - 2.07.6.2.2 Be treated as a critical alarm and shall be transmitted to the Level 0 Front End software.
 - 2.07.6.2.3 Be provided at each BAS device. It shall not require the connection of a computer to retrieve this information. Warning lights on the devices complete with a label explaining the meaning of the lights is sufficient.
 - 2.07.6.2.4 Provide a binary output or other feature to give a visual indication of an alarm on the BAS device to show a device failure. Provide an alarm indicator reset button to allow disabling the alarm indicator for an Operator defined period (configuration to be similar to the existing visual device alarms). The alarm indicator reset button shall not reset the alarm condition; all alarms must be acknowledged from the Level 0 Front End software.
- 2.07.7 Provide software counters for cold starts, warm starts, privilege violation, illegal instructions, address errors, communication errors and zero divide as a diagnostic tool.
 - 2.07.7.1 All error types and counts shall be Operator accessible and shall be controlled through password protection.
- 2.08 **Level 1 BAS Devices Network – Operating System Software Requirements**
 - 2.08.1 Operating system software shall operate in real time, provide task scheduling on a priority basis, control time programs, monitor and manage BAS device to BAS device and BAS device to server/POT communications, scan inputs and outputs, collect trend data, manage alarms and all other functions outlined in this Specification.
 - 2.08.2 The device operating system or BIOS at all device levels shall be stored in flash EPROM to permit firmware upgrades without having to make chipset changes.
 - 2.08.2.1 The Division 25 BAS Contractor has two (2) options with respect to RAM (referred to as memory in the Specification Documents):
 - 2.08.2.1.1 Provide a minimum of seventy two (72) hour battery backed RAM for the real-time clock, BAS programs and data files.
 - 2.08.2.1.2 Provide non-volatile EEPROM or flash EPROM for the real-time clock, BAS programs and data files.
 - 2.08.3 Each BAS device shall have a hardware real-time clock, accurate to within ten (10) seconds per month, to provide time-of-day, day-of-week, date, month, and year. A thirty six (36) year calendar with automatic leap year compensation shall be integral with the clock. All devices supplied in the Work shall be Year 2036 compliant as defined elsewhere.
 - 2.08.4 Each Level 1 BAS device required in 25 00 11 shall have sufficient memory to support its own operating system and databases, including all control and alarm programming of I/O points as listed in the Hardware Input/Output Object List by the Division 25 BAS Contractor and data for trending all inputs, outputs and software points or variables for samples as specified in 25 13 16 2.16.
 - 2.08.5 Each Level 1A BAS device required in 25 00 11 that is classed as a B-AAC, shall have sufficient memory to support its own operating system and databases, including all control and alarm programming of I/O points as listed in the Hardware Input/Output Object List by the Division 25 BAS Contractor and data for trending all inputs, outputs and software points or variables for samples as specified in 25 13 16 2.16.
 - 2.08.5.1 If there are memory shortages in one (1) or more devices of any Level, the Division 25 BAS Contractor is allowed to collect trend and store occupancy data in other devices not used to control the point (e.g., in a node controller or gateway or on a hard drive on the BAS device network).
 - 2.08.6 Each BAS device shall contain built-in diagnostics (e.g., device communications faults) that can be used as attributes or properties of objects, for alarming purposes. Variables that detect network communications faults or ensure that the systems automatically fail to heating mode on detecting a network fault shall reside in the device controlling the point.
- 2.09 **Level 1/1A BAS Devices Hardware – Board Design Requirements**
 - 2.09.1 The Manufacturer of the BAS devices shall provide documentation via the Shop Drawing process supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation

- and Servicing). Product literature provided by the Division 25 BAS Contractor shall contain the ISO-9001 Certification Mark from the applicable registrar.
- 2.09.2 The BAS device and associated hardware shall be designed to operate in conditions of 0 C to 44 C [32 F to 111 F] and twenty percent (20%) to ninety percent (90%) non condensing RH.
- 2.09.3 All input and output points in any BAS device shall be equipped with static, transient and short circuit protection. Communication lines shall be protected against static, transients and induced magnetic interference.
- 2.09.4 All outputs must be fused and/or isolated in a manner that is acceptable to the Owner.
- 2.09.5 BAS board packaging shall be such that complete installation and checkout of field wiring can be done prior to the installation of electronic boards.
- 2.09.5.1 All board terminations shall be made via plug-in termination modules to facilitate troubleshooting, repair and replacement.
- 2.09.5.2 The complete BAS device, including accessory devices such as relays, transducers, power supplies, etc., shall be mounted, wired and housed in steel cabinets. Cabinets shall be sized for the expansion requirements specified elsewhere.
- 2.09.6 All BAS devices shall be equipped with diagnostic LED indicators or be available at the local data display unit, for the following:
- 2.09.6.1 Transmit
- 2.09.6.2 Receive
- 2.09.6.3 Power up test
- 2.09.6.4 Power up fail
- 2.09.6.5 Power up test OK
- 2.09.6.6 Low battery
- 2.09.6.7 Communications error
- 2.09.6.8 Binary input and output status
- 2.09.6.9 Status of HOAs and analog potentiometers (light brightness shall be in proportion to output signal strength)
- 2.09.7 All BAS devices and network components shall:
- 2.09.7.1 Be fault tolerant and provide satisfactory operation without damage within $\pm 10\%$ rated voltage and ± 3 Hz variation in line frequency.
- 2.09.7.2 Perform an orderly shutdown below eighty percent (80%) nominal voltage.
- 2.09.7.3 Be protected against electrical noise of five (5) to one hundred and twenty (120) Hz and from keyed radios up to five (5) W at 1 m [3 ft.]

2.10 Level 1/1A BAS Devices Hardware – Input and Output Requirements

- 2.10.1 All input and output points shall comply with the IEEE 472 Standard for surge with-stand capability.
- 2.10.2 Binary input types that shall be supported are:
- 2.10.2.1 Normally open contacts
- 2.10.2.2 Normally closed contacts
- 2.10.2.3 Current/no current
- 2.10.2.4 Voltage/no voltage
- 2.10.2.5 Pulse accumulation sufficient to accommodate high speed pulsed inputs up to two (2) kHz (e.g., water meter)
- 2.10.3 All analog inputs shall be universal in type and shall handle current, voltage or resistance in any mix. Analog current and voltage inputs of the following types shall be supported:
- 2.10.3.1 4-20 mA
- 2.10.3.2 0-5 V
- 2.10.3.3 0-10 V
- 2.10.3.4 2-10 V
- 2.10.3.5 All analog inputs must exhibit common mode signal rejection greater than sixty (60) dB to sixty (60) Hz.
- 2.10.3.6 Provide programmable intermediate ranges and linearization tables for sensor types listed under the sensor section of this Specification

- 2.10.4 Level 1/1A BAS devices shall accommodate both binary and true analog outputs. True analog outputs means that the output is not a pulsed binary output that is fed into a transducer.
 - 2.10.4.1 Voltage (0-10 V) and current (4-20 mA) outputs shall be accommodated.
 - 2.10.4.2 All analog outputs shall be proportional type with a minimum incremental resolution of one percent (1%) of the full operating range of the actuating device.
 - 2.10.4.3 The proportional range of the output shall be matched to the full operating range of the actuating device.
 - 2.10.4.3.1 Zero and maximum output values shall be used for shut down and close-off modes.
- 2.10.5 Binary outputs on Level 1/1A devices shall handle continuous maintained, as well as pulsed outputs for momentary or magnetic latching circuits. There shall be a minimum one second increment resolution for ON and OFF.
 - 2.10.5.1 Provide potentiometers for all analog outputs on I/O points and all Level 1/1A devices that support hardware outputs. Provide HOAs for all binary outputs in all devices on the network on Level 1/1A devices that support hardware outputs.
 - 2.10.5.1.1 Potentiometers and HOAs shall:
 - 2.10.5.1.1.1 Operate when power or memory is lost to the device.
 - 2.10.5.1.1.2 Be on board the BAS device (with approval by the Owner, a potentiometer on the transducer and an outboard HOA may be sufficient to meet this requirement).
 - 2.10.5.1.1.3 Level 1 devices that do not have the capability to control hardware outputs do not have to meet this requirement.
 - 2.10.5.1.1.4 Operator shall be able to tell from POT or server if any point has been manually overridden from the onboard HOA (for binary outputs) or the onboard potentiometer (for analog outputs) on Level 1A devices.
 - 2.10.5.1.1.5 Level 1 devices that do not have the capability to control hardware outputs do not have to meet this requirement.
- 2.10.6 Multiplexing devices such as DMUXs to multiplex outputs or inputs are not allowed under any circumstances in the Work.
- 2.10.7 Extender boards plugged into BAS devices or external devices that provide input/output point expansion capability to standalone devices shall be powered from the same power supply as the devices to which they are connected and shall be in the same room within line of sight, or shall reside within the same cabinet assembly. Extender boards shall comply with all other requirements of Section 25 13 16 ~~2-12~~.
- 2.10.8 There shall be no more than one (1) transducer between any BAS device output and the end device.
- 2.11 **Level 1/1A BAS Devices Software – General Requirements**
 - 2.11.1 BAS devices shall operate totally stand alone and independent of a Front End for all specified control applications. Software shall include:
 - 2.11.1.1 A complete operating system
 - 2.11.1.2 Alarming and communications facility
 - 2.11.1.3 Trending facility
 - 2.11.1.4 Custom BAS programs to comply with the control strategies as called for in the Sequences of Operation section of this Specification
 - 2.11.1.5 Standard control algorithms and specific Sequences of Operation
 - 2.11.1.6 An Operator custom control and calculation package complete with interpreter and compiler
 - 2.11.2 Text-based, function block-based and graphics-based programming shall be considered as equals under this Specification providing all the features are provided as specified.
 - 2.11.3 The database for each physical or virtual point must only require definition once, regardless of the number of locations where it is used.
 - 2.11.4 The BAS devices shall store Operator Control Language (OCL) source code (i.e., the programming statements in the Working Language, function blocks or graphical programming information), programming (text or graphic programming), and Object code (i.e., machine language or compiled code) that can be read by the Operator in non-volatile memory. At minimum, source code for the BAS device network must be stored in the Level 0 server designated by the Owner.

- 2.11.5 If parts of the program are not resident in the devices, the Division 25 BAS Contractor shall provide the necessary software to make backups so the programming in the devices and the computer hard drive can be restored.
- 2.11.6 Source and object code for text-based or line-by-line programmed devices shall be available for inspection, modification, uploading and downloading by the Operator, using any Level 0 computer. The BAS shall support uploading and downloading of source and object code by using the Front End software.
 - 2.11.6.1 For devices using graphical programming systems, the Operator shall be able to use the Level 0 Front End resident the BAS server or other Level 0 device to retrieve revised code from a device without having to obtain a copy (electronically) from the person who made the edits. The options that will be considered by the Owner include:
 - 2.11.6.1.1 Using the Front End program to retrieve and de-compile the revised programming.
 - 2.11.6.1.2 Converting the graphical programming to text-based programming. The conversion shall be one hundred percent (100%) complete and accurate and the conversion shall not require editing or manual formatting.
 - 2.11.6.1.3 Downloading the revised programming that has been saved to the server hard drive.
- 2.12 **Level 1/1A BAS Devices Software – Point Processing Software Requirements**
 - 2.12.1 Provide, in memory (firmware) of all BAS devices, consistent operating rules and procedures, in form and function, specifically:
 - 2.12.1.1 Operator Control Language (OCL)
 - 2.12.1.2 Configuration process
 - 2.12.1.3 Calibration process
 - 2.12.1.4 Point definition
 - 2.12.1.5 Data retrieval and display
 - 2.12.1.6 Override control
 - 2.12.1.7 Alarm definition
 - 2.12.1.8 Trend definition
 - 2.12.1.9 Report definition
 - 2.12.2 The OCL running in the Level 1/1A BAS devices shall support the following requirements:
 - 2.12.2.1 The language shall permit statements to be constructed of multiple variables (or software points), and Boolean operators (AND, OR, NOT) without a fixed limit. Provide a feature to set line breaks as required,
 - 2.12.2.2 The language shall permit a mixture of logical and mathematical expressions in program statements,
 - 2.12.2.3 There shall be no restrictions on the order of Boolean operators (AND, OR, NOT) in program statements,
 - 2.12.2.4 The language shall support floating point and integer mathematical calculations,
 - 2.12.2.5 Provide a means of identifying programming lines by numbers or by names,
 - 2.12.2.6 Provide at least five (5) levels of parenthesis.
 - 2.12.3 The software shall include safeties to prevent equipment cycling:
 - 2.12.3.1 If one (1) line of software turns a piece of equipment ON, and then the next line turns the same piece of equipment OFF the software shall safeguard against rapid cycling of equipment due to programming error.
 - 2.12.3.2 If anti-cycling is not a built in feature, programming that checks for alarms and safeties for a piece of equipment shall be structured in such a manner so as to prevent equipment cycling.
 - 2.12.4 All setpoints shall be soft coded via variable or pseudo-points. Hard coded setpoints (MAT.SP = 13 C [55 F]) are not to be used in the Work.
 - 2.12.5 Setpoints and variables shall be named following a naming convention that is approved via the Shop Drawing process, as detailed in Section 25 00 33.
 - 2.12.6 The OCL shall allow comments to be inserted into the programming code regardless of whether the Division 25 BAS Contractor uses text, graphical or function-block based programming.
 - 2.12.6.1 These comments shall be resident in the BAS devices and available at the POT and the server.

- 2.12.6.2 The Division 25 BAS Contractor shall at minimum, provide one (1) 32-character line comment per logical block of code (i.e., an IF-THEN-ELSE, DO-WHILE or DO-UNTIL) explaining the purpose of the code block.
- 2.12.7 BAS device software shall be able to use either Imperial or Metric (SI) units in calculations, displays, etc. Selection of units on a point by point basis shall be at the Owner's discretion.
- 2.12.8 Provide Analog to Digital (A/D) conversion, scaling and offset, correction of sensor non-linearity, and no-response sensing of failed sensors.
 - 2.12.8.1 Both the maximum and minimum values sensed for each analog input shall be retained in memory (configurable retention period).
 - 2.12.8.2 It shall be possible to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full scale readout.
- 2.12.9 Command control software shall manage the receipt of commands from the server console, POT and from control programs.
 - 2.12.9.1 Each command shall be assigned a priority or execute in a hierarchical order to prevent contentions created by multiple programs having access to the same I/O point or internal variable.
 - 2.12.9.2 A "disabled/override mode" option shall be supported to allow input points, output points and internal variables in BAS control programs to be set to a fixed state or value. Input points, output points and internal variables shall be assigned the highest command priority to prevent override by application programs when in the "disabled/override mode".
- 2.12.10 Each BAS device shall have resident in its memory and available to the programs, a full library of BAS algorithms, intrinsic control operators, and mathematical, logical and relational operators for implementation of Sequences of Operation, including:
 - 2.12.10.1 Addition
 - 2.12.10.2 Subtraction
 - 2.12.10.3 Multiplication
 - 2.12.10.4 Division
 - 2.12.10.5 Square Root
 - 2.12.10.6 Exponents
 - 2.12.10.7 Absolute Value
 - 2.12.10.8 Greater Than
 - 2.12.10.9 Less Than
 - 2.12.10.10 Equal to
 - 2.12.10.11 AND [Boolean Logic]
 - 2.12.10.12 OR [Boolean Logic]
 - 2.12.10.13 NOR [Boolean Logic]
 - 2.12.10.14 NOT [Boolean Logic]
 - 2.12.10.15 Exclusive OR [Boolean Logic]
 - 2.12.10.16 Average
 - 2.12.10.17 Maximum
 - 2.12.10.18 Minimum
 - 2.12.10.19 Values from Operator defined lookup tables
 - 2.12.10.20 Logical operators including TRUE, FALSE, BETWEEN, ONTIME, OFFTIME
 - 2.12.10.21 System variables including TIME, DATE, HOUR, MINUTE, SECOND, DAY, DAY-OF-MONTH, YEAR
- 2.12.11 The language shall support the following logical structures and expressions:
 - 2.12.11.1 IF-THEN-ELSE
 - 2.12.11.2 DO-WHILE
 - 2.12.11.3 DO-UNTIL
 - 2.12.11.4 BEGIN-END
 - 2.12.11.5 DO-EVERY and END-DO
 - 2.12.11.6 GO TO
 - 2.12.11.7 Go to a subroutine and then return
 - 2.12.11.8 Exit program loop
 - 2.12.11.9 Exit program

- 2.12.12 The language shall support the following point commands:
 - 2.12.12.1 Binary output commands START and STOP.
 - 2.12.12.2 Analog output commands such as setting an analog output device to a set value.
- 2.12.13 The language shall support the creation of schedules:
 - 2.12.13.1 Each schedule shall have a minimum thirty (32) character identifier.
 - 2.12.13.2 Provide an annual schedule that allows for the identification of major and special holidays for each major piece of equipment listed on the Points List.
 - 2.12.13.3 Provide a seven (7) day, twenty four (24) hour, weekly schedule for each major piece of equipment listed on the Points List.
 - 2.12.13.4 The schedule shall be available for editing at any Level 0 Front End software package that is BACnet-based.
- 2.12.14 Provide a reasonability check on all analog inputs against the previously read value and discard those values falling outside pre-programmed reasonability limits.
- 2.12.15 Provide analog input alarm comparison with two (2) individual sets of high and low limits (warning and actual alarm) to an input or a set of floating limits (alarm follows a reset schedule or BAS control point) to the input.
 - 2.12.15.1 Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm.
 - 2.12.15.2 Alarm comparisons shall be made each scan cycle.
 - 2.12.15.3 De-bounce binary inputs to prevent nuisance alarms. De-bounce timing shall be adjustable from one (1) second to two (2) minutes in one (1)-second increments.
- 2.12.16 Provide facility for automatic tuning of all PID loops.
- 2.12.17 Provide facility for optimum start/stop of equipment based on a variety of conditions outlined in the Sequences of Operation.
 - 2.12.17.1 If an optimum start/stop program integral to the device is used, provide equations and/or a description of the logic for review via the Shop Drawing process. If not integral to the device, the Division 25 BAS Contractor shall program the optimum start/stop programs following the conditions outlined in the Sequences of Operation.
- 2.12.18 BAS control programs shall include assignment of initial values to all outputs to ensure that controlled devices assume a fail-safe position on initial system start-up.
- 2.12.19 All software shall be written by the Division 25 BAS Contractor and shall be evaluated by the Owner to comply with the following programming practices:
 - 2.12.19.1 The software design shall follow structured programming principles.
 - 2.12.19.2 Use of GO TO statements shall be kept to a minimum. All uses of GO TO statements shall be fully justified to the Owner and shall be removed, if requested to do so by the Owner. If a subroutine capability is supported, use of GO TO statements shall not be permitted.
 - 2.12.19.3 There shall be top down flow to the programming with subroutine calls to start and stop devices so that code can be easily understood and debugged by the Operator.
 - 2.12.19.4 Only one (1) logical block of programming or subroutine shall be used to control a device. For example, a valve or a damper shall be controlled by one (1) block even though there may be several parameters used to calculate the valve or damper setpoint. There shall be only one (1) exit and one (1) entry point in the logical block. Multiple exit and entry points are not allowed.
 - 2.12.19.5 All hardware and software points shall be labelled with the point name wherever it is used in software. For example, if OAT is Input 23, then OAT shall appear in the programming code – not Input 23.
- 2.13 **Level 1/1A BAS Devices Software – Point Naming Requirements**
 - 2.13.1.1 See 25 05 53 2.04 for details.
- 2.13.2 Identical point names on the same BAS device network are permitted providing they can be uniquely identified by using the naming convention prefix specified in 25 05 53 2.04 to identify the point.
- 2.14 **Level 1/1A BAS Devices Software – Audit Trail Requirements**
 - 2.14.1 At least one Level 1 and one Level 1A device shall support all of the following:

- 2.14.1.1 The device shall provide an audit trail of at least the last one hundred (100) events.
- 2.14.1.2 Access to the audit trail shall be password protected.
- 2.14.1.3 The audit trail shall record all logons/logouts and all changes to software, scheduling, trends, etc.
- 2.14.1.4 The audit trail file shall show the identity (ID) of the person making the changes, and the date and time that the changes were made.
- 2.14.1.5 The audit trail shall also include accesses to the BAS device network via the Owner's Intranet. It shall record the same information as outlined above.
- 2.14.1.6 The audit trail file shall be accessible only to Administrators access to the device. This may be done using vendor-proprietary BACnet objects and services.
- 2.14.1.7 The audit trail shall be resident in the device for this feature.

2.15 Level 1/1A BAS Devices Software – Password Protection Requirements

- 2.15.1 Operator access to the BAS must be password protected for entry at Level 0 computers at all levels of BAS devices.
- 2.15.2 There shall be at least four (4) access privilege classes at each device Level on the system.
- 2.15.3 Assignment of unique password and access privileges shall be supported for each level.
- 2.15.4 The requirements of this section shall also apply to accesses via the Owner's Intranet.
- 2.15.5 Password protection shall be on a point by point basis.

2.16 Level 1/1A BAS Devices Software – Trending Requirements

- 2.16.1 The value of each input, output and calculated variable shall be available in the database for historical and dynamic trending and display.
- 2.16.2 Each Level 1 BAS device shall retain within memory, a trend log of seventy two (72) hours of all I/O points and system variables from within its database and those of any Level 1, Level 2/2A or Level 3 BAS devices that network directly from it, if the Level 2/2A or Level 3 BAS devices do not have trending capability.
- 2.16.3 Provide trending in all device levels. Trending for Level 2/2A and Level 3 devices may be done in the Level 1/1A devices if there is not adequate memory for trending hardware or software point data in the Level 2/2A and Level 3 devices.
- 2.16.4 At minimum, the seventy two (72) hours' worth of data shall be stored as one hundred and forty four (144) values sampled over a thirty (30) minute interval. The BAS shall permit the Operator to trend the one hundred and forty four (144) values as:
 - 2.16.4.1 An averaged value
 - 2.16.4.2 A minimum value
 - 2.16.4.3 A maximum value
 - 2.16.4.4 An instantaneous value at the end of the time interval
 - 2.16.4.5 Operator definable exceptions to changes in points (e. g., variances to setpoints that are greater than 2 C [3.5 F])
 - 2.16.4.6 The number of occurrences of a definable value or the number of changes of state
- 2.16.5 Change of value (COV) trending is encouraged but COV trending does not substitute for, nor obviate the memory requirement for trending in the Specification Documents. COV trending methods may be used as a data compression routine to reduce memory consumption (e. g., storing AHU fan stop starts) providing the data can be uncompressed and presented as one hundred and forty four (144) values sampled over a thirty (30) minute interval, as outlined in 25 13 16 2.18.
- 2.16.6 The trend log length shall be Operator definable from one (1) to at least two hundred (200) samples.
- 2.16.7 Intervals shall be definable in one (1) second intervals from one (1) second to at least twenty four (24) hours.
- 2.16.8 The BAS shall pass to the server if the server is locally connected onto the BAS network, and shall download this trend data to the server for storage on the hard drive, when any device's memory is full, or on a scheduled basis, as defined by the Operator.
- 2.16.9 The Division 25 BAS Contractor shall set up trends for every hardware and software point that are accessible in the server for each network. These trends shall not count as a report or a graphic. The Owner shall specify the trend parameters for each point. Trend reports shall be grouped in a logical manner specified by the Owner (e.g., by AHU).
- 2.16.10 The Division 25 BAS Contractor shall provide the trend reports in spreadsheet form with a common time base for a group of points.
- 2.16.11 Provide extended trend logging (i.e., samples longer than 1000) to the server computer hard drive for points such as meter data. The Division 25 BAS Contractor shall provide a minimum of five hundred (500) trend logs as extended trends.

2.17 Level 1/1A BAS Devices Software – Troubleshooting Requirements

- 2.17.1 All BAS devices shall include a trace function in its operating system to identify which program line(s) or manual command is in control of a given point and how long the program has been on that programming line or in a particular subroutine. Graphical programming shall offer a similar feature (i.e., how long a program has been on a specific graphical component or function block, or which segment or thread is being executed).
- 2.17.2 The Operator shall be able to download a copy of the device database (i.e., programming, database definition, object definitions) for review in an ASCII editor, a word processing/graphics program or a proprietary program supplied by the Division 25 BAS Contractor.
- 2.17.3 All BAS devices shall have a troubleshooting function to permit a single execution of the entire program to determine which lines of code or components of graphical/function block programming have been executed.
- 2.17.4 All references to a given input point, output point, or internal variable shall be easily located in any device on the network from any device by a FIND command.
 - 2.17.4.1 The FIND command shall support the use of DOS-style wildcarding (e. g., issuing a *.TMP command causes the listing of all temperatures in one (1) device or across the BAS network). If the FIND command is not supported, the Division 25 BAS Contractor shall provide a list or report or group of all hardware and software points on the network. The software shall use the group point as any other software point in the BAS. The list shall be available from any computer using BACnet-based Level 0 Front End software. The Division 25 BAS Contractor shall provide a minimum of thirty (30) groups selected by the Owner.
- 2.17.5 The device software shall support at the command line or write a program to list all manual/disabled hardware and software points/programs on the network. The command or program shall be available at using BACnet-based Level 0 Front End software. The list of disabled points or programs shall be dynamically updated.
- 2.17.6 If requested during the Commissioning process, the Division 25 BAS Contractor shall provide the Owner with all software and hardware to permit the BAS to run an accelerated time base to simulate conditions. The simulation shall permit for example, a 1 C/min [1.5 F/min] change for -30 C to +30 C [-22 F to 88 F] to outdoor air temperature to permit the Operator to see how the software provides heating, free cooling and finally mechanical cooling, in response to outdoor air temperature changes.
- 2.17.7 All BAS setpoints, gains and time constants associated with BAS programs shall be available to the Operator for display and modification using BACnet-based Level 0 Front End software.

2.18 Level 1/1A BAS Devices Software – Runtime Accumulation Requirements

- 2.18.1 Runtime of an output shall be accumulated based on the status of a binary input point. Where no status point is provided on a piece of equipment (e. g., an exhaust fan), provide run time point variable based on the ON and OFF time of the output point. The BAS shall support the following runtime requirements:
 - 2.18.1.1 The BAS shall support totalising ON time and OFF time up to ten thousand (10,000) hours. Tantalizations based on the ON time or the OFF time shall be Operator selectable.
 - 2.18.1.2 Runtime counts shall be resident in memory and have BAS resident runtime alarm limits assignable through the POT.
 - 2.18.1.3 A runtime maintenance alarm shall automatically be displayed on selected POT (if connected), alarm printer or server when runtime limits listed in the Sequences of Operation Sections have been exceeded.
 - 2.18.1.4 The alarm shall only be reset by acknowledging the alarm and zeroing the counter.
- 2.18.2 Provide a transition counter to accumulate the number of times a device has been cycled ON or OFF.
 - 2.18.2.1 Counter shall be resident in non-volatile memory, and shall accumulate ten thousand (10,000) switching cycles in memory.
 - 2.18.2.2 Transition counters shall be resident in non-volatile memory and have BAS resident runtime alarm limits assignable through the POT or server.
 - 2.18.2.3 A transition counter alarm shall automatically be displayed on selected POT (if connected), alarm printer or any BACnet-based Level 0 Front End software, when transition counter limits specified by the Operator or listed in the Sequences of Operation, have been exceeded.
 - 2.18.2.4 The alarm shall only be reset by acknowledging the alarm and zeroing the counter.
- 2.18.3 The identification of the Operator who zeroed the runtime and transition counters shall be logged to the audit trail per 25 13 16 2.14.

2.18.4 Provide runtimes for all binary outputs. Set default runtime alarm counter to 1000 hours.

3 - EXECUTION

3.01 Location

3.01.1 Location of BAS devices and cabinets shall be approved by the Owner.

3.02 Installation

3.02.1 Install BAS devices in secure locking enclosures.

3.02.2 Provide necessary power from local branch circuit device for equipment. See the Division of Responsibilities table for the Trade responsible for this function.

3.02.3 This Division is responsible for installing tamper locks on breakers of circuit breaker device for any circuit breaker providing power to a BAS device provided by this Division as part of the Work.

3.03 Provision of Proprietary Objects in the Work

3.03.1 The following requirements are project specific:

3.03.1.1 Division 25 BAS Contractor must provide full disclosure of the operational details of the objects and their properties for all proprietary objects and proprietary services used in the Work.

3.03.1.2 The Division 25 BAS Contractor may create proprietary macro objects to represent equipment such as boilers, AHUs etc. The Owner shall review these objects and their proposed properties via the Shop Drawing process in Section 25 00 33.

3.03.1.3 The Owner shall provide this information to other Division 25 BAS Contractors who will be providing equipment in the future that will reside on the Intranet at the Place of Work in order to achieve interoperability.

3.04 Network Performance Test

3.04.1 The Owner may ask for a demonstration of the BAS device network alarm transmission performance under normal operating conditions. The Division 25 BAS Contractor shall provide this demonstration if requested to do so. The test criteria to test this performance requirement shall be as follows:

3.04.1.1 The network shall be fully operational for the test complete with BACnet features installed. Fully operational is defined as follows:

3.04.1.1.1 The BAS device network shall be fully loaded with all the required programming running.

3.04.1.1.2 All trends and groups that need to be defined for the network shall be set up and running. The minimum levels of trending and grouping are defined elsewhere.

3.04.1.1.3 One (1) POT shall be attached on the network and shall be used to make inquiries during the test so as to impose an I/O load on the network.

3.04.1.1.4 There shall be at least one (1) operational graphic and one (1) dynamic trend complete with six (6) points being displayed on the server computer monitor.

3.04.1.2 With the network fully operational, the Division 25 BAS Contractor shall then generate sixty (60) different alarms on the system (including fan status alarms, maintenance alarms, etc.). All sixty (60) alarms shall be received at the Level 0 Front End software monitor alarm window within two (2) minutes. The server shall be connected via WAN to the BAS device network. The data need not be printed during the test.

3.04.1.3 If the network fails this performance test, the Division 25 BAS Contractor shall upgrade the BAS devices, adjust programming or make other changes until network passes the test. Any changes made shall not reduce the requirements of the Specification (e.g., reducing trending volumes to increase network throughput).

3.05 BAS Device Network – Architecture Requirements of the BAS Device System Network

3.05.1 All devices in the network, with the exception of those device levels identified elsewhere in the Specification, shall be Level 1 or 1A devices only. At least one device shall be a Level 1 device. The remaining devices shall be Level 1A.

3.05.1.1 The Division 25 BAS Contractor shall provide enough Level 1 devices to accommodate the requirements outlined in Sections 25 13 16 2.18 and 25 13 16 2.08.5.

- 3.05.1.2 The network shall use no more than three (3) levels of programmable control devices (including Level 0). The requirements for where devices of specific levels can be used, is specified in this Division.

3.06 Devices And Network Media Allowed In The Work

- 3.06.1 NOTE: THE REQUIREMENTS LISTED IN THIS CLAUSE SUPERCEDE THE GENERAL REQUIREMENTS OF CLAUSE 2.01 IN THIS SPECIFICATION SECTION.

3.06.2 Level 0 devices:

- 3.06.2.1 Devices supplied and installed by this Division shall communicate with Level 1/1A devices located on the BACnet Internetwork. They shall use the BACnet protocol. They shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8 respectively as outlined in ASHRAE Standard 135-2024 (or latest published version), to communicate with BACnet objects located in devices on the BACnet Internetwork.
- 3.06.2.2 Devices such as printers that do not use BACnet but are not directly connected to the BACnet Internetwork, are permitted to be installed in the Work.
- 3.06.2.3 Level 0 devices may use BACnet/IP or BACnet/WS when communicating to other Level 0 and Level 1/1A devices that are located on an IP network or subnet.
- 3.06.2.4 Level 0 devices may use the ISO/IEC 8802-3 ("Ethernet") Data Link/Physical layer protocol when communicating to Level 1/1A, 2/2A and 3/3A devices located within a building.
- 3.06.2.5 Devices that support multiple communications protocols shall have access to all other protocols except BACnet turned off or disabled so the device communicates as a native BACnet device, per the definition in this Specification.
- 3.06.2.6 The following applies to vendor proprietary extensions or features to the BACnet standard:
- 3.06.2.6.1 Devices of this type that use proprietary mechanisms to represent BACnet objects and services that are approved in the current version of the standard not allowed in the Work.
- 3.06.2.6.2 Devices that use proprietary extensions of BACnet to meet an item in the Sequence of Operations (e. g., a room controller that controls a VAV box or reheat coil), or to provide a vendor specific feature (e. g., a local display of temperature or time of day) may be used in the Work with permission of the Owner.
- 3.06.2.6.3 Devices that implement of BACnet features (e. g., BACnet/SC etc.) are allowed in the Work and will be evaluated based on the current version of the feature.
- 3.06.2.7 Level 0 protocol translation devices may be used where there is a need for translation of one BACnet supported protocol (BACnet/WS, BACnet/IP, ~~BACnet Ethernet~~, BACnet MS/TP, BACnet LonTalk, BACnet ARCNET, BACnet ZigBee, and BACnet PTP).
- 3.06.2.8 The following applies to devices that are considered gateways in this Specification.
- 3.06.2.8.1 Devices that use any other protocols other than those supported by the BACnet standard shall be considered gateways and shall only be used with the prior permission of the Owner or where this Division is responsible for integrating non-BACnet devices into the BACnet Internetwork.
- 3.06.2.8.2 Where a Level 0 device is allowed in the Work as a BACnet gateway, the Owner will allow the objects to be created in a proprietary manner in non-BACnet BAS devices and then create duplicate BACnet objects in a Level 0 WS that functions as a BACnet gateway in order to provide the interoperable functions required by the Sequence of Operations.
- 3.06.2.8.3 When a Level 0 computer functions as the gateway, the Level 0 computer shall be upgraded or sized as required to comply with the specified network throughput requirements imposed by BACnet.
- 3.06.2.8.4 If support for BACnet objects and services is not provided directly within the proprietary Front End, the Division 25 BAS Contractor shall create pseudo-points or variables in their proprietary systems for alarming, trending and scheduling needed to comply with the Sequences of Operation. Audit trails may be done in a proprietary manner.
- 3.06.2.8.5 The use of gateways is restricted to integrating in proprietary points into the BACnet Internetwork.

- 3.06.2.9 Devices using LonTalk protocol or proprietary or legacy protocols that are tunnelled over an IP network, are not allowed by the Owner unless the device is specified in the Work or is provided by others for integration into a common Internetwork by this Division.
- 3.06.2.10 A Level 0 device that functions as a BACnet/LonWorks gateway may only be used for communications with LonWorks Level 1/1A, 2/2A or 3/3A devices supplied by others in the Work.
- 3.06.3 Level 1/1A devices:
 - 3.06.3.1 Devices supplied and installed by this Division shall communicate with all other devices located on the BACnet Internetwork shall use the BACnet protocol. Devices supplied and installed by this Division that use protocols other than BACnet are not allowed in the Work. These devices shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8 respectively as outlined in ASHRAE Standard 135-2024 (or latest published version), to communicate with BACnet objects in the BACnet Internetwork.
 - 3.06.3.2 Devices that support multiple communications protocols as well as BACnet shall have access to all other protocols except BACnet turned off or disabled so the device communicates as a native BACnet device, per the definition in this Specification.
 - 3.06.3.3 The following applies to vendor proprietary extensions or features to the BACnet standard:
 - 3.06.3.3.1 Devices of this type that use proprietary mechanisms to represent BACnet objects and services that are approved in the current version of the standard are not allowed in the Work.
 - 3.06.3.3.2 Devices that use proprietary extensions of BACnet to meet an item in the Sequence of Operations (e. g., a room controller that controls a VAV box or reheat coil), or to provide a vendor specific feature (e. g., a local display of temperature or time of day) may be used in the Work with permission of the Owner.
 - 3.06.3.3.3 Devices that implement of BACnet features (e. g., BACnet/SC etc.) are allowed in the Work and will be evaluated based on the current version of the feature..
 - 3.06.3.4 Level 1/1A devices may use BACnet/IP or BACnet/WS when communicating to other Level 0, 1/1A devices that are located on an IP network or subnet.
 - 3.06.3.5 Level 1/1A devices shall communicate with Level 2/2A and Level 3/3A devices using BACnet MS/TP or BACnet ZigBee.
 - 3.06.3.6 Devices that use BACnet/PTP are not allowed in the Work unless this protocol is required to integrate a device supplied by others into the BACnet Internetwork or to make a temporary connection to the device using a service tool or display device.
 - 3.06.3.7 Devices using the BACnet ARCNET communication protocol are not allowed in the Work unless allowed by the Owner.
 - 3.06.3.8 BACnet ARCNET may be used to make a temporary connection to the device using a service tool or display device.
 - 3.06.3.9 Protocol translation devices may be used where there is a need for translation of one BACnet supported protocol (BACnet/WS, BACnet/IP, ~~BACnet Ethernet~~, BACnet MS/TP, BACnet LonWorks, BACnet ARCNET, BACnet ZigBee, and BACnet PTP). Where required by the Work, the Division 25 BAS Contractor may also use such devices to extend the network (e. g., a network of MS/TP terminal devices)
 - 3.06.3.10 A Level 1 devices that functions as a BACnet/LonWorks gateway may only be used to communicate with LonTalk Level 1/1A, 2/2A or 3/3A devices supplied by others in the Work.
 - 3.06.3.11 The following applies to devices that are considered gateways in this Specification.
 - 3.06.3.11.1 Devices that use any other protocols other than those supported by the BACnet standard shall be considered gateways and shall only be used with the prior permission of the Owner or where this Division is responsible for integrating non-BACnet devices into the BACnet Internetwork.
 - 3.06.3.11.2 When a Level 1 device is allowed in the Work as a BACnet gateway, the Owner will allow the objects to be created in a proprietary manner in non-BACnet BAS devices and then create duplicate BACnet objects in a Level 0 WS that functions as a BACnet gateway in order to provide the interoperable functions required by the Sequence of Operations.

- 3.06.3.11.3 When a Level 0 device functions as the gateway, the device shall be upgraded or sized as required to comply with the specified network throughput requirements imposed by BACnet.
- 3.06.3.11.4 The use of gateways is restricted to integrating in proprietary points into the BACnet Internetwork.
- 3.06.3.12 This requirement applies to devices that use BACnet ARCNET as well as ~~BACnet Ethernet~~, BACnet/IP or BACnet/WS.
- 3.06.3.13 The following applies to Level 1 devices.
 - 3.06.3.13.1 Provide the following at the local data display for BACnet object manipulation and data sharing:
 - 3.06.3.13.1.1 Provide access to AO, AI, AV, BO, BI, BV objects by Object_Name and Description properties on the local data display.
 - 3.06.3.13.1.2 Provide writable access to Present_Value at minimum.
- 3.06.4 Level 2/2A devices:
 - 3.06.4.1 Devices supplied and installed by this Division shall communicate with all other devices located on the BACnet Internetwork shall use the BACnet protocol. Devices supplied and installed by this Division that use protocols other than BACnet are not allowed in the Work. These devices shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8 respectively as outlined in ASHRAE Standard 135-2024 (or latest published version), to communicate with BACnet objects in the BACnet Internetwork.
 - 3.06.4.2 Devices that support multiple communications protocols as well as BACnet shall have access to all other protocols except BACnet turned off or disabled so the device communicates as a native BACnet device, per the definition in this Specification.
 - 3.06.4.3 The following applies to vendor proprietary extensions or features to the BACnet standard:
 - 3.06.4.3.1 Devices of this type that use proprietary mechanisms to represent BACnet objects and services that are approved in the current version of the standard are not allowed in the Work.
 - 3.06.4.3.2 Devices that use proprietary extensions of BACnet to meet an item in the Sequence of Operations (e.g., a room controller that controls a VAV box or reheat coil), or to provide a vendor specific feature (e.g a local display of temperature or time of day) may be used in the Work with permission of the Owner.
 - 3.06.4.3.3 Devices that implement of BACnet features (e.g., BACnet/SC etc.) are allowed in the Work and will be evaluated based on the current version of the feature.
 - 3.06.4.4 Level 2/2A devices shall communicate with Level 1 or 1A devices using BACnet MS/TP or BACnet ZigBee.
 - 3.06.4.5 Devices that use BACnet/PTP are not allowed in the Work unless this protocol is required to integrate a device supplied by others into the BACnet Internetwork or to make a temporary connection to the device using a service tool or display device.
 - 3.06.4.6 Protocol translation devices may be used where there is a need for translation of one BACnet supported protocol (BACnet/WS, BACnet/IP, ~~BACnet Ethernet~~, BACnet MS/TP, BACnet LonTalk, BACnet ARCNET, BACnet ZigBee, and BACnet PTP). Where required by the Work, the Division 25 BAS Contractor may also use such devices to extend the network (e.g., a network of MS/TP terminal devices).
 - 3.06.4.7 Devices that use any other protocols shall be considered gateways and shall only be used with the prior permission of the Owner or where this Division is responsible for integrating non-BACnet devices into the BACnet Internetwork.
- 3.06.5 Level 3/3A devices:
 - 3.06.5.1 Devices supplied and installed by this Division shall communicate with all other devices located on the BACnet Internetwork shall use the BACnet protocol. Devices supplied and installed by this Division that use protocols other than BACnet are not allowed in the Work. These devices shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8 respectively as outlined in ASHRAE Standard 135-2024 (or latest published version), to communicate with BACnet objects in the BACnet Internetwork.

- 3.06.5.2 Devices that support multiple communications protocols as well as BACnet shall have access to all other protocols except BACnet turned off or disabled so the device communicates as a native BACnet device, per the definition in this Specification.
 - 3.06.5.3 The following applies to vendor proprietary extensions or features to the BACnet standard:
 - 3.06.5.3.1 Devices of this type that use proprietary mechanisms to represent BACnet objects and services that are approved in the current version of the standard are not allowed in the Work.
 - 3.06.5.3.2 Devices that use proprietary extensions of BACnet to meet an item in the Sequence of Operations (e. g., a room controller that controls a VAV box or reheat coil), or to provide a vendor specific feature (e. g. a local display of temperature or time of day) may be used in the Work with permission of the Owner.
 - 3.06.5.3.3 Devices that implement of BACnet features (e.g., BACnet/SC etc.) are allowed in the Work and will be evaluated based on the current version of the feature.
 - 3.06.5.4 Level 3 and 3A devices shall communicate with Level 1 or 1A devices using BACnet MS/TP or BACnet ZigBee.
 - 3.06.5.5 Devices that use BACnet/PTP are not allowed in the Work unless this protocol is required to integrate a device supplied by others into the BACnet Internetwork or to make a temporary connection to the device using a service tool or display device.
 - 3.06.5.6 Devices using the ARCNET communication protocol are not allowed in the Work unless allowed by the Owner.
 - 3.06.5.7 Protocol translation devices may be used where there is a need for translation of one BACnet supported protocol (BACnet/WS, BACnet/LIP, ~~BACnet Ethernet~~, BACnet MS/TP, BACnet LonTalk, BACnet ARCNET, BACnet ZigBee, and BACnet PTP). Where required by the Work, the Division 25 BAS Contractor may use such devices to extend the network (e. g., a network of MS/TP terminal devices).
 - 3.06.5.8 Devices that use any other protocols shall be considered gateways and shall only be used with the prior permission of the Owner or where this Division is responsible for integrating non-BACnet devices into the BACnet Internetwork.
- 3.07 All BAS Devices and the Installation shall meet UL 864 UUKL 10th Edition Requirements.**
- 3.07.1.1 All new BAS Devices provided in the Work shall be UL 864 UUKL 10th Edition listed. Provide evidence of this listing in the Submittal.
 - 3.07.1.2 All new Work shall be installed according to UL 864 UUKL requirements and the BAS Vendor's product specific procedures. Provide evidence that the BAS Work has been designed to UL 864 UUKL. Division 25 BAS Contractor shall attend a meeting with the Owner, the Lake County BAS Consultant and the AHJ to seek approval for the BAS Work design. No Work shall begin until the AHJ approval has been secured.
 - 3.07.1.2.1 ALC is the Basis of Design and Installation for UL 864 UUKL 10th Edition compliance for the BAS to be provided in the Work.
 - 3.07.1.2.2 See 25 00 11 ~~4-01-16.2~~ **1.06** for a citation of the relevant UL documents from ALC that form the Basis of Design and Installation for the UL 864 UUKL 10th Edition BAS.

End of Section

~~–25 14 23 INTEGRATED AUTOMATION – FIELD EQUIPMENT PANELS – UPS BACKUP~~

1 - **GENERAL**

Not Used

2 - **PRODUCTS**

2.01 **Uninterruptible Power Supply (UPS)**

- 2.01.1 ~~The UPS shall be a true on-line power conditioner and battery backup or uninterruptible power supply (UPS).~~
- 2.01.2 ~~The UPS shall consist of an input converter, battery charger, inverter, and battery consisting of the appropriate number of sealed battery cells, all housed in a NEMA type 1 enclosure and complies with the requirements of IP20.~~
- 2.01.3 ~~The UPS shall auto-sense input frequency when first powered up.~~
- 2.01.4 ~~The UPS shall be a microprocessor-based unit with status display and controls section designed for convenient and reliable Operator action. The monitoring functions such as status and alarm indicators shall be displayed on an LED/LCD display.~~
- 2.01.5 ~~The display shall indicate UPS load and battery capacity status as described below:~~
 - 2.01.5.1 ~~The “Fault” display to indicate a UPS fault condition.~~
 - 2.01.5.2 ~~The “Battery” display to indicate the UPS is operating from battery power.~~
 - 2.01.5.3 ~~The “Bypass” display to indicate the UPS is operating on Bypass power.~~
 - 2.01.5.4 ~~An audible alarm activated by any of the above alarm conditions.~~
 - 2.01.5.5 ~~The “UPS ON” display to indicate the UPS inverter is operating and supplying power.~~
 - 2.01.5.6 ~~The “AC Input” display to indicate the UPS is operating from utility/mains power.~~
- 2.01.6 ~~UPS start-up and shutdown operations shall be accomplished by the ON and OFF push buttons located on the front device of the UPS. The ON push button shall function to turn the UPS on and also serve as a means to manually test the battery and to reset active visual and audible alarms. The OFF push button shall allow manual transfers of the load from the inverter to bypass power. Pressing the OFF push button twice within a four (4) second time period will completely shut down the UPS and its connected load in normal and battery mode.~~
- 2.01.7 ~~A bypass circuit shall be integral to the UPS. The bypass control logic shall sense the status of the inverter logic signals, and operating and alarms conditions, and shall transfer the load to the bypass source if available and if the inverter is capable of powering the load.~~
- 2.01.8 ~~The transfer control logic shall automatically activate the bypass, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:~~
 - 2.01.8.1 ~~UPS overload~~
 - 2.01.8.2 ~~UPS over temperature~~
 - 2.01.8.3 ~~PFC failure~~
 - 2.01.8.4 ~~Inverter failure~~
 - 2.01.8.5 ~~DC Bus Overvoltage~~
 - 2.01.8.6 ~~Once overload condition is reduced, the load is automatically transferred back to inverter power.~~
- 2.01.9 ~~The UPS shall contain a communication port to allow the UPS to communicate via Ethernet SNMP, connected directly to the LAN.~~
- 2.01.10 ~~The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this Specification shall govern.~~
 - 2.01.10.1 ~~UL Standard 1778 (Suitable for Computer Room Applications)~~
 - 2.01.10.2 ~~FCC Part 15, Subpart B, Class A~~
 - 2.01.10.3 ~~IEEE 587, Category A & B~~
 - 2.01.10.4 ~~ISTA Procedure 1A Operation~~
- 2.01.11 ~~UPS Voltage Specifications~~

- 2.01.11.1 Input: 120V Units: 0 — 140 VAC, 60/50 Hz, single phase, 2-wire plus ground.
- 2.01.11.2 Output: 120 V Units: 120 VAC (Operator configurable: 100V, 110V, 115V, 120V, 127V)
- 2.01.11.3 Voltage regulation shall be + 3% steady state and frequency regulation shall be 5% Synchronized to utility/mains + 0.1 Hz free running or on battery operation.
- 2.01.11.4 Frequency Slew Rate: 1.0 Hertz per second maximum
- 2.01.11.5 Voltage Distortion: $\leq 3\%$ total harmonic distortion (THD) typical into a 100% linear load, $\leq 5\%$ THD typical into a 100% non-linear load with crest factor ratio of 3:1.
- 2.01.11.6 The UPS shall be able to sustain a maximum inrush current of six times the full load peak input current.
- 2.01.11.7 Input line transient immunity shall conform to an input line transient conforming to IEEE 587, Category A & B tests for 120 VAC models. The UPS shall have surge protection MOVs rated 175 Volt, 90 Joules minimum connected L-N and 300 Volt, 150 Joules minimum connected L-G and N-G. The L-G and N-G connected MOVs will have the capability of being disconnected and reconnected easily. The UPS shall have input fuses.
- 2.01.11.8 Load Power Factor Range: 0.65 lagging to 1.0 (unity).
- 2.01.11.9 Inverter Overload Capability: 112 — 130%, $\pm 10\%$ for 10 seconds then transfer to bypass, 131 — 200%, $\pm 10\%$ for 2 seconds then transfer to bypass, $> 201\%$, $\pm 10\%$ for 96 ms minimum then transfer to bypass.
- 2.01.11.10 Voltage Transient Response: $\pm 7\%$ in line mode 0-100-0 % loading of the UPS, $\pm 7\%$ in battery mode for 0-100-0 % loading of the UPS rating.
- 2.01.11.11 Transient Recovery Time: To nominal voltage within ninety (90) milliseconds.
- 2.01.11.12 Efficiency: $\geq 88\%$ AC-AC, minimum
- 2.01.12 Internal Battery
 - 2.01.12.1 The battery shall consist of valve regulated, non-spillable, flame-retardant lead-acid cells.
 - 2.01.12.2 The battery shall be housed internal to the UPS cabinet, and sized to support the inverter at rated load and power factor, with ambient temperature of 25 °C [77 °F] for a minimum of thirty (30) minutes when running at full load of attached equipment.
 - 2.01.12.3 The expected life of the battery shall be three to five (3 to 5) years or a minimum two hundred and fifty (250) complete discharge cycles.
 - 2.01.12.4 The UPS units have the capability to allow the Operator to replace the internal battery.
 - 2.01.12.5 The battery system shall be certified and field proven to meet or exceed NEMA temperature standards from -40 °C to +74 °C [-40 °F to 165 °F].
 - 2.01.12.6 Hydrogen gas emissions: must comply with Mil-Spec #MIL-B-8565J
- 2.01.13 The UPS shall have a battery recharge rate designed to prolong battery life. Recharge time for UPS internal batteries shall be no longer than five (5) hours to ninety five per cent (95%) capacity after a complete discharge into full load.
- 2.01.14 The UPS shall meet or exceed NEMA temperature standards from -40 °C to +74 °C [-40 °F to 165 °F].
- 2.01.15 The UPS shall be certified and field proven to meet or exceed NEMA temperature standards. A certificate of compliance shall be made available upon request.
- 2.01.16 The UPS shall be designed to operate as a true on-line double conversion system in the following modes:
 - 2.01.16.1 Normal — In normal operation, incoming AC power is fed to the input power factor corrected (PFC) rectifier that converts the AC power to DC power for the inverter. In this mode, power is also derived from utility power for the battery charger. The inverter derives DC power from either the PFC rectifier or the battery and regenerates filtered and regulated AC sine wave power for the connected load. The battery will be charged once the unit is connected to utility power, regardless of whether the UPS is ON or OFF. In the event of a power outage or severe abnormality (sag or swell), the inverter will support the connected load from battery power, until the battery is discharged or the utility returns; whichever occurs first.
 - 2.01.16.2 Battery — Upon failure of AC power, the critical AC load is supplied by the inverter, which obtains power from the battery. There is no interruption in power to the critical load upon failure or restoration of the AC source.
 - 2.01.16.3 Recharge — Upon restoration of AC power, after an AC power outage, the input converter automatically restarts and assumes supplying power to the inverter and the battery charger to recharge the battery.
 - 2.01.16.4 Automatic Restart — Upon restoration of AC power, after an AC power outage and complete battery discharge, the UPS automatically restarts and assumes supplying power to the critical

~~load and the battery charger automatically recharges the battery. This feature shall be capable of being disabled by the Operator.~~

- 2.01.16.5 ~~Bypass— The integral bypass performs an automatic transfer of the critical AC load from the inverter to the bypass source, in the event of an overload, PFC failure, over temperature, DC Bus over voltage, or inverter failure conditions.~~
- 2.01.17 ~~Output Distribution~~
 - 2.01.17.1 ~~Output distribution is integral to the UPS, and located on the rear of the unit~~
 - 2.01.17.2 ~~(4) NEMA 5-15R~~
 - 2.01.17.3 ~~(1) NEMA L5-30R~~
 - 2.01.17.4 ~~(4) EN 60320/C13~~
- 2.01.18 ~~The specified UPS system is supplied with one (1) user's manual. The User's Manuals include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step by step operating procedures, and general maintenance guidelines.~~
- 2.01.19 ~~The UPS manufacturer warrants the UPS against defects in materials and workmanship for two (2) years.~~

3 - EXECUTION

3.01 **Uninterruptible Power Supply (UPS)**

- 3.01.1 ~~Provide UPS(s) sufficient to back all Level 1/1A panels for no less than fifteen (15) minutes.~~

End of Section

**25 14 23.36 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE
BACNET DEVICES) – AIR TERMINAL UNITS (ALL TYPES)**

1 - GENERAL

1.01 Scope of Work

- 1.01.1 The BACnet Interface Devices and Work responsibilities for this equipment are listed in 25 20 23.36.

2 - PRODUCTS

- 2.01.1 The BACnet Interface Devices and Work responsibilities for this equipment are listed in 25 20 23.36.

3 - EXECUTION

- 3.01.1 The BACnet Interface Devices and Work responsibilities for this equipment are listed in 25 20 23.36.

End of Section

25 15 11 INTEGRATED AUTOMATION – OPERATOR WORKSTATION SOFTWARE

1 - GENERAL

Not Used

2 - PRODUCTS

2.01 Level 0 Front End Software - General Requirements

2.01.1 The Level 0 Front End software shall include as a minimum the following:

- 2.01.1.1 Operating system
- 2.01.1.2 Database manager
- 2.01.1.3 Communications control
- 2.01.1.4 Operator interface
- 2.01.1.5 Graphical Front End
- 2.01.1.6 ASCII text mode interface
- 2.01.1.7 History/trend filer (including the extended trending facility)
- 2.01.1.8 Context sensitive help facility
- 2.01.1.9 Graphics development program
- 2.01.1.10 Report generator
- 2.01.1.11 Graphic trending (dynamic and historic)
- 2.01.1.12 Support utilities
- 2.01.1.13 Occupancy scheduler for each control zone or piece of equipment that requires a schedule
- 2.01.1.14 Time and event program manager
- 2.01.1.15 Custom BAS program development facility
- 2.01.1.16 Web browser-based software to access the BAS system device network via Lake County's Intranet
- 2.01.1.17 Other features as needed to comply with the requirements of the Contract Documents.

2.01.2 The Level 0 Front End software package shall:

- 2.01.2.1 Serve as an Operator interface to the BAS system, as well as for multiple remote BAS networks via secure connection.
- 2.01.2.2 Have an auto-executing boot-up routine that requires no Operator intervention. Shall a power failure affect the Front End, all current unacknowledged alarms must be recorded in the BAS network and be readily available when the power is restored.
- 2.01.2.3 Permit simultaneous use of other programs in a multi-tasking environment while receiving alarms, collecting trends and other data, in the Front End.

2.01.3 The Level 0 Front End software configuration shall support the full expansion of the BAS network without the addition of BAS field devices. In order to facilitate future expansion and addition of the BAS systems, either within the local building or remote buildings, the Front End software licence provide as part of the Work shall support ~~at least 100,000~~ **unlimited** hardware and software objects located on Lake County's BACnet Internetwork. See 25 00 11 ~~1-12.4~~ **1.15** and sub-clauses for license requirements.

2.01.3.1 Update software license to meet these requirements.

2.01.4 The Level 0 Front End software shall be able to use either Imperial or Metric (SI) units in calculations, displays, etc. Selection of units on a point by point basis shall be at Lake County's discretion.

2.01.5 The hardware requirements for this Front End shall not be met using one or more web appliances in order to meet the object count requirements in this Specification. The requirements must be met using Front End software running on a server provided by Owner.

2.01.6 Division 25 BAS Contractor is responsible for product activation of all software provided.

2.02 Level 0 Server Computer Software

2.02.1 The Operating System shall be based on:

- 2.02.1.1 Windows Server 2019 or latest edition.

- 2.02.2 Lake County will spin up a new VM for the Front End Server software. Division 25 BAS Contractor shall provide the requirements via a Submittal.
- 2.02.3 The Front End shall use the Windows interface, menuing system and the Common User Access keystroke conventions.
- 2.02.4 All software supplied for the Work shall not require Windows Administrator privileges to run. Windows Administrator privilege level shall only be required for installing new software, upgrades, patches, etc.
- 2.02.5 Provide Level 0 Front End software that dynamically displays all BAS functions and values through a graphical Operator interface.
 - 2.02.5.1 The Front End shall permit concurrent execution of other software programs running under the operating system environment while the Front End software is being used (e.g., to download/upload BAS device programs, view trends, edit graphics, etc.).
- 2.02.6 Design all software specified and supplied to utilize the complete graphical Operator interface and all utility and accessory programs provided by the operating system chosen by the Division 25 BAS Contractor.
- 2.02.7 Level 0 Front End software that prevents concurrent access to other non-BAS applications is not acceptable.
- 2.02.8 The database manager shall manage all Front End and BAS data on an integrated and non-redundant basis.
 - 2.02.8.1 If the Operator with the appropriate password level deletes a point, the system shall delete all occurrences of this point throughout the BAS system without the Operator having to manually delete every occurrence of the point.
 - 2.02.8.2 If data is deleted in a device through the use of a POT or a BACnet device that is registered as a Foreign Device, the database manager shall notify the Level 0 Front End that changes have taken place in the BAS devices when the Division 25 BAS Contractor's server signs onto the network.
- 2.02.9 Division 25 BAS Contractor is responsible for operating system activation through Microsoft if the computer hardware is provided by the Division 25 BAS Contractor.
- 2.02.10 The Front End shall use the Windows interface, menuing system and the Common User Access keystroke conventions.
- 2.02.11 All software supplied for the Work shall not require Windows Administrator privileges to run. Windows Administrator privilege level shall only be required for installing new software, upgrades, patches, etc.
- 2.02.12 Provide Level 0 Front End software that dynamically displays all BAS functions and values through a graphical Operator interface.
 - 2.02.12.1 The Front End shall permit concurrent execution of other software programs running under the operating system environment while the Front End software is being used (e.g., to download/upload BAS device programs, view trends, edit graphics, etc.).
- 2.03 **Level 0 Front End Software - Software License Agreement**
 - 2.03.1 Proposer shall submit for Lake County's review the Manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Lake County as defined by the Manufacturer's license agreement, but shall protect Manufacturer's rights to non-disclosure of Trade secrets contained within such software.
- 2.04 **Level 0 Computer Software - Security Requirements**
 - 2.04.1 Operator access to any Level 0 computer shall be under personal ID and password control.
 - 2.04.1.1 Up to sixteen (16) alphanumeric characters (mixed case) shall be assignable to each Operator. The Operator shall be able to access the Level 0 computer by entry of the proper ID and password.
 - 2.04.1.2 All Operators shall be permitted to change their own password without permitting access to any other password.
 - 2.04.1.3 Sign-off from a Level 0 computer shall be a manual operation via pull-down menu or, shall be automatic if no mouse or keyboard activity takes place within an assignable time period.
 - 2.04.1.3.1 Automatic sign-off period shall be selectable from one (1) minute to one hundred and twenty (120) minutes for each Operator or may be disabled on a per Operator basis.

- 2.04.1.3.2 All sign-on/off activity shall be automatically archived on a Level 0 computer hard drive for display or printout if necessary.
- 2.04.1.3.3 An Operator with an appropriate level password shall have the option of disabling this feature.
- 2.04.2 All Level 0 computers shall be provided the following security functions and capabilities: The Level 0 Front End software shall operate in this environment.
 - 2.04.2.1 Active content filtering to manage the degree of risk from computer viruses, malicious Java or Active-X, Trojan programs, etc. Provide tools, embedded security features or third-party software programs that perform active content monitoring to examine data entering a computer/network for potentially damaging content. The active content filtering system shall be updated on a continuous basis to protect against new forms of attack.
 - 2.04.2.2 Intrusion detection software or hardware that alerts the Operator of unauthorized attempts to gain access to computer systems, networks and BAS systems and provides countermeasures when unauthorized access attempts are made on data, files or services, or when it identifies traffic patterns on the network that appear to be scanning attempts, denial of service, or some other form of attack.
 - 2.04.2.3 Authentication processes to determine whether something or someone is who they are declared to be. The computer, network and BAS system authentication processes shall limit access after a number of unsuccessful login attempts and notify the Operator of the attempt to gain access.
 - 2.04.2.4 Authorization controls to verify that Operators only have access to those services, data, files and resources that they are supposed to have.
 - 2.04.2.5 Security measures to allow secure connection to the Intranet for exchange of information with other BAS systems or Level 0 computers. Provide mechanisms to ensure data confidentiality and integrity when data is exchanged across the Intranet and WAN. The security measures shall include protection from spoofing attacks, eavesdropping, snooping and port scanning.
 - 2.04.2.6 Security mechanisms to ensure the Operating Systems and security systems/software are continuously upgraded and patched to provide protection against attacks and attempts to gain control of the system.
- 2.05 **Level 0 Front End Software - Graphics Navigation Requirements**
 - 2.05.1 Operator access to the Front End and BAS system via any Level 0 computer shall be under personal ID and password control.
 - 2.05.1.1 Up to sixteen (16) alphanumeric characters (mixed case) shall be assignable to each Operator via the Front End. The Operator shall be able to access the system from any Front End by entry of the proper ID and password.
 - 2.05.1.2 All Operators shall be permitted to change their own password without permitting access to any other password.
 - 2.05.1.3 Sign-off from a Front End shall be a manual operation via pull-down menu or, if no mouse or keyboard activity takes place within an assignable time period, shall be automatic.
 - 2.05.1.3.1 Automatic sign-off period shall be selectable from one (1) minute to one hundred and twenty (120) minutes for each Operator or may be disabled on a per Operator basis.
 - 2.05.1.3.2 All sign-on/off activity shall be automatically archived on the server hard drive for display or printout if necessary.
 - 2.05.1.3.3 An Operator with an appropriate level password shall have the option of disabling this feature.
 - 2.05.2 Operator access to system points shall be controlled by individual Operator-assigned graphic hierarchy and by privileges as hereinafter described.
 - 2.05.2.1 The hierarchy shall permit access to an Operator-assigned initial graphic and to all graphics linked to and below the initial graphic.
 - 2.05.2.2 The Operators shall not have access to graphics in another hierarchical graphic "tree" unless permission has been given to do so. For example, an Operator may have access to one (1) building, but not another building, or to HVAC points, but not to alarm points.
 - 2.05.2.3 Each Operator shall have any combination of Operator assigned keyboard privileges of alarm acknowledgement, point commanding, data modification, operating system access, schedule changes and system configuration changes.

- 2.05.2.4 At least three (3) Operator privilege levels shall be assigned in the following hierarchical manner:
 - 2.05.2.4.1 View only. No access to programming and graphics.
 - 2.05.2.4.2 View with selected setpoint changes allowed. View only access to programming and graphics.
 - 2.05.2.4.3 Full access to Owner's as System Administrator.
 - 2.05.3 Provide authentication processes to determine whether something or someone is, who they are declared to be. The computer, network and BAS system authentication processes shall limit access after a number of unsuccessful login attempts and notify the Operator of the attempt to gain access.
 - 2.05.4 Provide authorization controls to verify that Operators only have access to those services, data, files and resources that they are supposed to have.
- 2.06 Level 0 Front End Software - BACnet Features**
- 2.06.1 Provide all BACnet objects and services listed in this Specification as being provided through the Level 0 Front End software.
 - 2.06.1.1 Provide object creating, deleting and editing services using the Level 0 Front End software.
 - 2.06.1.1.1 All objects created for the Work by this Division or by others shall be available for viewing and editing at the Front End using the graphical user interface.
 - 2.06.1.1.2 Use the CreateObject and DeleteObject services create, delete and edit all objects resident on Lake County's BACnet Internetwork. The Level 0 Front End service implementation by this Division shall support creating and deleting objects in another vendor's BAS device that is resident on the BACnet Internetwork.
 - 2.06.1.1.2.1 "Support" in this case means that the initiate side of the service shall permit the creation and deletion of objects.
 - 2.06.1.1.2.2 "Support" does not include creating, deleting or editing system or other specialized objects used by other vendors.
 - 2.06.1.2 Provide object manipulation and data sharing services using the Level 0 Front End software.
 - 2.06.1.2.1 Any object or its property from any device on the Internetwork shall be able to be placed on a graphic following the provisions of Section 25 15 11.
 - 2.06.1.2.2 The Division 25 BAS Contractor's Front End shall support dynamic creation of an Object Tree as described in Section 25 15 11 that will permit easy access to all objects. Support the sorting and selecting of objects in a manner similar to Windows Explorer. If this feature is not supported within the Front End, the Division 25 BAS Contractor shall provide a copy of Cimetrics BACnet Explorer, Polarsoft Explorer, CAS Explorer (or approved equal) on every WS and POT supplied in the Work. Providing a graphic representing the Object Tree in another device on a BACnet Internetwork is only acceptable if this graphic can be built dynamically by the Operator, by issuing a single command to build this graphic.
 - 2.06.1.2.2.1 Detail how the Front End supports dynamic creation of an Object Tree (as described in Section 25 15 11) that permits easy access to all objects. This Object Tree shall support sorting and selection of objects in a manner similar to Windows Explorer™.
 - 2.06.1.3 Provide file uploading and downloading services using the Level 0 Front End software.
 - 2.06.1.3.1 Support AtomicReadFile, AtomicWriteFile, AddListElement, RemoveListElement services at the server to accomplish this requirement.
 - 2.06.1.3.2 Permit BAS device program uploads and downloads in a network visible manner using the File object and AtomicReadFile, AtomicWriteFile.
 - 2.06.1.4 Support alarm and event summarisation using the Level 0 Front End software.
 - 2.06.1.4.1 Permit the Operator to receive, at any time, a summary of all alarms that are currently in effect and whether or not they have been acknowledged.

- 2.06.1.4.2 Permit the Operator to receive a summary of all alarms regardless of acknowledgment status:
 - 2.06.1.4.2.1 For which a particular recipient is enrolled for notification
 - 2.06.1.4.2.2 Based on current event state
 - 2.06.1.4.2.3 Based on the particular BACnet event algorithm (e. g., Change of Bitstring, Change of State, Change of Value, Command Failure, Floating Limit and Out of Range alarms)
 - 2.06.1.4.2.4 Alarm priority
 - 2.06.1.4.2.5 Notification Class

2.07 Level 0 Front End Software – Remote Access Through Citrix Functionality Requirements

- 2.07.1.1 Provide local and remote services using the Level 0 Front End software.
 - 2.07.1.1.1 The Level Front End software shall permit users to access devices on the BACnet Internetwork while connected on the LAN or remotely using Citrix.
 - 2.07.1.1.2 Owner shall provide a Citrix account to Division 25 BAS Contractor’s authorized personnel.

2.08 Level 0 Front End Software - Database Requirements

- 2.08.1 The Division 25 BAS Contractor’s database shall use an Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database for all system database parameter storage.

2.09 Level 0 Front End Software - Web Server Features

- 2.09.1 The Web server shall support read/write access to all objects, programming and device configurations using a Java-enabled browser without requiring proprietary Operator interface and configuration programs.
- 2.09.2 The Level 0 Web server and the Level 0 Front End licenses provided in the Work shall allow for the object and concurrent user requirements specified in 25 00 11 4-12.4 **1.15** and sub-clauses.
 - 2.09.2.1 Read/write access to ~~a minimum of one hundred thousand (100,000)~~ **unlimited** hardware and software objects located on Lake County’s BACnet Internetwork.
 - 2.09.2.2 A minimum of five (5) seats or concurrent users who have access to hardware and software objects found on Lake County’s BACnet Internetwork.
- 2.09.3 The Division 25 BAS Contractor’s system shall use ~~Microsoft Internet Explorer~~ **Chrome** as the Web browser. Manufacturer-specific browsers or the requirement for using other browsers (e.g., ~~Foxfire~~ **FireFox**) ~~shall not be is~~ acceptable.
- 2.09.4 The Web server software shall not require a vendor proprietary plug-in to Internet Explorer running on a web client machine for any service including logons, translation proprietary graphics from the Front End into HTML format, object access or any other services. The exceptions to the requirement are as follows:
 - 2.09.4.1 Security software or devices such as an RSA key fob, fingerprint devices needed for two-factor authentication, or other equipment, to meet Lake County’s security requirements.
- 2.09.5 The Web Server shall support industry third party software such as Java applet engine J2SE.
- 2.09.6 ~~For security reasons, Lake County requires that the Division 25 BAS Contractor’s Web server software be based on Microsoft IIS or Apache Tomahawk.~~

2.10 Level 0 Front End Software - Web Client Features

- 2.10.1 The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.
- 2.10.2 The Web browser client shall support at a minimum, the following functions:
 - 2.10.2.1 Operator log-on identification and password shall be required. If an unauthorized Operator attempts access, a blank Web page shall be displayed.
 - 2.10.2.2 Lake County will implement security using authentication and encryption techniques to prevent unauthorized access.
 - 2.10.2.3 The graphical screens created for the Level 0 Front End software shall be the same graphical screens created for display on the Web browser client. The software shall support a “publish to HTML” feature that allows for automatic creation of HTML graphics from the proprietary Front End graphics creation software.

- 2.10.2.3.1 View only. No access to programming and graphics.
- 2.10.2.3.2 View with selected setpoint changes allowed. View only access to programming and graphics.
- 2.10.2.3.3 Full access to Owner's as System Administrator.
- 2.10.2.4 The same animated graphical objects supported by the Front End shall be supported by the Web browser interface.
- 2.10.2.5 HTML programming by the Operator shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the Operator desires a specific look or format.
- 2.10.2.6 Permanent storage of the HTML graphical screens shall be in the server, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client machine are not acceptable. Graphics may be temporarily cached using the cache support features built into the IE browser to speed up operations for the Operator, is acceptable.
- 2.10.2.7 Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
- 2.10.3 The Web browser shall present the same view of the system and shall provide the same interface method as provided by the Front End, for the following:
 - 2.10.3.1 View and command data (such as setpoints, binary and analog objects) on all custom created graphics. This includes equipment graphics, floor plan graphics, BAS device graphics, Bill of Materials, Sequences of Operation and other data or links to other data shown on the custom created graphics.
 - 2.10.3.2 Modify common application objects, such as schedules, calendars and setpoints in a graphical manner.
 - 2.10.3.3 View logs and charts created by the Front End software.
 - 2.10.3.4 View and acknowledge alarms.
- 2.10.4 Operators shall have administrator-defined access privileges. Depending on the access privileges assigned, the Operator shall be able to perform the following:
 - 2.10.4.1.1 There shall be an access level that allows for only viewing the data.
 - 2.10.4.1.2 There shall be access levels to restrict an Operator to:
 - 2.10.4.1.2.1 Change the PresentValues of specific objects such as changing setpoints
 - 2.10.4.1.2.2 Acknowledge alarms
 - 2.10.4.1.2.3 Create, delete or alter schedules
 - 2.10.4.1.2.4 Create, delete or alter schedules
 - 2.10.4.1.2.5 Create, delete or alter trend reports or other reports
 - 2.10.4.1.2.6 Create or delete objects such as trendlogs, AVs, BVs or other objects
 - 2.10.4.1.2.7 View, create, delete or edit programming
 - 2.10.4.1.3 Provide an audit trail to capture all changes by login ID.
 - 2.10.4.1.4 The system shall provide the capability to specify an Operator's (as determined by the log-on Operator identification) home page. Provide the ability to limit a specific Operator to just their defined home page. Links from the home page to other views or pages in the system shall be supported, if allowed by the System Administrator.
- 2.10.4.2 The system shall give the Operate options to enter data including:
 - 2.10.4.2.1 Commands may be entered picking values from a drop down menu. Examples include:
 - 2.10.4.2.1.1 Starting and Stopping binary objects by right-clicking the selected object and selecting the appropriate command from the pop-up menu.
 - 2.10.4.2.1.2 Adjusting the schedule times using a graphical slider, without requiring any keyboard entry from the Operator.
 - 2.10.4.2.1.3 Setting holidays by using a graphical calendar, without requiring any keyboard entry from the Operator.
 - 2.10.4.2.2 Commands may also be entered by typing in values into dialog boxes.

- 2.10.4.3 Graphic screens on the Web Browser client shall support hypertext links to other locations by specifying the Uniform Resource Identifier (URI) for the desired link.

2.11 Level 0 Front End Software - LonWorks Network Management

- 2.11.1 LonWorks and LonMark products and networks are not allowed in the Work.

2.12 Level 0 Front End Graphic Requirements

- 2.12.1 Provide a graphic for each grouped list of points in this Specification Section that closely represents the device or devices that are being controlled.
 - 2.12.1.1 If there are limitations on the number of software and hardware points per graphic that can be displayed in a graphic, Division 25 BAS Contractor shall split the graphics in a logical manner that accommodates the limitations of their equipment and/or Front End.
 - 2.12.1.2 The main points are shown on the main graphic. Points such as statuses or faults shall be shown in a subgraphic in alphabetical order with the mapped point name and the present value.
 - 2.12.1.3 Division 25 BAS Contractor shall assume that none of the points supplied in the BACnet interfaces conforms to the Lake County naming convention. Division 25 BAS Contractor shall provide a list of mapped point names based on the point name list provided by the BACnet interface supplier. All points supplied and installed by the Division 25 BAS Contractor shall conform to the Lake County naming convention. Names shall be approved via the Shop Drawing process.
 - 2.12.1.4 Provide details on the hierarchical structure and linkage between the graphics.
- 2.12.2 All graphics (devices, equipment, panel, floor plans, etc.) shall be isometric, 2-D style.
- 2.12.3 Division 25 BAS Contractor shall allow in the Work for his Senior Graphics Design personnel to attend a one day meeting at the Owner's Place of the Work to review and confirm all graphics requirements.
 - 2.12.3.1 The starting graphic will be a site map of the Place of Work. The Division 25 BAS Contractor shall add a link to this project from this graphic. The Division 25 BAS Contractor shall also provide a graphic for each facility building consisting of a digital picture of the facility building.
 - 2.12.3.2 Create graphics for each plant (also called a system) including:
 - 2.12.3.2.1 RTUs,
 - 2.12.3.2.2 Gas Detection
 - 2.12.3.2.3 Unit and Roof Mounted Heaters
 - 2.12.3.2.4 Radiant Heaters
 - 2.12.3.2.5 Exhaust Fans
 - 2.12.3.2.6 Fire Alarm
 - 2.12.3.3 Each plant/system shall have starting graphics showing the key operational indicators set out by the Owner.
 - 2.12.3.4 Provide a graphic for each device in the system. Access to point data shall be from either the device graphic or the equipment graphic. Provide a linked graphic for each piece of major equipment (or grouping) that contains all the Operator adjustable setpoints, alarm limits and other Operator settable parameters for controlling the system.
 - 2.12.3.5 Provide an isometric view graphic to gain access to the floor graphics.
 - 2.12.3.6 Provide a graphic of each floor in the building on which the space temperatures and plants/systems are located.
 - 2.12.3.7 Create Energy Dashboards for each plant.
 - 2.12.3.8 Provide a table of all meter and runtime data from all BACnet MS/TP devices and analog input current transducers showing the following.
 - 2.12.3.8.1 current kW and daily maximum kW
 - 2.12.3.8.2 current kWh and daily maximum kWh
 - 2.12.3.8.3 daily runtime data for the device based on status.
 - 2.12.3.8.4 Reset the runtime and kWh values daily after the data has been captured in the trendlog.
 - 2.12.3.8.5 Provide a plant/system summary for daily kWh for all equipment in the plant/system.
 - 2.12.3.8.6 Provide long term trends for all meter data collected by the Front End.
 - 2.12.3.9 The Division 25 BAS Contractor shall conduct a site survey to determine equipment locations and systems in the building so the equipment can be spotted on the floor plan graphics.

- 2.12.3.10 Provide a digital picture or graphic from the Equipment Supplier for each piece of equipment.

AHU1 Configuration

Floorplan Zone 1 Zone 2 Zone 3 Zone 4 Zone 5 Zone 6 Home Previous

Temp Control Settings	FreeCool/Purge Settings	Advanced Settings Temp Control
Space Temp Setpoint: 19.5 °C	OAT Summer/Spring/Fall SP: 8.0 °C	Temp Control Prop Band: 1.0
Supply Temp Hi SP: 26.0 °C	Season Mode: Summer	Temp Control Integral: 1.0
Supply Temp Lo SP: 16.0 °C	Schedule Point (4AM-8AM): Off	Mixed Air Damper MIN: 15.0
PH Heat Temp Setpoint: 13.0 °C	Hi OAT FreeCg Setpoint: 20.0 °C	HR Temp/Low Ctrl Prop Band: 1.0
PH Cool Temp Setpoint: 20.0 °C	Lo OAT FreeCg Setpoint: 8.0 °C	HR Temp/Low Ctrl Integral: 1.0
HR Temp/Low Setpoint: 4.0 °C	MAX Space > Summer SP: 20.0 °C	SpaceTemp Control Prop Band: 1.0
EHR Temp/Low Setpoint: 2.0 °C	MAX Space > Spring/Fall SP: 22.0 °C	SpaceTemp Control Integral: 1.0
Coast Mode Hi Setpoint: 23.0 °C	MIN Space < Summer SP: 19.0 °C	PreHeat Control Prop Band: 1.0
UnOcc Hi Setpoint: 26.0 °C	MIN Space < Spring/Fall SP: 20.0 °C	PreHeat Control Integral: 1.0
UnOcc Lo Setpoint (summer): 13.0 °C	Space Temp: 20.2 °C	EHR Control Prop Band: 1.0
UnOcc Lo Setpoint (winter): 15.0 °C		EHR Control Integral: 1.0
Coast Mode Lo Setpoint: 18.0 °C		

AHU1 AHU3 AHU5 Boiler East Loop Domestic Hot Water
AHU2 AHU4 AHU6 Ground Loop West Loop Information

- 2.12.3.11 Provide a configuration screen that allows for configuring each setpoint range (e. g., room setpoint range) or seasonal parameter (e.g., FREE.COOLING starts at 8 C [46.5 F]). See graphic below as a sample that will be used as the benchmark for evaluating graphics that are submitted by the Shop Drawing process.
- 2.12.3.12 Provide access to the audit trail, OAT and the starting graphic or Object Tree on all graphics.
- 2.12.4 All graphics on the Front End shall closely match the AutoCAD or Visio Shop Drawings for the respective equipment. The Division 25 BAS Contractor shall follow one (1) of the options listed below to provide this requirement.
- 2.12.4.1 Graphics may be created in AutoCAD and then captured and colorized in the Front End graphic development software package providing the Front End graphics remain vector based. Text superimposed over the graphic shall be clear and legible.
- 2.12.4.2 The Division 25 BAS Contractor may redraw the AutoCAD files in a drawing package.
- 2.12.4.2.1 Acceptable products: The latest versions of internal graphics program, AutoCAD or Visio. Provision of this third party software is not necessary unless it is required for editing the custom created graphics or programming.
- 2.12.5 The Division 25 BAS Contractor shall install and configure all Shop Drawings as soft copies (such as the Sequences of Operation text, Bill of Materials data and all physical point and internal BAS variable descriptors) into Front End in a manner that is easily accessible by the Operator.
- 2.12.5.1 If the Shop Drawing soft copy is in AutoCAD or Visio format, the Division 25 BAS Contractor shall assume that this software is installed on the Front End computers, unless required for graphics or programming creation/editing.
- 2.12.6 Provide for an additional fifteen (15) graphics (as requested by Lake County) for the Work as a whole. These additional graphics shall have up to twenty (20) points, shall be similar to the graphics already being supplied and shall be designed to the level of detail described in the Contract Documents.
- 2.13 Level 0 Front End Software - Required Graphic Design, Creation, Modification and Navigation Features**
- 2.13.1 Provide a Front End graphic development software package to allow the Operator to view, create, delete or modify graphic displays, to assign and to position any array of points within each graphic.
- 2.13.2 The system shall permit the Operator to collect, display and store data from BAS devices at any remote site or site on Lake County's Intranet, while simultaneously allowing the Operator full access to any other

- remote BAS devices for the display of real-time graphics or status reports. Support real time presentation of multiple custom-created graphic, trend, Sequences of Operation, etc. from at least three different building sites when one site is connected locally and two (2) other sites are connected via Lake County's Intranet.
- 2.13.3 For Operators with the appropriate privilege(s), points shall be commanded directly from the graphical interface via mouse selection.
- 2.13.3.1 A keyboard equivalent shall be available for those Operators with that preference.
- 2.13.3.2 For a binary command point such as a fan, the fan would show its current state (e. g., OFF) and the Operator could select ON via mouse click. The colour will change according to the colouration convention set by Lake County via the Shop Drawing process.
- 2.13.3.3 Upon selection of analog commandable points such as an AHU heating valve, a dialogue box shall appear to allow the Operator to command the point to a specified value.
- 2.13.4 Alarms shall be displayed at the server/client/POT and printed to each printer, but only those Operators having proper password level shall be allowed to acknowledge alarms. Alarm acknowledgements shall be logged to the audit trail.
- 2.13.5 All graphics, reports and trends shall be printable on the graphics printer. All printouts shall be a true representation of what is seen on the server monitor. Screen printing of graphics, reports and trends is not acceptable.
- 2.13.6 Provide a hierarchical, linked, dynamic graphic Operator interface (based on the Front End's Operating System software) for accessing and displaying system data and commanding and modifying equipment operation or programs.
- 2.13.6.1 The interface shall utilise the mouse to provide operation with pull-down menus, dialogue boxes and colouration/animation to facilitate Operator understanding of the system.
- 2.13.6.2 Graphics, points, alarms, graphics-based programs etc. shall be created, deleted or modified through the Front End under password control features specified in 25 15 11 2.04.
- 2.13.6.3 All hardware and software points on the Internetwork shall be assignable to a graphic regardless of physical hardware address or point type.
- 2.13.6.4 All hardware and software points shall be assignable to multiple graphics twenty (20) minimum to facilitate Operator understanding of system operation.
- 2.13.6.5 Each physical point and each point assigned to a graphic shall be assigned a descriptor for use in report column titles or headers.
- 2.13.6.6 Provide data segregation for control of specific data routed to a Front End, to an Operator assigned to a Front End or to a given output device such as a printer (e. g., sending certain alarms or trend data to different locations as specified by Lake County).
- 2.13.7 All graphics and all Operator accessed data shall be displayed in 1024 x 768 resolution (minimum). Display of any data, graphics, or trends in lower resolution formats (e. g., 640 x 480 VGA or EGA) is not acceptable. Resolution formats lower than 1024 x 768 are permitted in ASCII text mode with approval by Lake County.
- 2.13.8 All graphics within each window shall be vector-based (e.g., HTML-5) and shall be scalable from 50% to 300% of original size.
- 2.13.8.1 Adobe SVG is not acceptable in the Work.
- 2.13.8.2 JPEG or other bit-mapped graphics are not acceptable in the Work. JPEG may only be used for equipment photos provided by Lake County.
- 2.13.9 An Operator shall be permitted to split, tile and resize the viewing screen to show one (1) graphic plus up to five (5) custom created graphics, trends, Sequences of Operation, etc. This feature shall permit the Operator to monitor one (1) part of the system in real time while displaying other parts of the system or data from the system to facilitate system operation.
- 2.13.10 The Front End shall show the following for each piece of equipment (e. g., an AHU) in stacked and/or tiled windows:
- 2.13.10.1 The equipment graphic.
- 2.13.10.2 The schedule or schedules for the piece of equipment.
- 2.13.10.3 The trend or trends set up for the device.
- 2.13.10.4 The programming for the device or piece of equipment as provided by other.
- 2.13.10.5 The Sequences of Operation provided by Owner.
- 2.13.10.6 The Bill of Materials provided by Owner.

- 2.13.10.7 Information on troubleshooting for each piece of equipment. The Division 25 BAS Contractor need not provide troubleshooting information, only the file linked on the graphic so the Operator can add his own information. This feature may also be provided as a two hundred and fifty (250) character minimum field in the point definition database.
 - 2.13.10.7.1 The Division 25 BAS Contractor shall set up a troubleshooting file for each device that can be accessed for recording and reviewing troubleshooting and maintenance activity.
 - 2.13.10.7.2 The file need only be an empty ASCII file or a Windows Notepad file, but provide the hot-links to the help file.
 - 2.13.10.7.3 Provide this feature for each graphic and each distinct piece of equipment within the graphic.
- 2.13.11 Graphics shall be displayed in tiled or stacked windows for each piece of equipment shown in the Graphics List.
 - 2.13.11.1 Provide macros to automate this graphics tiling/stacking process if such functionality is not natively supported.
 - 2.13.11.2 Provide the Operator with the ability to save the stacked/tiled windows when exiting the program and then to retrieve the stacked/tiled windows screen upon return to the program.
- 2.13.12 The Operator shall be able to navigate by use of a single screen “tree” of all objects created in the system such as graphics, programs, reports, inputs and outputs that are structured in a manner similar to a Windows Explorer Object Tree. Sort and select points in alarm, by name, in manual, etc. by clicking on the bar at the top of the column (referred to as the details view in Windows Explorer.)
- 2.13.13 To aid in navigation and in addition to menu-based point commanding features outlined herein, each output point on the graphic shall have “hot-links” via Operator defined “buttons” that are mouse selectable.
 - 2.13.13.1 This feature shall permit the Operator to have access to the programming, trend data, the schedule (if applicable to the device), the Sequences of Operation, Bill of Materials and any troubleshooting information loaded by other Operators. The hot-link feature shall be resident on the graphic and shall access the programming, trend data, etc. for the particular piece of equipment. The button feature may alternately be based around running a command macro in the background to access the trend, programming, schedule or other menu features as a result of clicking on the hot-link or button.
 - 2.13.13.2 At least one hundred (100) hot-links or buttons per graphic shall be supported.
 - 2.13.13.3 Graphics shall also support web-based hyperlinks to other Web pages.
- 2.13.14 Penetration within a graphic hierarchy shall display each graphic name, as graphics are selected, to facilitate Operator understanding.
 - 2.13.14.1 The graphic backtrace shall permit the Operator to move upward in the linked graphic hierarchy by mouse click on the backtrace.
 - 2.13.14.2 The backtrace shall show at least the previous four (4) penetration levels and shall permit jumping to the floor plan or a tree of graphics.
 - 2.13.14.3 Provide a minimum of eight (8) levels of graphic penetration with the hierarchy (e.g., area, building, wing, floor, AHU, point group).
 - 2.13.14.4 Provide the Operator with the option of showing each graphic full screen size with the backtrace as the horizontal header or by showing tiled or stacked graphics, each with a backtrace.
 - 2.13.14.5 Provide the Operator with a means to directly access any graphic without going through the penetration path. The Operator shall be able to jump from the floor plan or tree of graphic images to any graphic at lower levels by picking an icon from the floor plan or from the graphic or Object Tree.
 - 2.13.14.6 The Operator shall select further penetration via mouse click on an area, building, floor plan, and equipment under control or a BAS device graphic. The defined linked graphic below that selection shall then be displayed.
 - 2.13.14.6.1 Penetration shall also permit the Operator to jump from the graphic showing the BAS device to the graphic containing the equipment points for that device. If for example, Device 2 contains the points for AHU-n, the Operator shall be able to jump between the two (2) graphics in a single keystroke.

- 2.13.14.6.2 The Operator shall be able to navigate through the graphics via the floor plans. There shall be an isometric drawing for each multi-storey building (a crawl space is considered a storey). Each floor plan shall be available from this isometric drawing. Each object such as AHUs, boilers, BAS devices, shall be placed on the floor plans. Clicking on the object placed on the floor plan shall allow the Operator to access the equipment or device graphic.
- 2.13.14.6.3 Penetration through hot-links between the equipment, BAS device and floor plan graphics shall be approved via the Shop Drawing process.
- 2.13.14.7 Access to various levels within the graphical hierarchy shall be password controlled so that Operators with different access levels will have access to some or all of the graphics.
- 2.13.15 All graphic displays shall be created, deleted or modified on-line via the Front End graphics package provided by the Division 25 BAS Contractor.
 - 2.13.15.1 Editing graphics shall not require the Operator to exit the Front End program, nor shall this function interfere with network communications, alarming and trending.
 - 2.13.15.2 Graphics shall be created via mouse and keyboard selection of stored symbols or system profiles in the equipment graphic library.
 - 2.13.15.3 Provide the capability to create custom symbols, system profiles, floor plans, buildings, etc. and to store them in the graphic library.
 - 2.13.15.4 If the server software selected by Lake County (e. g., Windows Server 2019 or latest software release) restricts editing capability (e.g., use of mouse movements), then the graphics shall be created under another Operating System without these restrictions and then added to the Server.
- 2.13.16 Points (physical and internal BAS variables/virtual points) shall be displayed with dynamic data provided by the BAS system, with appropriate text descriptors, status or value and engineering unit.
 - 2.13.16.1 Dynamic data shall be assignable to any and all graphics.
 - 2.13.16.2 All points shall be dynamic with update rates Operator adjustable on a per-point basis from five (5) seconds to one hundred and twenty (120) seconds, depending upon the process dynamics.
 - 2.13.16.3 The Front End shall also support dynamic trending as outlined in 25 15 11 2.17.3.
- 2.13.17 Provide assignment of proper engineering units and status condition identifiers to all analog and binary input and outputs on all graphics.
 - 2.13.17.1 The Division 25 BAS Contractor shall use the convention for analog points (e. g., modulating dampers and valves) that 0% represents no medium (air, water, heat, static pressure) and 100% represents full medium (for diverting valves, full AB to A shall represent 0%, full AB to B shall represent 100%).
- 2.13.18 Provide animation/colouration features on all graphics so as to denote equipment status, levels (e. g., tank levels), alarm states and temperatures on equipment and floor plan graphics.
 - 2.13.18.1 Colouration conventions shall be variable for each class of points and shall be approved by Lake County via the Shop Drawing process. The following represents a typical colouration convention:
 - 2.13.18.1.1 Blue: temperature control point is below the acceptable level.
 - 2.13.18.1.2 Green: temperature control point is within the acceptable temperature range or the equipment is operating normally.
 - 2.13.18.1.3 Red: temperature control point is above the acceptable temperature range or the equipment is in alarm or has failed.
 - 2.13.18.1.4 Yellow: The equipment is in trouble (use for troubles on fire alarm devices).
 - 2.13.18.1.5 Black: Equipment control point is under Operator control.
 - 2.13.18.2 At least two hundred and fifty six (256) colours shall be supported.
 - 2.13.18.3 The Front End software shall support an animation/colouration capability that includes movement of rotating fan blowers and modulating dampers and valves. Provide these features on all graphics.
 - 2.13.18.4 Background graphics (e.g., floor plans) shall be black lines on a black, grey or off-white background. Reserve colours for point data and “clickable” links only.

2.14 Level 0 Front End Software - System Performance Requirements

- 2.14.1 Graphic Refresh: The system shall update a graphic with twenty (20) dynamic points with all current data within eight (8) seconds.
- 2.14.2 Object Command: The maximum time between the command of a binary object by the Operator and the reaction by the device shall be less than two (2) seconds. Analog objects shall start to adjust within two (2) seconds.
- 2.14.3 Object Scan: All changes of state and change of analog values will be transmitted over the high-speed network such that any data used or displayed at a BAS device or server will have been current within the previous six (6) seconds.
- 2.14.4 Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the server shall not exceed forty five (45) seconds.
- 2.14.5 Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every five (5) seconds. The Division 25 BAS Contractor shall be responsible for selecting execution times consistent with the equipment that is being controlled.
- 2.14.6 Multiple Alarm Annunciation: See the network performance test requirements.
- 2.15 **Level 0 Front End Software - Context-Sensitive Help and Training Utility**
 - 2.15.1 Provide a context-sensitive HELP utility to facilitate Operator training and understanding.
 - 2.15.2 The HELP feature shall have the ability to bridge to further explanation of selected keywords. The document shall contain text and graphics to clarify system operation.
 - 2.15.3 At a minimum, HELP shall be available for every menu item and dialogue box.
 - 2.15.4 The server shall support accessing the Vendor's web site for web-based help services within the HELP system.
 - 2.15.5 The HELP utility shall allow Operators to add their own notes. The troubleshooting files described in clause 25 15 11 2.13.10.7.1 can be used for this purpose.
- 2.16 **Level 0 Front End Software - BAS Network Management**
 - 2.16.1 The Front End shall provide all software necessary for management of the network of BAS devices and devices.
 - 2.16.2 Provide a multi-page set of graphic architectural displays showing each BAS device as shown in the first branch of the Graphics List. Clicking on any device shall start an interactive dialogue allowing the Operator to observe the device status and to select point management options. Provide each device with a descriptor in the Working Language for this project.
 - 2.16.3 Programming in all BAS devices shall be uploadable from or downloadable to the server hard disk for backup archival or for restoring programming as specified elsewhere.
 - 2.16.3.1 Programming in BAS field controllers shall also be uploadable to and downloadable from any Level 0 computer by the Operator using BACnet services and the File Object Type.
 - 2.16.4 Provide software to execute and observe diagnostics of any BAS device connected to the network and the ability to deactivate and restart the device.
 - 2.16.5 The Front End shall support duplicate Object_Names (e.g., AHU1.FAN) that may reside in different, BACnet devices buildings or facilities.
- 2.17 **Level 0 Front End - Software Requirements**
 - 2.17.1 Provide software that will allow the Operator to modify and tailor the BAS to the specific and unique requirements of the equipment controlled, the control strategies and programs implemented and to staffing and operational practices. Provide on-line modification of system configuration, program parameters, Sequences of Operation and database via menu selection and keyboard entry of data. As a minimum, provide the following modification features:
 - 2.17.1.1 Operator assignment including designation of Operator passwords, privilege(s), starting graphic and auto sign-off.
 - 2.17.1.2 Peripheral assignment (e.g., allow the use of printer for report printing).
 - 2.17.1.3 System configuration/diagnostics including communications and peripheral port assignments, BAS point assignments, BAS point enable/disable, assignment of command trace to points and initiations of diagnostics.
 - 2.17.1.4 System text add/change including descriptors for graphic points, action messages for alarms, runtime and trouble condition messages.
 - 2.17.2 Provide time/schedule change including time/date set, time/occupancy schedules, holiday schedules and activity defined schedules. Provide the following:

- 2.17.2.1 Operators with the appropriate password level shall be able to schedule an activity (e.g., board meeting) to which equipment can be assigned to support that activity.
- 2.17.2.2 Once the named equipment is assigned such activities, the activity can be scheduled by an Operator. The underlying associated equipment shall then be automatically provided with an identical schedule by the Level 0 Front End software. For example, if the AHU is in the day mode, the 3-way valve that provides perimeter radiation to this zone shall also be in day mode.
- 2.17.2.3 Equipment shall be able to be assigned to more than one (1) schedule.
- 2.17.2.4 The Operator shall be able to use the calendar to assign a day to be a regular, holiday or various kinds of special days (e.g., board meeting) and devices assigned to these schedules shall operate to the appropriate schedule (at least ten (10) schedule types shall be permitted per day).
- 2.17.2.5 All time and calendar scheduling and schedule modification shall be accomplished graphically via colour bars and calendars.
- 2.17.2.6 The Operator shall have the ability to copy individual or entire yearly schedules from one (1) site to another site through Lake County's Intranet to the other site, using the scheduling BIBB.
- 2.17.2.7 The system shall show scheduling conflicts on pieces of equipment.
- 2.17.2.8 The scheduling system shall automatically compensate for daylight savings time and leap years.
- 2.17.3 The Front End software shall support a dynamic trending system that permits the Operator to create dynamic XY-style trend graphs (or other styles such as bar graphs, pie charts etc.) using data from any hardware or software point.
 - 2.17.3.1 The Operator shall be able to add or delete points as required.
 - 2.17.3.2 The Operator shall be able to adjust the base and range for time on the X-axis and point values on the Y-axis.
 - 2.17.3.3 The Y-axis shall support at least three (3) different types of units simultaneously (e.g., °C, psi, ON/OFF) on one trend graph. The scaling for each unit type shall be capable of being adjusted manually by the Operator to create a satisfactory graph.
 - 2.17.3.4 Dynamic trending shall allow the Operator to place the mouse cursor on the trend to see the value of the point at that location.
 - 2.17.3.5 Provide a minimum of ten (10) dynamic plots that show six (6) points or variables, for each site.
- 2.17.4 Hardware and software points shall be definable as to:
 - 2.17.4.1 Colouration/animation
 - 2.17.4.2 Audible alarm rate and duration
 - 2.17.4.3 Point description (thirty two (32) characters minimum)
 - 2.17.4.4 Operator messages (eighty (80) character minimum)
 - 2.17.4.5 Printer options
 - 2.17.4.6 Alarm archival option
 - 2.17.4.7 Alarm and warning limits
 - 2.17.4.8 Engineering units
- 2.17.5 The Operator shall be able to change hardware and software points as follows:
 - 2.17.5.1 System/point enable/disable
 - 2.17.5.2 Runtime enable/disable
 - 2.17.5.3 Assignment of points to point classes
 - 2.17.5.4 Analog value offset
 - 2.17.5.5 Lockout
 - 2.17.5.6 Runtime
 - 2.17.5.7 Setting a fixed input or output value
- 2.17.6 The Operator shall be able to change software programs as follows:
 - 2.17.6.1 Enable/disable of BAS programs
 - 2.17.6.2 BAS program parameter changes
 - 2.17.6.3 Definition and assignment of comfort limits
 - 2.17.6.4 Definition and assignment of global points
 - 2.17.6.5 Definition and assignment of start/stop initiators
 - 2.17.6.6 Definition and assignment of start/stop schedules
 - 2.17.6.7 Any other function required to fully comply with the requirements of the Sequences of Operation section

- 2.17.7 Provide software which will allow the Operator to add points, or to form groups of points and to link them to control programs.
- 2.17.8 All additions and modifications shall be on line programmable via the Front End loaded on the POT or server, uploaded to BAS devices and entered into their databases.
- 2.17.9 After verification of point additions and associated program operation, the database may be downloaded from the devices and stored on the server for subsequent re-initialization and then uploaded to the BAS devices following provisions specified elsewhere in this Specification.
- 2.17.10 The Front End software shall support the use of Automated Fault Detection and Diagnostic Software Algorithms to enable the Operator to detect common mechanical faults and control errors in AHUs, chillers, boilers, VAV boxes, etc.
- 2.18 **Level 0 Front End - Alarm Software Requirements**
 - 2.18.1 Provide alarm handler software to respond to alarm conditions sensed and transmitted from BAS devices.
 - 2.18.1.1 First In, First Out (FIFO) handling of alarms in accordance with alarm priority ranking is required with buffer storage for a minimum of twenty (20) alarms in case of simultaneous multiple alarms.
 - 2.18.1.2 Alarm handler shall be active in both the "Signed On" and "Signed Off" modes to assure that alarms will be processed even though an Operator is not currently signed on.
 - 2.18.2 Alarms shall be displayed in a dialogue box on the server monitor. Display shall include as a minimum:
 - 2.18.2.1 Indication of alarm condition; i.e., ABNORMAL OFF, HI ALARM/LO ALARM, failed point, analog value or status, group and point identification and date/time stamp in the Working Language
 - 2.18.2.2 A discrete per point alarm action taking message of a minimum of two hundred (200) characters
 - 2.18.3 Provide a discrete "Return to Normal (RTN)" message complete with date/time stamp for each alarm that will tell the Operator that the alarm condition no longer exists.
 - 2.18.3.1 All alarms that have been returned to normal shall be automatically deleted from the active alarms list but shall be retained in a log file available to the Operator.
 - 2.18.4 Alarm silencing shall be by selecting the "silence" button or by authorized Operator's acknowledgement. In all cases, alarm acknowledgement shall only be allowed by Operators authorized to acknowledge a point in alarm.
 - 2.18.5 Each point shall be assigned to an alarm class, with no limit to the quantity of alarm classes. Each alarm class shall be uniquely assignable to any combination of the following alarm processing attributes:
 - 2.18.5.1 Audible beep duration (none, ten (10) seconds, twenty (20) seconds, continuous).
 - 2.18.5.2 Audible beep rate (slow, medium, fast).
 - 2.18.5.3 Alarm historically archived (yes or no).
 - 2.18.5.4 Alarm printed to local alarm printer or to server.
 - 2.18.5.5 Unacknowledged alarm repeat interval (e. g., critical alarms are repeated every sixty (60) minutes). This repeat interval only applies to alarms that are transmitted on the network, to the Front End. Alarms passed to a Front End that is locally connected to the BAS system device network do not have to be repeated.
 - 2.18.5.6 Associated colouration with any of two hundred and fifty six (256) colours, with separate brightness control assignable to each alarm state (high alarm, high warning, normal, low warning, low alarm). Binary points shall similarly be distinguished with different colours for each possible state.
 - 2.18.5.7 The Division 25 BAS Contractor shall support printing of critical alarms to the network printer. The Division 25 BAS Contractor is not responsible for any upgrades to the printer to achieve this. The Division 25 BAS Contractor shall assume that the standard suite of printer drivers within Windows will work or that Lake County shall provide a Windows-based printer driver. Lake County shall provide an IP address for the printer.
 - 2.18.5.8 Table 3 below shows attributes for typical classes of alarms to be provided by the Division 25 BAS Contractor.

TABLE 3 : ALARM CLASSES

Alarm Type	Repeat (mins)	Remove from Alm Log When	Alarm Option					Screen Colour	Paths		
			Prnt Alm	Prnt Ack	Prnt RTN	Beep Front End Alm	Display Graphic Device		Local Printer at site	Owner's network Printer	Wire-less text device
Very Critical (e. g., , powerout failure, low/high space temperature, static pressure problems)	60	Ack & RTN	Yes	Yes	Yes	Yes	Yes	R	Yes	Yes	Yes
Important (e. g., system/plant equipment failure)	240	Ack & RTN	Yes	Yes	Yes		Yes	Y	Yes		
Problem (e. g., exhaust fan failure)	720	RTN	Yes	Yes	Yes			Y	Yes		
Notification (e. g., runtime)	1440	Ack Only	Yes	Yes				O	Yes		

COLOURS: R = Red for critical alarms
Y = Yellow for non-critical alarms or troubles
O = Orange for notification alarms.

- 2.18.6 Provide an acknowledged alarm indicator on the server or POT to alert the Operator that there are unacknowledged alarms in the system. This facility shall be available as follows:
- 2.18.6.1 If the Operator is signed into the Front End
 - 2.18.6.2 The Front End shall be shown as a minimised icon on the server monitor when the Operator is working in another software application. When an alarm comes into the server, the minimised Front End icon shall provide an indication to the Operator that there are alarms on the system. The Operator shall, at his convenience, open the minimised icon to deal with the alarm(s).
- 2.18.7 Points in a graphic display that are in an unacknowledged alarm state shall have a visual indication of an unacknowledged alarm and when in an acknowledged alarm state, the point shall have a different visual indication of an acknowledged alarm.
- 2.18.7.1 The alarm display shall be present in the equipment, device and floor plan graphic or on the graphics or Object Tree.
 - 2.18.7.2 Clicking on the visual indication shall take the Operator to the equipment graphic where the alarm occurs.
 - 2.18.7.2.1 The alarm indication shall show in this equipment graphic.
 - 2.18.7.2.2 Acknowledging the alarm on the equipment graphic shall also acknowledge the same alarm displayed on the device and floor plan graphics.
 - 2.18.7.3 Provide this link to the graphics for each alarm.
- 2.18.8 Runtime limit messages shall be presented and processed as alarm messages, except they shall be of a maintenance nature and shall not be treated as critical.
- 2.18.9 Echo all alarms to the network printer if it is resident on the Intranet. Include the time, date and message.
- 2.18.10 Provide software for positive acknowledgement for receipt of alarms at Front End by the Operator. The alarm shall remain active until it is acknowledged.
- 2.18.10.1 Report all acknowledgements in the audit trail showing the time, date and ID of the Operator who acknowledged the alarm.
- 2.18.11 Alarms shall be directed to all of the following devices as required to comply with the Sequences of Operation:
- 2.18.11.1 Level 0 computer (if connected on the network or available via Internet)
 - 2.18.11.2 POT (if connected on the network or available via Internet)
 - 2.18.11.3 Local alarm printer (if connected to a BAS field device or Level 0 computer or available via Internet)
 - 2.18.11.4 Owner's wireless text message device

2.19 Alarm Sequencing and Transmission

- 2.19.1 This section outlines the general requirements for alarm sequencing and transmission. Each building shall have different alarm requirements based upon the equipment that is controlled by the BAS system. Alarm sequencing shall be approved by the Engineer.
- 2.19.2 The following conditions shall generate alarms:
 - 2.19.2.1 Low and high space temperatures during the various schedule modes
 - 2.19.2.2 Comfort alarms. Provide one alarm for each AHU zone that uses all space temperatures in the zone to determine when one of the space temperatures is out of the comfort limits during the occupied cycle.
 - 2.19.2.3 Low mixed air temperature in winter, low supply air temperature in winter and high supply air temperature in summer
 - 2.19.2.4 Tripped low limits and no-flow conditions on the AHUs, unit ventilators or other monitored equipment
 - 2.19.2.5 Fire alarms that are activated or which show these devices in alarm or in trouble
 - 2.19.2.6 Heating loop low supply water temperature in winter
 - 2.19.2.7 RTU cooling failure in summer
 - 2.19.2.8 Low DHW supply water temperature during occupancy
 - 2.19.2.9 AHU, exhaust fan or other device failures or low limits
 - 2.19.2.10 Other high and low limits
 - 2.19.2.11 Sewage and sump level alarms
 - 2.19.2.12 Refrigeration gas alarm
 - 2.19.2.13 Smoke damper statuses failures in a fire alarm condition
 - 2.19.2.14 Alarm points on equipment being monitored (e.g., oil supply, etc.)
 - 2.19.2.15 Low and high RH alarms while the humidification equipment shall be running
 - 2.19.2.16 High and low static pressure alarms
 - 2.19.2.17 Filter alarms
 - 2.19.2.18 Runtime alarms such as the running of AHUs or chillers for longer than an Operator specified period
 - 2.19.2.19 Pump status alarms
 - 2.19.2.20 Variations in all setpoints of greater than an Operator defined limit
 - 2.19.2.21 Analog output feedback alarms
 - 2.19.2.22 Controller ON and OFF line alarms (i.e., network communications faults)
 - 2.19.2.23 Controller powerout and UPS alarms
 - 2.19.2.24 Generator set run/fail status
 - 2.19.2.25 Oil tank level alarms and oil pump status failures
 - 2.19.2.26 Loss of meter data due to controller powerouts
 - 2.19.2.27 Consumption of water, steam and electricity (consumption and demand) over user defined time periods
 - 2.19.2.27.1 Water consumption: Provide a water consumption alarm based on the weekday average and the weekend average for the past weekly period. The weekday and weekend averages are rolling averages that are recalculated every twenty four (24) hours. In addition, provide an alarm based on a daily fixed maximum. The Owner shall provide all alarm limits.
 - 2.19.2.27.2 Gas consumption: Provide a gas consumption alarm based on the weekday average and the weekend average for the past weekly period. The weekday and weekend averages are rolling averages that are recalculated every twenty four (24) hours. In addition, provide an alarm based on a daily fixed maximum. The Owner shall provide all alarm limits. The data used for alarming and the alarm setpoints shall be normalised for weather conditions.
 - 2.19.2.27.3 Electricity demand and consumption: Provide an electrical demand and consumption alarm based on the weekday average and the weekend average for the past weekly period. The weekday and weekend averages are rolling averages that are recalculated every twenty four (24) hours. In addition, provide an alarm based on a daily fixed maximum. The Owner shall provide all alarm limits. The data used for alarming and the alarm setpoints shall be normalised for weather conditions and corrected for power factor. In the case of demand, the alarm needs to be based on the demand reading

parameters used by the electrical utility. A winter and a summer demand ceiling for each building is required.

- 2.19.2.28 Other alarms as required to meet the Control Sequences for each building.
 - 2.19.3 Alarms shall be processed and transmitted as follows:
 - 2.19.3.1 Flexible time delays defined by the Owner shall be used before generating an alarm to insure that it is a true alarm.
 - 2.19.3.2 All alarms shall be automatically printed out on the local site alarm printer.
 - 2.19.3.3 All alarm messages shall show a time and date of occurrence.
 - 2.19.3.4 Alarm messages shall be sent to the Front End, or other remote locations (as specified elsewhere).
 - 2.19.3.5 BAS system shall send messages to different devices based on type of message, time of day, or if the previously transmitted message was not acknowledged as described elsewhere in the Specification.
 - 2.19.3.6 All alarms defined as critical by the Owner shall be transmitted to the wireless text message device(s) at any time the alarm occurs. These alarms would also be sent to the Front End as critical alarms. Critical alarms include but are not necessarily restricted to:
 - 2.19.3.6.1 RTU failure in summer (i.e., out of range chilled or condenser supply water temperature) DX equipment alarms.
 - 2.19.3.6.2 Critical equipment alarms (e.g., oil tank level, oil leak, cathode protection, etc.).
 - 2.19.3.6.3 Low heating loop supply water temperature.
 - 2.19.3.6.4 Primary heating circulating pump failures (including ground loop pumps) in winter and cooling circulating pump failures (including ground loop pumps) in summer.
 - 2.19.3.6.5 High static pressure alarms.
 - 2.19.3.6.6 Refrigerant gas alarm.
 - 2.19.3.6.7 Sump/sewage alarm.
 - 2.19.3.6.8 Space temperatures above 29.5 °C and/or below 10 °C [fifty (50)°F]
 - 2.19.3.6.9 Transformer room exhaust fan and high/low electrical room temperature.
 - 2.19.3.6.10 Controller powerout.
 - 2.19.3.6.11 UPS alarm.
 - 2.19.3.6.12 Generator set run/fail status.
 - 2.19.3.6.13 Oil tank level alarm, oil leak alarm, oil pump status failure when there is an oil tank alarm.
 - 2.19.3.6.14 Domestic water panel alarm.
 - 2.19.3.6.15 Smoke damper status failures in a fire alarm condition.
 - 2.19.3.6.16 Low and high heat exchanger loop water temperatures.
 - 2.19.4 Provide a “*return to normal*” message complete with time and date stamp for each alarm when the alarm condition returns to normal. Retain all alarms in the log file on the Front End.
 - 2.19.5 Provide software to sort and select alarms from the active alarms list:
 - 2.19.5.1 At the Central Station Front End
 - 2.19.5.2 Using the Web client computer
 - 2.19.6 Provide a daily scheduled transmission or report for each building to verify that all panels have their programming and are communicating properly, that the utility meter have been read and all alarms have been transmitted to the Front End. Report any problems found to the Front End alarm window.
 - 2.19.7 All alarms shall be passed to the Front End and/or transmitted to wireless device and/or printed on alarm printer for each piece of equipment.
 - 2.19.8 All alarms shall be assigned an alarm type, class or level based on Table 3 : Alarm Classes. The alarm classification process shall be approved via the Shop Drawing process.
 - 2.19.9 All alarm logic and messages shall be approved by the Owner via the Shop Drawing process.
- 2.20 Level 0 Front End - Reporting Requirements**
- 2.20.1 All reports shall be available at the:
 - 2.20.1.1 Front End regardless of whether either device is locally connected on the network or remotely connected via WAN or the public Internet.

- 2.20.1.2 Alarm printer if the alarm printer is locally connected to the BAS device system network, an Owner's web client machine or remotely connected to Lake County's Intranet.
- 2.20.2 Except for the reports and requirements described in Sections 25 15 11 2.20.7 and 25 15 11 2.20.10, all reports and requirements shall be available at the POT regardless of whether the POT is locally connected on the network or remotely connected to Lake County's Intranet.
- 2.20.3 Provide a menu of all reports provided that is available at the server or POT by executing a menu command.
- 2.20.4 Provide standard pre-formatted, hard coded reports or a report generator program using Structured Query Language (SQL) or other approved report generator software. If the report generator program is provided, provide the reports defined in the Specification. In either case, all reports listed shall be readily executable without requiring the Operator to write software. All reports provided shall:
 - 2.20.4.1 Indicate the status at the time the request was entered and when displayed.
 - 2.20.4.2 Be updated at scan frequency or an Operator selectable time interval.
 - 2.20.4.3 Include time, day, month, year and report title.
 - 2.20.4.4 Be scheduled to run at a specific time and/or interval via an Operator function supported by necessary data entry templates and interactive prompts.
 - 2.20.4.5 Allow the Operator the option to specify report type, point name, scan rate, output device.
 - 2.20.4.6 Have a "terminate report" command to allow the Operator to stop any report in the process of being printed.
- 2.20.5 Provide a custom report capability using SQL, Crystal Reports or other approved report generator software to allow the Operator to format reports in any mix of text, points with status/value and descriptors and points with status value only. Custom reports may be scheduled or requested manually by the Operator.
- 2.20.6 Provide point summary reports that comply with the following requirements:
 - 2.20.6.1 Point summary reports shall include the current value/status and condition (in SI or Imperial units) and point names and labels for all points.
 - 2.20.6.2 Point summary reports shall be selectable for all points, only those points in alarm, fixed points, points disabled in software, points manually overridden at the HOA or potentiometers, points in commissioned mode, runtime points and schedule points.
 - 2.20.6.3 Point summary reports may be requested at any penetration level (building, system) and shall include only points at and below that level requested.
 - 2.20.6.4 These reports shall be available dynamically and issued as commands (using techniques such as DOS-style wildcarding) rather than as hard coded reports requiring alterations every time changes to a report is needed. If reports are hard coded, provide a menu of these reports and additional training on how to change the reports.
 - 2.20.6.5 Point summary reports shall be available on the following basis:
 - 2.20.6.5.1 All hardware and software points in BAS system
 - 2.20.6.5.2 All points in a defined area or control zone
 - 2.20.6.5.3 All points in device
 - 2.20.6.5.4 All hardware and software points by type in BAS system
 - 2.20.6.5.5 All points by type in a defined area or control zone
 - 2.20.6.5.6 All points by type in device
 - 2.20.6.5.7 Individual point
 - 2.20.6.5.8 All setpoints used in the Work
- 2.20.7 Provide point attribute (object property) summary reports as outlined below:
 - 2.20.7.1 Reports shall include:
 - 2.20.7.1.1 All start-stop schedules including start-stop times and days and point name and description.
 - 2.20.7.1.2 All high and low alarm limits. Include as a minimum, the point name and all alarm limits including deviation limits.
 - 2.20.7.1.3 All alarm messages of alarm points. Include as a minimum, point name, point description, alarm type, current value and limit exceeded.
 - 2.20.7.1.4 All point runtime limits.

- 2.20.7.1.5 All point statuses (e.g., manual, disabled or in commissioning mode). Include point name and description and whether point is disabled by Operator or system.
- 2.20.7.1.6 Other point attributes as available on the system to the Operator.
- 2.20.7.2 Point attribute reports may be requested at any penetration level (building, system, device) and shall include only points at and below that level requested.
- 2.20.7.3 If reports are hard-coded and are not dynamically generated using wild-carding or some other command-line function or scripting, then a menu of these reports and additional training on how to change the reports shall be provided.
- 2.20.7.4 Point attribute reports shall be available on the following basis:
 - 2.20.7.4.1 All hardware and software points in BAS system
 - 2.20.7.4.2 All points in a defined area or control zone
 - 2.20.7.4.3 All points in device
 - 2.20.7.4.4 All hardware and software points by type in BAS system
 - 2.20.7.4.5 All points by type in a defined area or control zone
 - 2.20.7.4.6 All points by type in device
 - 2.20.7.4.7 Individual point
 - 2.20.7.4.8 All setpoints used in the Work
- 2.20.8 All report data shall be exportable to Microsoft Excel as a CSV file at minimum.
- 2.20.9 Provide software for the Operator to analyse the alarm log, the log of logons and logouts and database transactions (i.e., the audit trail). The Operator shall be able to parse and print or display these log(s) using SQL or some other approved report generator software or other software tools, to:
 - 2.20.9.1 Select and sort alarms by type, priority or date
 - 2.20.9.2 Select and sort logins and logouts by priority or date
 - 2.20.9.3 Sort and select database changes by Operator or date
- 2.20.10 Provide command trace/archive reports that comply with the following requirements:
 - 2.20.10.1 They shall be selectable on a per point basis allowing the archiving of all commands issued to each point.
 - 2.20.10.2 The archived trace shall include the command, the command source, the point ID and time and date.
 - 2.20.10.3 Command trace reports shall be output upon Operator demand.
 - 2.20.10.4 The last ten (10) command reports shall be retained.
- 2.20.11 Provide history/trend log reports that comply with the following requirements:
 - 2.20.11.1 They shall allow the Operator to randomly select logical arrays of points to be recorded at selectable time intervals.
 - 2.20.11.2 Support assigning up to ten (10) inputs, outputs and variables to each trend report.
 - 2.20.11.3 The format, headers, footers and calculated variables shall be selectable by the Operator.
 - 2.20.11.4 The trend log report shall be stored to disk and shall be subsequently displayed and printed by the Operator.
 - 2.20.11.5 Provide a history report for each input, output and setpoint. Organise in a logical manner (e.g., by AHU zone, chiller circuit, boiler circuit) as directed by Lake County. The trend log report shall be in the form of a spreadsheet where Column 1 is the common time base and the other columns are the individual trend logs. Provide a separate report for the heating plant, the AHUs and miscellaneous points. Provide a menu command that permits the Operator to select the desired report. Provide a feature to permit the Operator to scroll through the report on the screen and to print some or all of the report on the graphics printer provided under the Work.
- 2.20.12 Provide dynamic trend reports at the Front End that comply with the following requirements:
 - 2.20.12.1 They shall provide at least six (6) points and show real time activity of the associated points.
 - 2.20.12.2 This dynamic trend information shall be displayed in numeric format, bar chart, curve plot, pie chart, etc., as selected by the Operator.
 - 2.20.12.3 The Operator shall have the option of mixing line and bar charts on the same graph.
 - 2.20.12.4 Graphic plots shall allow a unique colour for each point.
 - 2.20.12.5 As new point values are sampled, they shall be processed, scaled and dynamically appended to any plot being displayed.

- 2.20.12.6 See 25 15 11 2.17.3 for further details.
- 2.20.13 Provide runtime and runtime alarm reports that comply with the following requirements:
- 2.20.13.1 They shall be available by Operator command or shall be automatically issued to the server, POT and alarm printer when the runtime limit is reached.
 - 2.20.13.2 They shall consist of the point name, the status or value of the point with engineering unit, the time and date, runtime to date, runtime alarm limit setting and an action taking alarm or runtime message.
 - 2.20.13.3 The runtime shall continue to accumulate until reset individually by means of an Operator-issued command.
 - 2.20.13.4 Runtime reports shall be available per 25 15 11 ~~2.20.4.5~~ **2.20.5**.
 - 2.20.13.5 . The report shall be in spreadsheet format and shall consist of a reference to the piece of equipment in Column 1 and the runtime in hours in Column 2.
- 2.20.14 All reports shall be approved via the Shop Drawing process in Section 25 00 33.
- 2.21 **Level 0 Ancillary Services - Remote Device Alarm Notification**
- 2.21.1 The Level 0 Front End software shall support email or text messaging notification of alarms to cell phones and other handheld wireless devices.
 - 2.21.2 The Division 25 BAS Contractor shall transmit all alarms defined as critical by Lake County (e. g., boiler failure in winter or chiller failure in summer) to an email or text message enabled cell phone. Lake County shall provide this cell phone. The Division 25 BAS Contractor shall make this cell phone operational and shall commission it.
 - 2.21.3 The Division 25 BAS Contractor is responsible for all Work necessary to provide this service. The Division 25 BAS Contractor shall define how to use Lake County's existing cell phone(s). If using Lake County's existing cell phone is not possible, the Division 25 BAS Contractor shall instruct Lake County which cell phone to purchase/lease. The Division 25 BAS Contractor shall then implement and commission this feature following the terms and conditions of this Specification.

3 - EXECUTION

Not Used

End of Section

25 15 11.01 INTEGRATED AUTOMATION – OPERATOR WORKSTATION SOFTWARE - GRAPHICS REQUIREMENTS

1 - GENERAL

Not Used

2 - PRODUCTS

2.01 Scope of Work

- 2.01.1 Create Graphics for the Work.
- 2.01.2 Update Front End software and license to suit the new Work.
- 2.01.3 Provide Submittals per this Specification on all graphics required for the Work.

2.02 Graphics Samples shown in this Specification

- 2.02.1 The graphics shown in this Specification are examples are from other Lake County BAS project.
- 2.02.2 These samples show the level of effort expected by the Division 25 BAS Contractor.
- 2.02.3 Lake County has final approval for all graphics provided in the Work.
- 2.02.4 **Division 25 is responsible for referring to and using Room and Equipment Plans updates to Contract Document Addenda and Site Instructions before creating any graphics for this project.**

3 - EXECUTION

3.01 Graphics List

- 3.01.1 Provide a similar to the graphic samples shown below. Provide clickable links to each graphic. Organize inventory in a logical manner including the floor plans, equipment layouts and where required, flow diagrams.
- 3.01.2 Where there is no example graphic, the Division 25 BAS Contractor shall use similar graphics in this Specification or as already created in previous Lake Country BAS projects to create a suitable graphic to the satisfaction of the Owner.

Admin Tower (Building A)					
Color	Name	Status	Address	Reference Name	Type
	Up to 10 N County AHU Summary				
	AHUs			#admin_ahus	
	10th Floor ATU			#10th_floor_atu	
	5th Floor FAS			#lc_admin_tow_5th_floor_fas	
	5th Floor Lighting			#5th_floor_lighting	
	5th Floor VAV			#5th_floor	
	6th Floor FAS			#lc_admin_tow_6th_floor_fas	
	6th Floor Lighting			#6th_floor_lighting	
	6th Floor VAV			#6th_floor	
	7th Floor FAS			#lc_admin_tow_7th_floor_fas	
	7th Floor Lighting			#7th_floor_lighting	
	7th Floor VAV			#7th_floor	
	6th Floor FAS			#lc_admin_tow_6th_floor_fas	
	6th Floor Lighting			#6th_floor_lighting	
	6th Floor VAV			#6th_floor	
	5th Floor FAS			#lc_admin_tow_5th_floor_fas	
	5th Floor Lighting			#5th_floor_lighting	
	5th Floor VAV			#5th_floor	
	4th Floor FAS			#lc_admin_tow_4th_floor_fas	
	4th Floor Lighting			#4th_floor_lighting	
	4th Floor VAV			#4th_floor	
	3rd Floor FAS			#lc_admin_tow_3rd_floor_fas	
	3rd Floor Lighting			#3rd_floor_lighting	
	3rd Floor VAV			#3rd_floor	
	2nd Floor FAS			#lc_admin_tow_2nd_floor_fas	
	2nd Floor Lighting			#2nd_floor_lighting	
	2nd Floor VAV			#2nd_floor	
	1st Floor RTU			#lc_031a_1st_floor_rtu	
	FAS Panel	0.00	2400.10.30.2.161 #eq_241001_58	fas_panel_monitor	
	Radio Rm Temp	68.26	2400.10.30.2.168 #admin_tower_radio_room_zone_temp jcl_admin_radio_rm_temp_monitor		

3.02 Site, Floor and Roof Plan Base Plan Graphics. Refer to Contract Documents for updated Site, Floor and Roof Base Plans to use in graphics creation.

3.02.1 Provide a 3-D Site plan for the Work using the Consultant's site plan shown below, as a guide.

3.02.1.1 Show the room layouts and provide clickable links to the major areas or pieces of equipment including:

3.02.1.1.1 the Main building floor plans for the 2nd floor,

3.02.1.1.2 the Main building floor plans 3rd through 6th floors (Note the 3rd through 6th floors Work was done in a previous project. The Division 25 BAS Contractor is only responsible for the graphics for this previous project.

3.02.1.1.2.1 There are no new controls required for the 3rd through 6th floors. Graphics shall be created from existing ALC Submittals and Owner-supplied as-built documents.

3.02.1.1.3 the Mechanical and Electrical Floor Plans (including Floor Plans for the 3rd through 6th floors),

3.02.1.1.4 the Mechanical Room floor Plans (including Floor Plans for the 3rd through 6th floors),

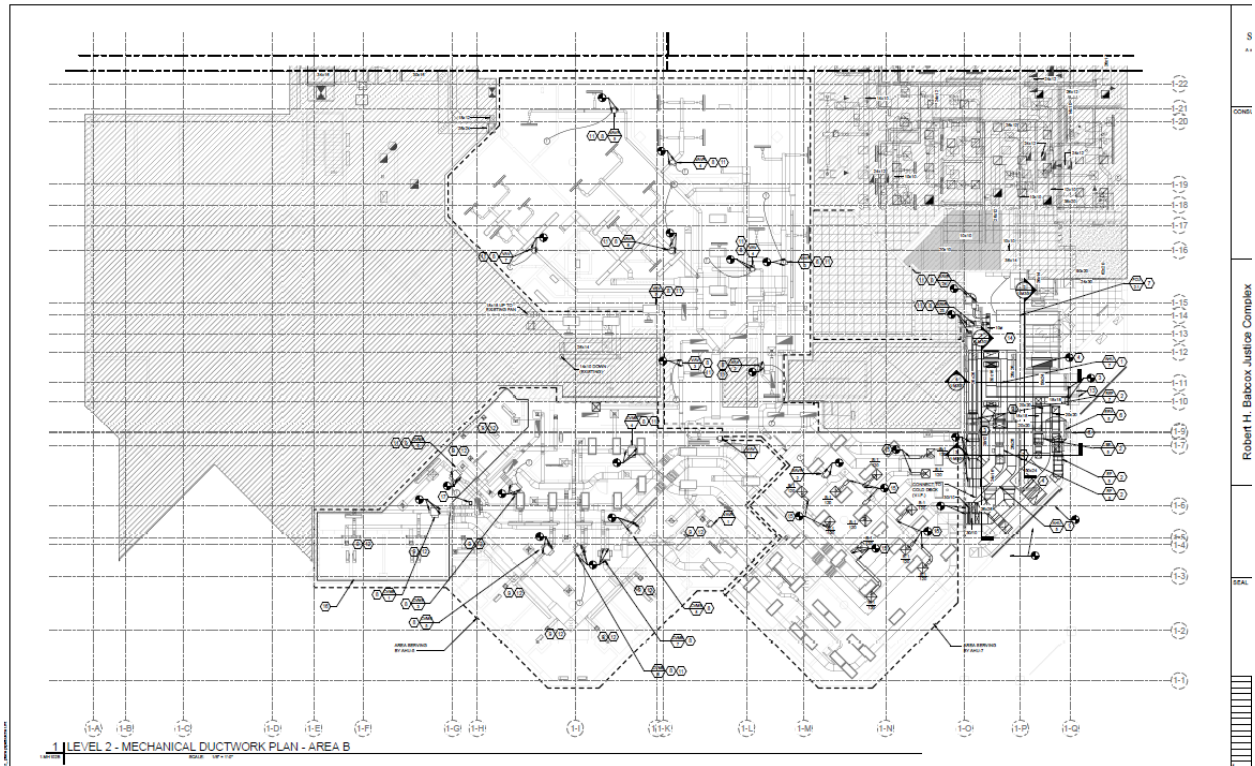
3.02.1.1.5 the roof plan showing the mechanical equipment on the roof (SOAP device).



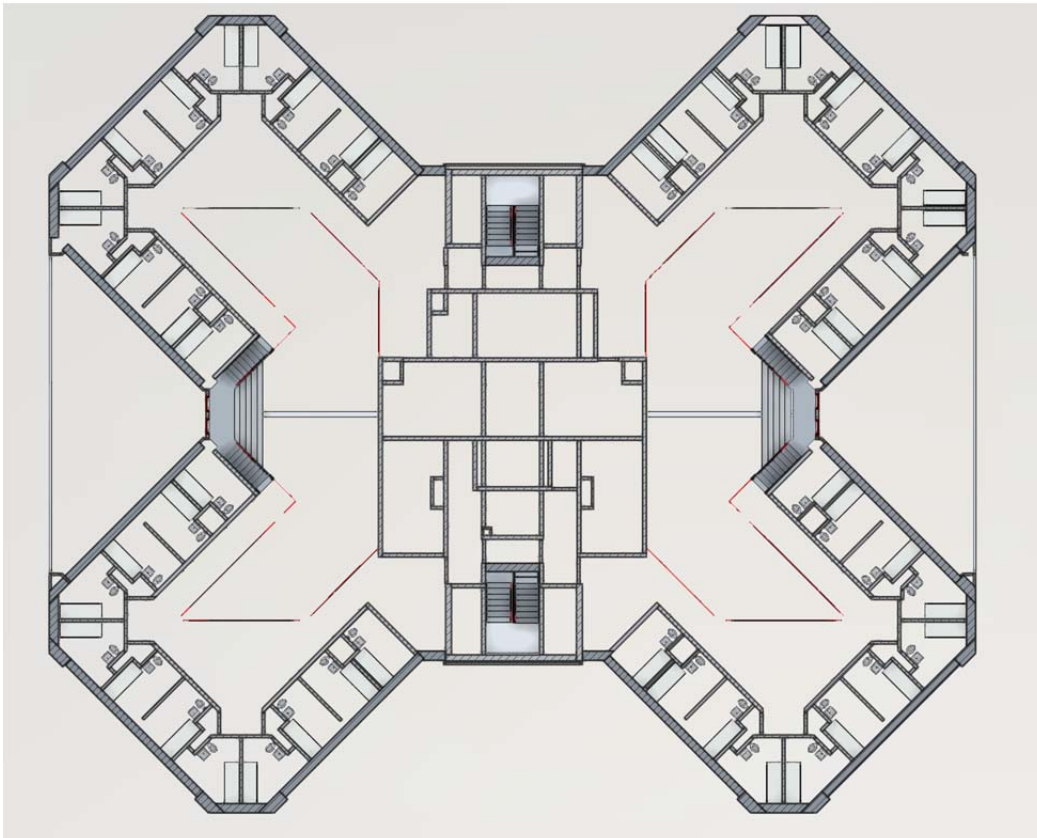
PROJECT LOCATION



3.02.2 Provide a 3-D floor plan for the new Work using the Consultant's second floor plan shown below, as a guide.



- 3.02.3 Provide a 3-D floor plan for the Work using the Owner's 3rd through 6th floor plan template shown below, as a guide. These are graphics that the Division 25 BAS Contractor shall create from the original Babcox Justice Complex AHU01 through AHU04 project undertaken by ALC.



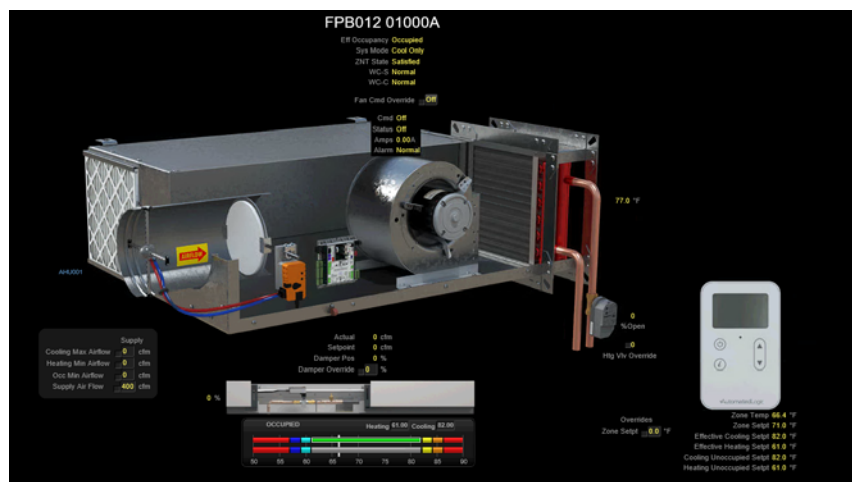
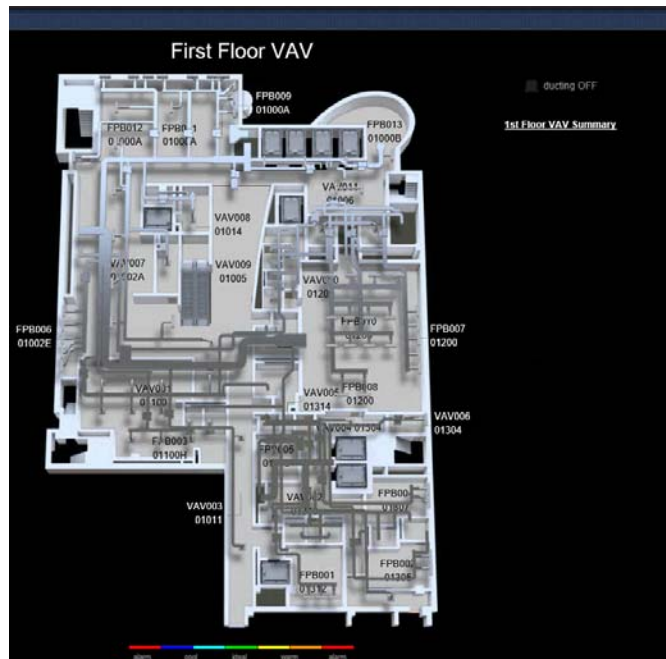
3.02.4 General Requirements for Floor Plan Graphics

- 3.02.4.1 The floor plan graphics shall show the room layouts complete with clickable links to major pieces of equipment. Use the Consultant's Drawings for the background.
- 3.02.4.2 Add a 01 in front of each room number as the standard Lake County numbering scheme is Floor (two digits) – Room (three digits) – FFRRR. Provide a subgraphic for the points that could not fit on the main graphic.
- 3.02.4.3 Provide a clickable link to each room containing the equipment covered in this Specification. Clicking this link shall open up the room plan showing the devices contained in that room.
- 3.02.4.4 Organise the floorplans in a manner to allow the Owner to choose which floor plan to be viewed.

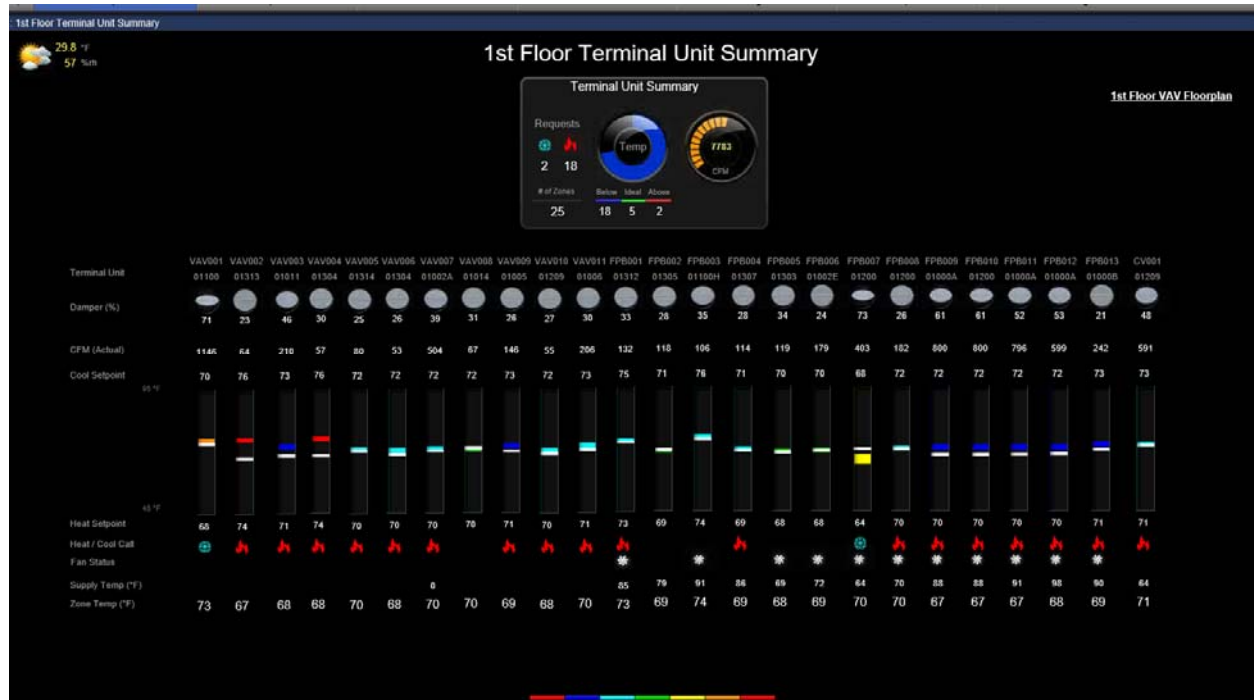
3.02.5 HVAC Floor Plan

- 3.02.5.1 Provide a floor plan showing the HVAC equipment similar to the example below.
- 3.02.5.2 Provide a thermograph showing the space temperatures in each room. The Owner will set criteria for the thermograph to be followed in the design of the graphic.
- 3.02.5.3 Draw the ductwork as 3-D per the example below. Allow the ductwork to be toggled on and off. The thermograph was turned off so the ductwork can be shown. Overlay the ductwork on the thermograph.
- 3.02.5.4 Provide a clickable link from the floor plan to the major pieces of equipment like the ATUs and all other equipment in the second floor new Work as well as the 3rd through 6th floor existing Work. This graphics Work shall be done for AHUs 01, 02, 03, 04, 05 and 07.





- 3.02.5.5 Provide a terminal unit summary similar to the graphic shown below for AHUs 01, 02, 03, 04, 05 and 07.



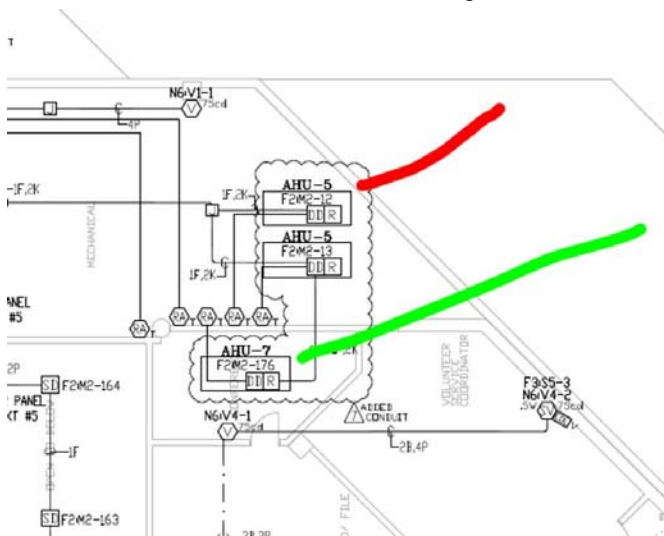
3.02.6 Fire Alarm Floor Plan

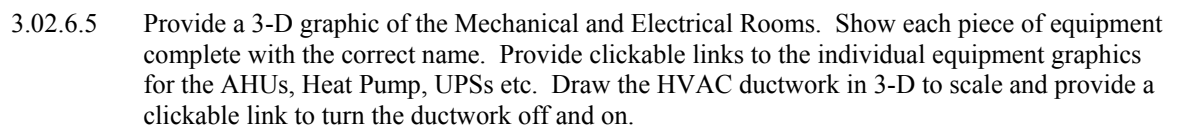
- 3.02.6.1 Provide a floor plan showing the Fire Alarm equipment similar to the example below. The device shall carry the Simplex fire alarm device name available from Simplex. The Simplex AV points shall be mapped as MSVs. The State Text is shown below in the style of a thermograph. Use these colors as this is a Lake County standard. Provide a separate equipment graphic for the fire alarm panel points.



LAKE COUNTY ADULT CORRECTIONAL FACILITY	
FIRE ALARM SYSTEM DRAWINGS	
PROJECT LAKE COUNTY ADULT CORRECTIONAL FACILITY 20 S. COUNTY STREET WAUKEGAN, IL 60085	
ELECTRICAL CONTRACTOR HOMESTRAD ELECTRIC 27839 W. CONCRETE DR. SUITE A FOX LAKE, IL 60041 MIKE AHERN 815.363.1222	
	
91 N. VILLAGE COURT ADDISON, IL 60101 SALES & SERVICE (630) 948-1100 FAX (630) 948-1150	
	
tyco SimplexGrinnell	
LAKE COUNTY ADULT CORRECTIONAL FACILITY FIRE ALARM SYSTEM DRAWINGS DRAWING NO. FA-01	

- 3.02.6.3 Simplex Zones 9 and 10 for the second floor are shown on the Simplex Drawing below as these are two zones for the new Work in this project. Simplex will re-issue new Fire Alarm Drawings for the second floor. The Division 25 BAS Contractor shall use these new Drawings to create Fire Alarm device floor plans for Simplex Zones 9 and 10. This Drawing file shall be used to create Fire Alarm floor plan graphics for the 3rd through 6th Fire Alarm device floor plans. All Fire Alarm floor plans shall be 3-D.





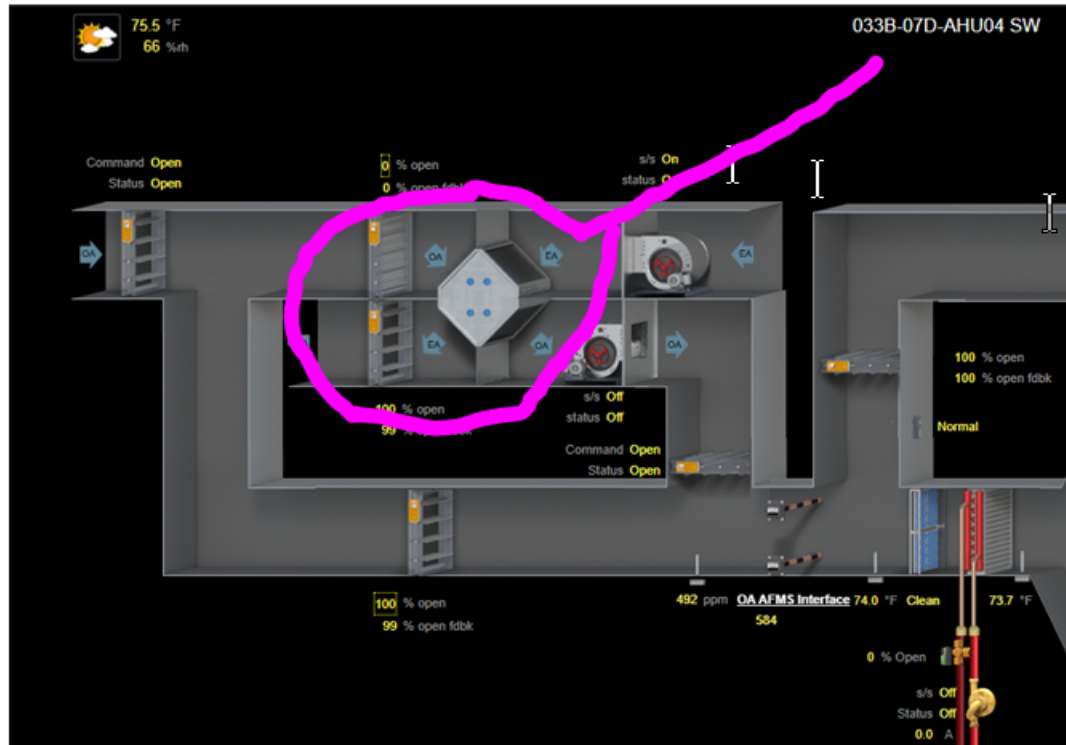


3.03 Graphics for 25 09 23.21.23 Integrated Automation – Stick Built – Hydronic Pumps – Constant Speed (All Types)

- 3.03.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.

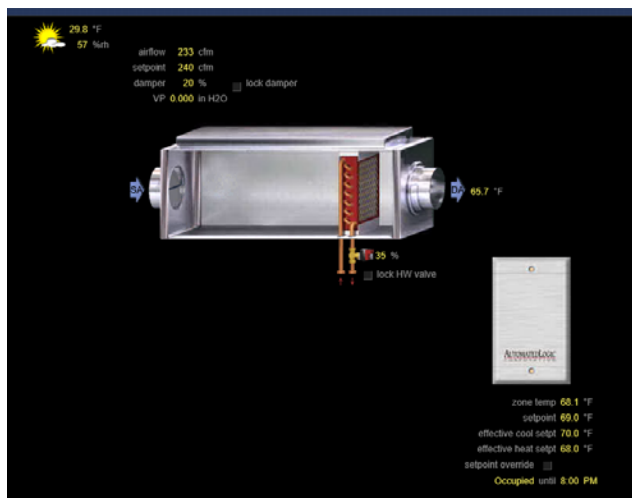
3.04 Graphics for 25 09 23.72.00 Integrated Automation – Stick Built – Air to Air Energy Recovery Equipment (All Types)

- 3.04.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.
- 3.04.2 This graphic is part of the AHUs graphics where this equipment is provided. The Air to Air Energy Recovery Equipment in the graphic below is tagged with a purple highlight below.



3.05 Graphics for 25 14 23.36 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – Air Terminal Units (All Types)

- 3.05.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.
- 3.05.2 Provide the VAV summary as shown above. Group by AHU. Provide for AHUs 01, 02, 03, 04, 05 and 07.



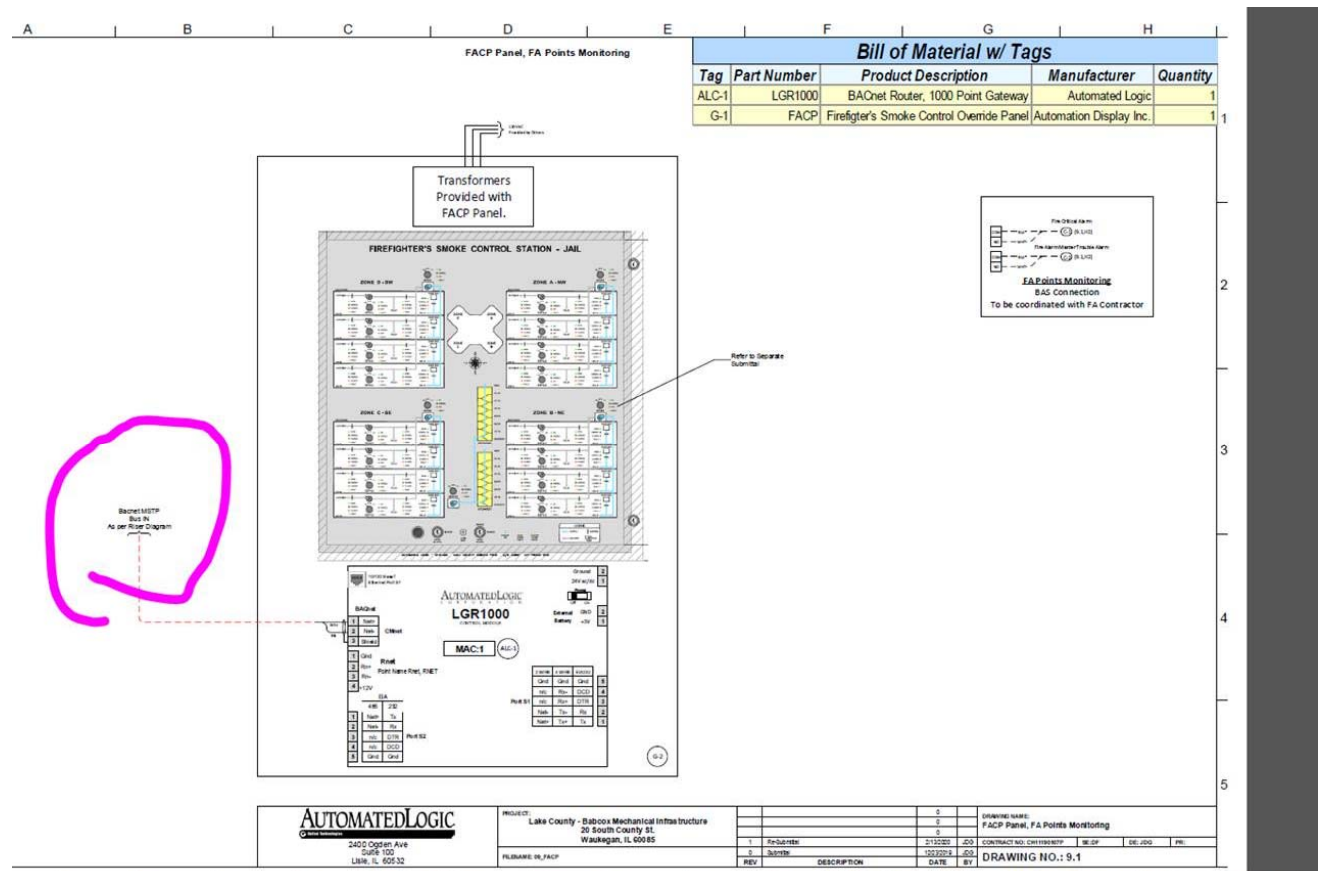
3.06 Graphics for 25 20 23.05.19 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – Flowmeters (All Types).

3.06.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.

3.07 Graphics for 25 20 23.09.00 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – ADi Panel (All Types).

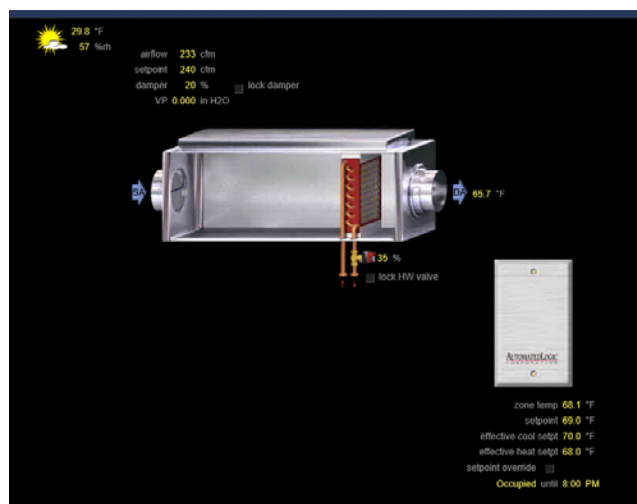
3.07.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.

3.07.2 Here is a picture of the existing ADi panel from the Division 25 BAS Contractor's Submittal for this project. The Division 25 BAS Contractor is responsible for creating graphics of the existing ADi panel shown below as well as the new ADi panel to be installed in the new Work.



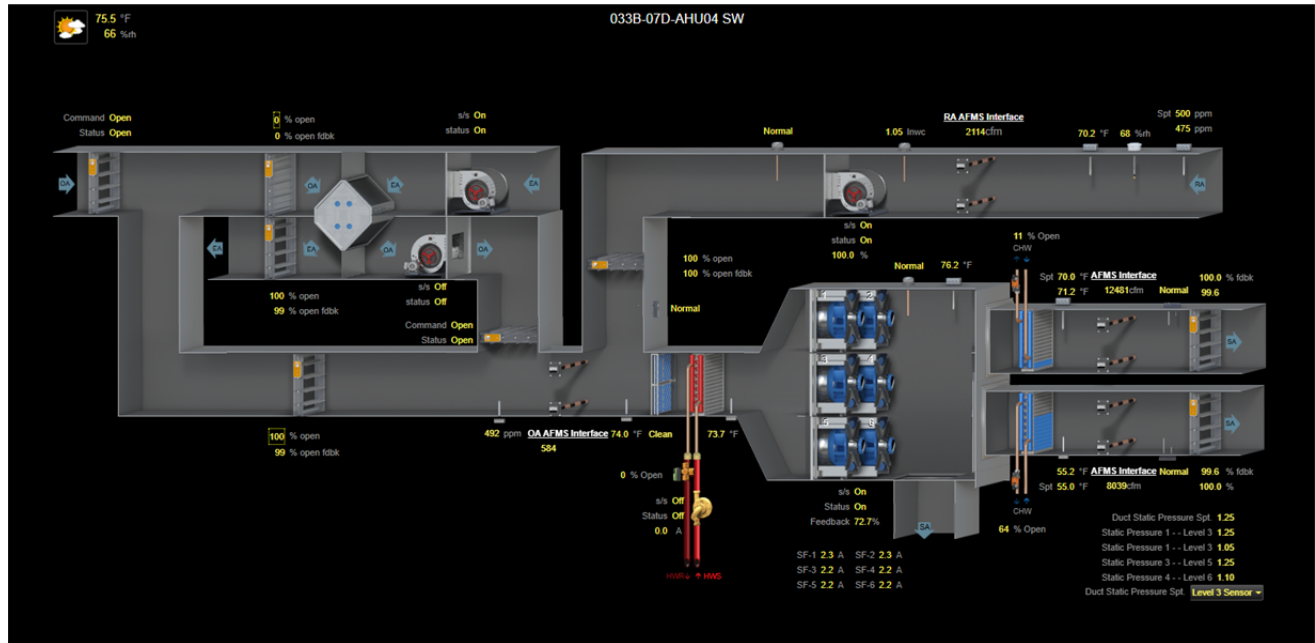
3.08 Graphics for 25 20 23.36.00 Integrated Automation –BACnet Interface Device (Gateways/Native BACnet Devices) –Air Terminal Units (All Types)

- 3.08.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.
- 3.08.2 Provide the VAV summary as shown above. Group by AHU. Provide for AHUs 01, 02, 03, 04, 05 and 07.



3.09 Graphics for 25 20 23.73.13 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – Indoor Central Station AHUs (All Types)

- 3.09.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.
- 3.09.2 Provide links to the equipment that form part of the AHU such as the VFDs, AFSs, the SOAP device and other equipment. Draw the AHU based on the based on the Consultant's Drawing.
- 3.09.2.1 Note that AHU01, AHU02, AHU03 and AHU04 equipment graphics have already been created by the Division 25 BAS Contractor.
- 3.09.2.2 The Division 25 BAS Contractor is only responsible for creating AHU05 and AHU07 equipment graphics.



webVIEW

AHU-1 N/W

4th Floor
5th Floor
6th Floor
AHU-1 N/W
033B-07A-AHU01
033B-07A-AHU01-SF01-VFD01
033B-07A-AHU01-RF01-VFD02
033B-07A-AHU01-EF01-VFD03
033B-07A-AHU01-OA-AFS01
033B-07A-AHU01-RA-AFS02
033B-07A-AHU01-SA-AFS03
033B-07A-AHU01-SAHD-AFS04
033B-07A-AHU01-SACD-AFS05
033B-07-UH06-6
033B-08-UH02-2
033B-07A-AHU01-SF01-ECM01
033B-07A-AHU01-SF02-ECM02
033B-07A-AHU01-SF03-ECM03
033B-07A-AHU01-SF04-ECM04
033B-07A-AHU01-SF05-ECM05
033B-07A-AHU01-SF06-ECM06
AHU-2 N/E
AHU-3 S/E
AHU-4 S/W
AHU-09
Sheriff Office
Domestic HW Plant
Boilers
LPS Boiler

AHU-1 N/W

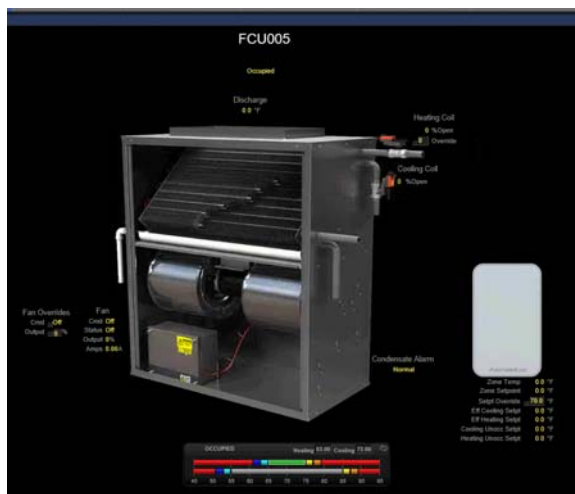
Color	Name	Status	Address	Reference Name	Type
	Up to 'Babcox_Jail'				
	033B-07A-AHU01	0.00	2400.10.1.107.3 #033b-07a-ahu01	babcox_ahu1	
	033B-07A-AHU01-SF01-VFD01	8.71	2400.10.1.107.3 #033b-07a-ahu01-sf01-vfd01	danfoss_vit_vfd_bacnet	
	033B-07A-AHU01-RF01-VFD02	1.12	2400.10.1.107.3 #033b-07a-ahu01-rf01-vfd02	danfoss_vit_vfd_bacnet	
	033B-07A-AHU01-EF01-VFD03	0.00	2400.10.1.107.3 #033b-07a-ahu01-ef01-vfd03	danfoss_vit_vfd_bacnet	
	033B-07A-AHU01-OA-AFS01	0.00	2400.10.1.107.3 #033b-07a-ahu01-oa-afs01	ebtron_bacnet	
	033B-07A-AHU01-RA-AFS02	0.00	2400.10.1.107.3 #033b-07a-ahu01-ra-afs02	ebtron_bacnet	
	033B-07A-AHU01-SA-AFS03	0.00	2400.10.1.107.3 #033b-07a-ahu01-sa-afs03	ebtron_bacnet	
	033B-07A-AHU01-SAHD-AFS04	0.00	2400.10.1.107.3 #033b-07a-ahu01-sahd-afs04	ebtron_bacnet	
	033B-07A-AHU01-SACD-AFS05	0.00	2400.10.1.107.3 #033b-07a-ahu01-sacd-afs05	ebtron_bacnet	
	033B-07-UH06-6	71.90	2400.10.1.107.3 #033b-07-uh06-6	babcox_ph_unit_heater	
	033B-08-UH02-2	69.00	2400.10.1.107.3 #033b-08-uh02-2	babcox_ph_unit_heater	
	033B-07A-AHU01-SF01-ECM01	0.00	2400.10.1.107.3 #033b-07a-ahu01-sf01-ecm01	babcox_ziehl_abegg_bacnet	
	033B-07A-AHU01-SF02-ECM02	0.00	2400.10.1.107.3 #033b-07a-ahu01-sf02-ecm02	babcox_ziehl_abegg_bacnet	
	033B-07A-AHU01-SF03-ECM03	0.00	2400.10.1.107.3 #033b-07a-ahu01-sf03-ecm03	babcox_ziehl_abegg_bacnet	
	033B-07A-AHU01-SF04-ECM04	0.00	2400.10.1.107.3 #033b-07a-ahu01-sf04-ecm04	babcox_ziehl_abegg_bacnet	
	033B-07A-AHU01-SF05-ECM05	0.00	2400.10.1.107.3 #033b-07a-ahu01-sf05-ecm05	babcox_ziehl_abegg_bacnet	
	033B-07A-AHU01-SF06-ECM06	0.00	2400.10.1.107.3 #033b-07a-ahu01-sf06-ecm06	babcox_ziehl_abegg_bacnet	

3.09.1 Provide an AHU management graphic showing the heating and cooling requests for each AHU. Provide for AHUs 01, 02, 03, 04, 05 and 07.



3.10 Graphics for 25 20 23.82.19 Integrated Automation – BACnet Interface Device (Gateway/Native BACnet Devices) Daikin Fan Coil Units (All Types)

- 3.10.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.



3.11 Graphics for 25 20 23.85 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – Air Flow Measuring Stations (All Types)

- 3.11.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner. Provide for AHUs 01, 02, 03, 04, 05 and 07.

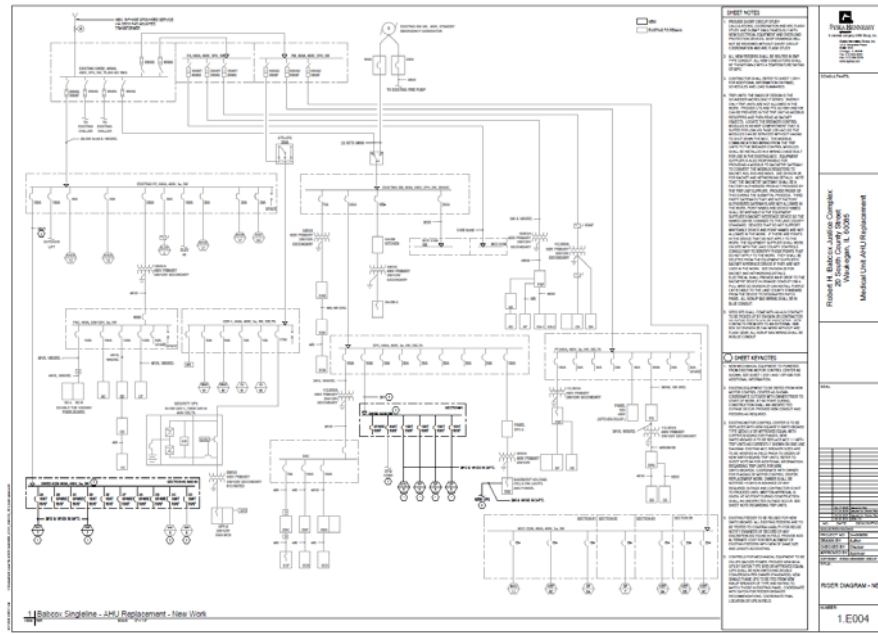


3.12 Graphics for 25 20 26.28.16 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – Enclosed Switches and Circuit Breakers (All Types)

- 3.12.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.
- 3.12.2 Use the Electrical One-Line Diagram on Drawing 1.E004 for the Motor Control Center (MCC). Create a graphic for each MCC similar to the graphic below. Show the relevant Trip Units in each MCC. Provide links to the Trip Units graphics.
- 3.12.2.1 Note the terms Motor Control Center (MCC) and Switchboard (SWBD) are used interchangeably in all of the Contract Documents in the Work.



- 3.12.3 Create a One-Line Diagram graphic using the Consultants Drawing 1.E004 below as a guide. Add links to access all Trip Units shown in the New Work. The existing One-Line Diagram devices on this Drawing can remain grayed out when the graphic is created.



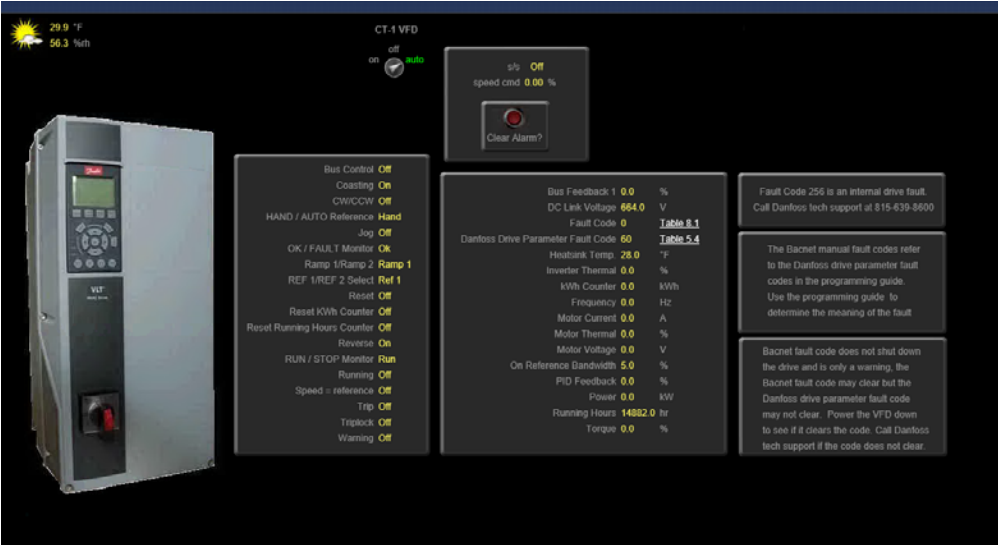
- 3.12.4 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.





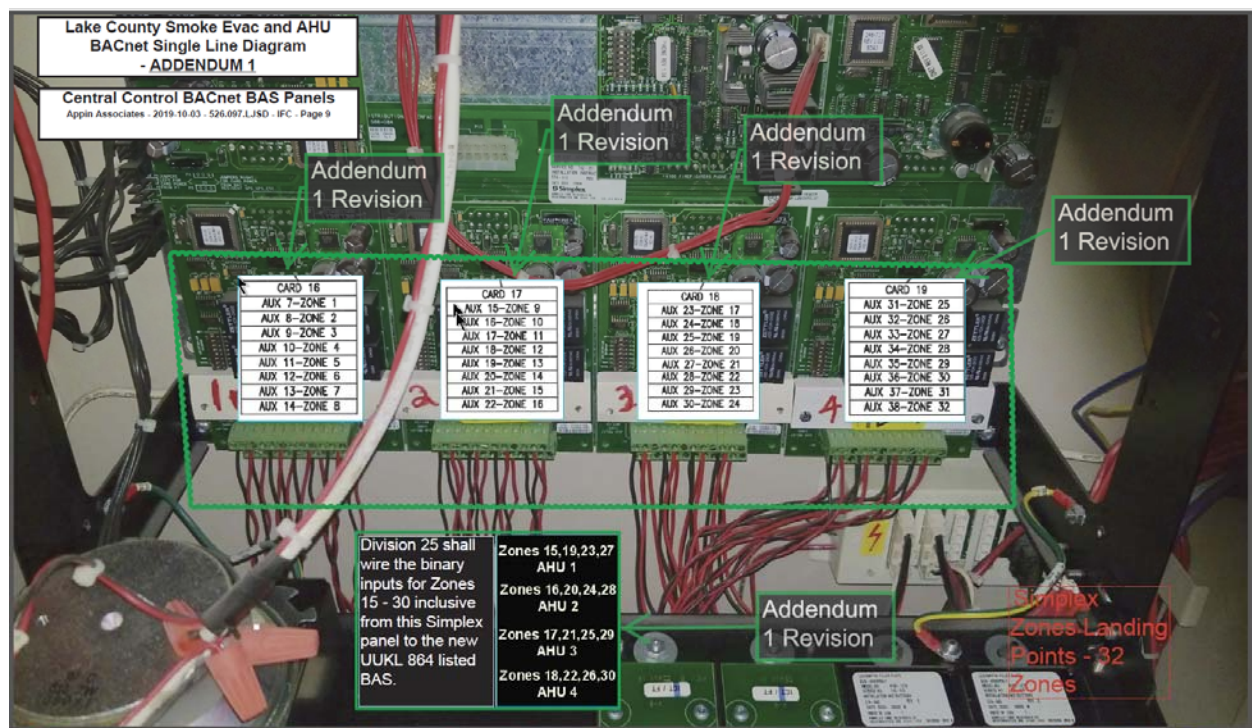
3.13
Graphics for 25 20 26.29.23 Integrated Automation – BACnet Interface Device (Gateway/Native BACnet Devices) Variable Frequency Motor Controller (All Types)

3.13.1
Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier’s web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner. Provide for AHUs 01, 02, 03, 04, 05 and 07.



3.14
Graphics for Graphics for 25 20 28.31.11 Integrated Automation – BACnet Interface Device (Gateways/Native BACnet Devices) – Simplex Fire Detection and Alarm (All Types)

- 3.14.1 Create equipment graphic(s) for each piece of equipment provided in the Work. Use graphic images that represent the make and model used in the Work. Obtain the equipment graphic from the Equipment Supplier or from the Equipment Supplier's web site. Create a table of points and show the Present_Values for each point. If the point count exceeds 10 points, only put the points deemed to be critical by the Owner on the main graphic. Put the remaining points in a table in a sub-graphic. Follow the colorization standard specified in 25 15 11. Provide a clickable link from the relevant floor plan location to this equipment graphic. All graphics shall be approved by Owner.
- 3.14.2 Add the Fire Alarm field device points to the floor plan as discovered in the existing Simplex FieldServer BACnet Interface Device.
- 3.14.3 Create an equipment graphic of the Fire Alarm panel points as discovered in the existing Simplex FieldServer BACnet Interface Device.
- 3.14.4 Create an equipment graphic showing the interconnections to the following Simplex Fire Alarm Zones shown below.
- 3.14.4.1 Zones 15, 19, 23, 27 for existing AHU 01,
 - 3.14.4.2 Zones 16, 20, 24, 28 for existing AHU 02,
 - 3.14.4.3 Zones 17, 21, 25, 29 for existing AHU 03,
 - 3.14.4.4 Zones 18, 22, 26, 30 for existing AHU 04,
 - 3.14.4.5 Zone 09 for new AHU 05,
 - 3.14.4.6 Zone 10 for new AHU 07.



End of Section

25 20 23.05.19 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE BACNET DEVICES) – FLOW METERS (ALL TYPES)

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 23 and Flow Meter Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
 - 1.01.1.1 Division 25 BAS Contractor is responsible for providing all equipment and all BACnet Interface Devices for the flow meters and is designated as the Equipment Supplier in this Specification section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:
 - 1.03.1.1 Single On-board BACnet Interface Device Type:

- 1.03.1.1.1 This device is a single onboard BACnet Interface Device. Electrical is responsible for providing power to this device is power is not available via the single point of connection. Division 25 is responsible for networking this device with a BACnet MS/TP network connection. . The Lake County BAS Consultant shall then verify network connectivity to the BACnet MS/TP device and then to the Division 25 supplied BACnet/IP device that hosts the MS/TP network connection.. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAm and the BACnet WhoHas/IHave services. Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.
 - 1.03.1.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.
 - 1.03.1.2.1 The flow meter shall be supplied and installed by the Flow Meter Equipment Supplier or the Division 25 BAS Contractor.
 - 1.03.1.3 The demarcation of Work responsibilities between Division 25 and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
 - 1.03.1.4 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.03.1.5 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.
- 1.04 Work By Others for this BACnet Interface Device**
- 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 Related Division 25 Sections that Apply to the Equipment Supplier**
- 1.05.1 25 00 11 Integrated Automation – General Requirements – Division 25 Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation – General Requirements – Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation – General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation – General Requirements – Starting & Adjusting
 - 1.05.6 25 00 77 Integrated Automation – General Requirements – Closeout Procedures
 - 1.05.7 25 00 78 Integrated Automation – General Requirements – Closeout Submittals
 - 1.05.8 25 00 79 Integrated Automation – General Requirements – Demonstration & Training
 - 1.05.9 25 05 01 Integrated Automation – Common Work Results – General
 - 1.05.10 25 05 05 Integrated Automation – Common Work Results – Device Interface Integration
 - 1.05.11 25 05 13 Integrated Automation – Common Work Results – Conductors & Cables
 - 1.05.12 25 05 26 Integrated Automation – Common Work Results – Grounding & Bonding
 - 1.05.13 25 05 28 Integrated Automation – Common Work Results – Pathways
 - 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
 - 1.05.15 25 06 00 Integrated Automation – Schedules
 - 1.05.16 25 08 00 Integrated Automation – Controls Commissioning

2 - PRODUCTS

2.01 General

- 2.01.1 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:
 - 2.01.1.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.

- 2.01.1.2 Working with the Lake County BAS Consultant to commission the BACnet Interface Device once it is connected the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet/IP BACnet Interface Device complete with an Annex J router to support BACnet/IP to act as a client and/or server for all BACnet information from this system to the BAS System.
- 2.02.2 The device shall support use of a static IP address for remote access through the Owner's firewall. Provision of remote access is not included in the Work.
- 2.02.3 The device shall have an open Ethernet port for connection to the network infrastructure (network connection to panel by the Owner). Co-ordinate network configuration requirements with the IT department through the Owner.
- 2.02.4 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.4.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.5 If the equipment interface is a native BACnet Interface Device, all objects must be represented externally on the network using BACnet objects and services.
 - 2.02.5.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.6.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data must be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.6.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.7 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.7.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.7.1.1 NONE.
- 2.02.8 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.8.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.8.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.8.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.8.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.8.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.8.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.8.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.8.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.8.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.8.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.8.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.8.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.8.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.8.14 Device Management - Restart - B (DM-R-B)
- 2.02.9 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for

BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.

2.02.10 The BACnet Interface Device shall support the following Object types:

- 2.02.10.1 Analog Input
- 2.02.10.2 Analog Output
- 2.02.10.3 Analog Value
- 2.02.10.4 Binary Input
- 2.02.10.5 Binary Output
- 2.02.10.6 Binary Value
- 2.02.10.7 Device Object
- 2.02.10.8 Multi-state Input
- 2.02.10.9 Multi-state Output
- 2.02.10.10 Multi-state Value

2.02.11 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences.

2.03 Water Flow Meters

2.03.1 The BACnet Interface Device shall be represented externally as a BACnet MS/TP device on the Owner's network.

2.03.2 Provide the following objects at a minimum:

Water Flow Meter BACnet Interface Device Objects (Typical)				
Object Name	Read/Write	Object Type	Alarmable Y/N	Description (acceptable value range)
Total Flow	R	A	Y	gallons liters ³ or meters ³
Flow Rate	R	A	Y	gpm, gph, mgd, l/s, l/m, l/hr or m ³ /hr
Flow Total Reset	W	B	N	Writeable to zero via BACnet WriteProperty
Alarm	R	B	Y	1 = Normal; 0 = Off-Normal

Notes: A= analog, B=Binary, MS=multi-state

2.04 BTU Meters

2.04.1 The BACnet Interface Device shall be represented externally as a BACnet MS/TP device on the Owner's network.

2.04.2 Provide the following objects at a minimum:

BTU Meter BACnet Interface Device Objects (Typical)				
Object Name	Read/Write	Object Type	Alarmable Y/N	Description (acceptable value range)
Total Energy	R	A	Y	BTU, kW-hrs or ton-hrs
Energy Rate	R	A	Y	Btu/hr, kW or tons
Total Flow	R	A	Y	gallons liters ³ or meters ³
Flow Rate	R	A	Y	gpm, gph, mgd, l/s, l/m, l/hr or m ³ /hr
Supply Temperature	R	A	N	°F or °C
Return Temperature	R	A	N	°F or °C
Delta-T	R	A	N	°F or °C
Energy Total Reset	W	B	N	Writeable to zero via BACnet WriteProperty
Flow Total Reset	W	B	N	Writeable to zero via BACnet WriteProperty

Notes: A= analog, B=Binary, MS=multi-state

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

- 3.01.1 BACnet/IP BACnet Interface Devices are not allowed in the Work.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

- 3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.

3.02.1.1 Meters

- 3.02.2 The Owner will arrange for the following:

- 3.02.2.1 The IT department shall provide a static IP address for the BACnet/IP BAS panel supplied by the Division 25 BAS Contractor that is used to network to the Equipment Supplier's BACnet MS/TP device.

- 3.02.2.2 The IT department will assist with the commissioning of the network connection with this Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.

- 3.02.2.3 The Owner shall provide the passwords and access levels required for the Work.

- 3.02.3 The Equipment Supplier of the BACnet Interface Device shall provide the following:

- 3.02.3.1 Provide a BACnet MS/TP device meet the following requirements. The device shall:

- 3.02.3.1.1 Operate as a Manager device on the BACnet MS/TP network.

- 3.02.3.1.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m [4,005 ft.].

- 3.02.3.1.3 Provide a separate MS/TP trunk for non-UL listed devices in the Work.

- 3.02.3.1.4 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet Interface Devices on any BACnet MS/TP network segment without requiring the use of repeaters.

- 3.02.3.1.5 Provide information on the baud rate used. The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.

- 3.02.3.1.6 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network. Devices with fixed BACnet Interface Device IDs that cannot be changed on site are not allowed in the Work.

- 3.02.3.1.7 Size the Division 25 BACnet integration device to provide and map all the objects listed in the Equipment Supplier's approved Submittal.

- 3.02.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved. Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.

- 3.02.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.

- 3.02.3.4 Configure the device with the approved network number and BACnet Interface Device instance number.

- 3.02.3.5 The Equipment Supplier or the Division 25 BAS Contractor shall install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.

- 3.02.3.6 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.
- 3.02.3.7 Assist the Division 25 BAS Contractor to Commission the final network connection to the Owner's network.
- 3.02.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
- 3.02.3.9 Participate in the commissioning process as outlined in this Division.
- 3.02.4 Division 27 shall provide the following:
 - 3.02.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.02.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.02.5 Division 25 BAS Contractor is responsible for the following:
 - 3.02.5.1 Install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.
 - 3.02.5.2 Provide details of the required alarms, schedules and trends as outlined in the Sequence of Operation.
 - 3.02.5.3 Provide a graphic of the equipment to be controls and review the graphics created by ALC Chicago. This information may be provided as a .dwg file or a graphics format file. Provision of paper documents requiring scanning and post processing by Division 25 is not allowed.
 - 3.02.5.4 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.
 - 3.02.5.5 Participating in the commissioning process as outlined in this Division.
- 3.02.6 Division 25 BAS Contractor is responsible for the following:
 - 3.02.6.1 A schedule as to when the networking requirements need to be completed. See the Division 25 section for this information to be provided as a Shop Drawing.
 - 3.02.6.2 Confirmation that the BACnet Interface Device ID and network number are unique BACnet Interface Device ID and network number are unique to the BAS Device Network.
 - 3.02.6.3 Confirmation that the BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.6.4 Create a separate BACnet MS/TP network segment for each data rate provided in the Work.
 - 3.02.6.5 Connection of the BACnet MS/TP network cable to the BACnet Interface Device.
 - 3.02.6.6 Connect a shield wire to earth or device chassis at one point along the MS/TP bus prevent ground potential differences on the BAS device network.
 - 3.02.6.7 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.
 - 3.02.6.8 A network drop from the Division 25 BAS Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.
 - 3.02.6.9 Joint commissioning the network connection to this Division 25 BAS Contractor's MS/TP network.
 - 3.02.6.10 Exposing all BACnet MS/TP devices and objects in the Division 25 BAS Contractor supplied BACnet/IP device to which the BACnet MS/TP device is connected.
 - 3.02.6.11 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.02.6.11.1 Consultant's Drawings and Specifications.
 - 3.02.6.12 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:

- 3.02.6.12.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
- 3.02.6.12.2 A minimum of 1 schedule.
- 3.02.6.12.3 A minimum of 10 Extended Trends.
- 3.02.6.13 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
- 3.02.6.14 See 25 15 11.01 for expected level of graphics to be provided.
- 3.02.6.15 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.02.6.15.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.6.15.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.02.6.15.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.6.15.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
 - 3.02.6.15.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
- 3.02.6.16 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
- 3.02.6.17 Participating in the commissioning process as outlined in this Division.
- 3.02.7 The BACnet Interface Device to the Equipment Supplier's BACnet, Modbus or proprietary protocol Device shall be jointly commissioned by Division 25, Equipment Supplier, ALC Chicago and Appin Associates to the satisfaction of the Owner. The Work includes the following:
 - 3.02.7.1 All parties shall each allow 8 hours of technician on-site time for this Work (excluding travel to and from the Work) for all devices. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.02.7.2 Equipment Supplier must provide written confirmation that the BACnet Interface Device is ready for commissioning.
 - 3.02.7.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
 - 3.02.7.4 The commissioning process shall be overseen by Lake County BAS Consultant.
 - 3.02.7.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
 - 3.02.7.6 The Work includes the following:
 - 3.02.7.6.1 Complete commissioning of all network visible object types according to the procedures outlined in Section 25 08 00, using the relevant Commissioning Forms for each BACnet Object Types.
 - 3.02.7.6.2 Verify all network visible BACnet Object Types correctly display the same information on the ALC Front End as is being displayed on the equipment local interface. All network visible objects shall be commissioned.
 - 3.02.7.6.3 Commission the BACnet MS/TP network connection to the Division 25 BACnet/IP device.
 - 3.02.7.6.4 Assist ALC Chicago to integrate this system into the building-wide BACnet Internetwork.
 - 3.02.7.6.5 The process shall be overseen by BAS Consultant.
 - 3.02.7.6.6 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.02.7.6.7 Allow 8 hours of on-site time for this Work.

- 3.02.7.6.8 The following special provisions apply to the commissioning Work.
- 3.02.7.7 NONE.

End of Section

25 20 23.09.00 INTEGRATED AUTOMATION –BACNET INTERFACE DEVICE (GATEWAYS/NATIVE BACNET DEVICES) – AUTOMATION DISPLAY (ADI) PANELS (ALL TYPES)

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 23 and Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
 - 1.01.1.1 Division 25 BAS Contractor is responsible for providing all equipment and all BACnet Interface Devices for the Air Terminal Units and is designated as the Equipment Supplier in this Specification section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:
 - 1.03.1.1 Single On-board BACnet Interface Device Type:

- 1.03.1.1.1 This device is a single onboard BACnet Interface Device that is Modbus RTU.
 - 1.03.1.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.
 - 1.03.1.2.1 The *Basis of Design* is the ADi panel from Automation Display to with Division 25 BAS Contractor a Modbus RTU to BACnet MS/TP integration device that the Division 25 BAS Contractor shall map the Modbus registers to BACnet Object Types.
 - 1.03.1.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
 - 1.03.1.3.1 The Work of this Specification Section shall be provided as a *Designated Design* by the Division 25 BAS Contractor. The Division 25 BAS Contractor is responsible for the design, supply, installation and commissioning of the ADi panel and the BACnet MS/TP panel.
 - 1.03.1.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
 - 1.03.1.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAm and the BACnet WhoHas/IHave services.
 - 1.03.1.6 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.03.1.7 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.
- 1.04 Work By Others for this BACnet Interface Device**
- 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 Related Division 25 Sections that Apply to the Equipment Supplier**
- 1.05.1 25 00 11 Integrated Automation – General Requirements – Division 25 Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation – General Requirements – Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation – General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation – General Requirements – Starting & Adjusting
 - 1.05.6 25 00 77 Integrated Automation – General Requirements – Closeout Procedures
 - 1.05.7 25 00 78 Integrated Automation – General Requirements – Closeout Submittals
 - 1.05.8 25 00 79 Integrated Automation – General Requirements – Demonstration & Training
 - 1.05.9 25 05 01 Integrated Automation – Common Work Results – General
 - 1.05.10 25 05 05 Integrated Automation – Common Work Results – Device Interface Integration
 - 1.05.11 25 05 13 Integrated Automation – Common Work Results – Conductors & Cables
 - 1.05.12 25 05 26 Integrated Automation – Common Work Results – Grounding & Bonding
 - 1.05.13 25 05 28 Integrated Automation – Common Work Results – Pathways
 - 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
 - 1.05.15 25 06 00 Integrated Automation – Schedules
 - 1.05.16 25 08 00 Integrated Automation – Controls Commissioning
 - 1.05.17 25 08 03 Integrated Automation – BAS UL 864 UUKL Commissioning

2 - PRODUCTS

2.01 General

- 2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Division 23, 23 09 00.
- 2.01.2 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:
 - 2.01.2.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
 - 2.01.2.2 Working with Lake County BAS Consultant to commission the BACnet Interface Device once it is connected to the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet MS/TP BACnet Interface Device.
- 2.02.2 Division 25 BAS Contractor is responsible for networking to this device using a Level 1 BACnet/IP BAS panel that supports up to 32 BACnet MS/TP Manager devices.
- 2.02.3 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.3.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
 - 2.02.3.2 The Division 25 BAS Contractor shall assume that the ADi panel is a Modbus RTU device requiring a BACnet gateway device that is designed, supplied, installed and commissioned by the Division 25 BAS Contractor. The Division 25 BAS Contractor's gateway shall map all device points and their present values residing in the gateway device to BACnet objects.
- 2.02.4 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.4.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.4.1.1 NONE.
- 2.02.5 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.5.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.5.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.5.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.5.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.5.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.5.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.5.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.5.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.5.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.5.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.5.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.5.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.5.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.5.14 Device Management - Restart - B (DM-R-B)
- 2.02.6 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
- 2.02.7 The BACnet Interface Device shall support the following Object types:

- 2.02.7.1 Analog Input
- 2.02.7.2 Analog Output
- 2.02.7.3 Analog Value
- 2.02.7.4 Binary Input
- 2.02.7.5 Binary Output
- 2.02.7.6 Binary Value
- 2.02.7.7 Device Object
- 2.02.7.8 Multi-state Input
- 2.02.7.9 Multi-state Output
- 2.02.7.10 Multi-state Value
- 2.02.8 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences outlined in the Contract Documents.
- 2.03 **ADi Panel**
 - 2.03.1 The ADi panel and the Division 25 BACnet MS/TP BACnet Interface Device shall both be UL 864 UUKL 10th Edition listed devices as they both perform UL-listed functions and are part of the UL Chain of Custody.

2.04 Requirements for mapping FSCS ADi panel points from the ADi panel to the ALC BACnet Interface Device.

- 2.04.1 Allow for mapping 100 points to an ALC device from the ADi Modbus RTU device.
2.04.2 The ADi Modbus RTU device and the ALC BACnet MS/TP device shall be a UL 864 UUKL 10th Edition listed device.
2.04.3 The points list for the existing ADi panel is shown below to provide guidance on the type Modbus RTU registers to be mapped to BACnet object types required for the new Work of this project.

ADI addr	I/O crd	Con/Pin	Description	Color	Int addr	PLC 4X reg	Reg bits
0	L0	2/21	Sonalert			401	1,2
1	L0	2/Y	FSCS Comm Fault	Yellow		401	3,4
2	L0	2/20	System Comm Fault	Yellow		401	5,6
3	L0	2/X	Addressable Sonalert			401	7,8
4	L0	2/19	Zone D, Fan AHU01 On	Green		401	9,10
5	L0	2/W	Zone D, Fan AHU01 Normal	White		401	11,12
6	L0	2/18	Zone D, Fan AHU01 Off	Red		401	13,14
7	L0	2/V	Zone D, Fan AHU01 Fault	Yellow		401	15,16
8	L0	2/17	Zone D, 6th Floor, Ex Damper Open	Green		402	1,2
9	L0	2/U	Zone D, 6th Floor, Ex Damper Normal	White		402	3,4
10	L0	2/16	Zone D, 6th Floor, Ex Damper Closed	Red		402	5,6
11	L0	2/T	Zone D, 6th Floor, Ex Damper Fault	Yellow		402	7,8
12	L0	2/15	Zone D, 6th Floor, Fan SEF-6.1 On	Green		402	9,10
13	L0	2/S	Zone D, 6th Floor, Fan SEF-6.1 Normal	White		402	11,12
14	L0	2/14	Zone D, 6th Floor, Fan SEF-6.1 Off	Red		402	13,14
15	L0	2/R	Zone D, 6th Floor, Fan SEF-6.1 Fault	Yellow		402	15,16
16	L0	2/13	Zone D, 6th Floor, Ret Damper Open	Green		403	1,2
17	L0	2/P	Zone D, 6th Floor, Ret Damper Normal	White		403	3,4
18	L0	2/12	Zone D, 6th Floor, Ret Damper Closed	Red		403	5,6
19	L0	2/N	Zone D, 6th Floor, Ret Damper Fault	Yellow		403	7,8
20	L0	2/11	Zone D, 6th Floor, Dump Box Damper Open	Green		403	9,10
21	L0	2/M	Zone D, 6th Floor, Dump Box Damper Normal	White		403	11,12
22	L0	2/10	Zone D, 6th Floor, Dump Box Damper Closed	Red		403	13,14
23	L0	2/L	Zone D, 6th Floor, Dump Box Damper Fault	Yellow		403	15,16
24	L0	2/9	Zone D, 5th Floor, Ex Damper Open	Green		404	1,2
25	L0	2/K	Zone D, 5th Floor, Ex Damper Normal	White		404	3,4
26	L0	2/8	Zone D, 5th Floor, Ex Damper Closed	Red		404	5,6
27	L0	2/J	Zone D, 5th Floor, Ex Damper Fault	Yellow		404	7,8
28	L0	2/7	Zone D, 5th Floor, Fan SEF-5.1 On	Green		404	9,10
29	L0	2/H	Zone D, 5th Floor, Fan SEF-5.1 Normal	White		404	11,12
30	L0	2/6	Zone D, 5th Floor, Fan SEF-5.1 Off	Red		404	13,14
31	L0	2/F	Zone D, 5th Floor, Fan SEF-5.1 Fault	Yellow		404	15,16
32	L0	2/5	Zone D, 5th Floor, Ret Damper Open	Green		405	1,2
33	L0	2/E	Zone D, 5th Floor, Ret Damper Normal	White		405	3,4
34	L0	2/4	Zone D, 5th Floor, Ret Damper Closed	Red		405	5,6
35	L0	2/D	Zone D, 5th Floor, Ret Damper Fault	Yellow		405	7,8
36	L0	2/3	Zone D, 5th Floor, Dump Box Damper Open	Green		405	9,10
37	L0	2/C	Zone D, 5th Floor, Dump Box Damper Normal	White		405	11,12
38	L0	2/2	Zone D, 5th Floor, Dump Box Damper Closed	Red		405	13,14
39	L0	2/B	Zone D, 5th Floor, Dump Box Damper Fault	Yellow		405	15,16
40	L0	1/21	Zone D, 4th Floor, Ex Damper Open	Green		406	1,2
41	L0	1/Y	Zone D, 4th Floor, Ex Damper Normal	White		406	3,4
42	L0	1/20	Zone D, 4th Floor, Ex Damper Closed	Red		406	5,6
43	L0	1/X	Zone D, 4th Floor, Ex Damper Fault	Yellow		406	7,8
44	L0	1/19	Zone D, 4th Floor, Fan SEF-4.1 On	Green		406	9,10
45	L0	1/W	Zone D, 4th Floor, Fan SEF-4.1 Normal	White		406	11,12
46	L0	1/18	Zone D, 4th Floor, Fan SEF-4.1 Off	Red		406	13,14

47	L0	1/V	Zone D, 4th Floor, Fan SEF-4.1 Fault	Yellow		406	15,16
48	L0	1/17	Zone D, 4th Floor, Ret Damper Open	Green		407	1,2
49	L0	1/U	Zone D, 4th Floor, Ret Damper Normal	White		407	3,4
50	L0	1/16	Zone D, 4th Floor, Ret Damper Closed	Red		407	5,6
51	L0	1/T	Zone D, 4th Floor, Ret Damper Fault	Yellow		407	7,8
52	L0	1/15	Zone D, 4th Floor, Dump Box Damper Open	Green		407	9,10
53	L0	1/S	Zone D, 4th Floor, Dump Box Damper Normal	White		407	11,12
54	L0	1/14	Zone D, 4th Floor, Dump Box Damper Closed	Red		407	13,14
55	L0	1/R	Zone D, 4th Floor, Dump Box Damper Fault	Yellow		407	15,16
56	L0	1/13	Zone D, 3rd Floor, Ex Damper Open	Green		408	1,2
57	L0	1/P	Zone D, 3rd Floor, Ex Damper Normal	White		408	3,4
58	L0	1/12	Zone D, 3rd Floor, Ex Damper Closed	Red		408	5,6
59	L0	1/N	Zone D, 3rd Floor, Ex Damper Fault	Yellow		408	7,8
60	L0	1/11	Zone D, 3rd Floor, Fan SEF-3.1 On	Green		408	9,10
61	L0	1/M	Zone D, 3rd Floor, Fan SEF-3.1 Normal	White		408	11,12
62	L0	1/10	Zone D, 3rd Floor, Fan SEF-3.1 Off	Red		408	13,14
63	L0	1/L	Zone D, 3rd Floor, Fan SEF-3.1 Fault	Yellow		408	15,16
64	L0	1/9	Zone D, 3rd Floor, Ret Damper Open	Green		409	1,2
65	L0	1/K	Zone D, 3rd Floor, Ret Damper Normal	White		409	3,4
66	L0	1/8	Zone D, 3rd Floor, Ret Damper Closed	Red		409	5,6
67	L0	1/J	Zone D, 3rd Floor, Ret Damper Fault	Yellow		409	7,8
68	L0	1/7	Zone D, 3rd Floor, Dump Box Damper Open	Green		409	9,10
69	L0	1/H	Zone D, 3rd Floor, Dump Box Damper Normal	White		409	11,12
70	L0	1/6	Zone D, 3rd Floor, Dump Box Damper Closed	Red		409	13,14
71	L0	1/F	Zone D, 3rd Floor, Dump Box Damper Fault	Yellow		409	15,16
72	L0	1/5	Zone C, Fan AHU02 On	Green		410	1,2
73	L0	1/E	Zone C, Fan AHU02 Normal	White		410	3,4
74	L0	1/4	Zone C, Fan AHU02 Off	Red		410	5,6
75	L0	1/D	Zone C, Fan AHU02 Fault	Yellow		410	7,8
76	L0	1/3	Zone C, 6th Floor, Ex Damper Open	Green		410	9,10
77	L0	1/C	Zone C, 6th Floor, Ex Damper Normal	White		410	11,12
78	L0	1/2	Zone C, 6th Floor, Ex Damper Closed	Red		410	13,14
79	L0	1/B	Zone C, 6th Floor, Ex Damper Fault	Yellow		410	15,16
80	L1	2/21	Zone C, 6th Floor, Fan SEF-6.2 On	Green		411	1,2
81	L1	2/Y	Zone C, 6th Floor, Fan SEF-6.2 Normal	White		411	3,4
82	L1	2/20	Zone C, 6th Floor, Fan SEF-6.2 Off	Red		411	5,6
83	L1	2/X	Zone C, 6th Floor, Fan SEF-6.2 Fault	Yellow		411	7,8
84	L1	2/19	Zone C, 6th Floor, Ret Damper Open	Green		411	9,10
85	L1	2/W	Zone C, 6th Floor, Ret Damper Normal	White		411	11,12
86	L1	2/18	Zone C, 6th Floor, Ret Damper Closed	Red		411	13,14
87	L1	2/V	Zone C, 6th Floor, Ret Damper Fault	Yellow		411	15,16
88	L1	2/17	Zone C, 6th Floor, Dump Box Damper Open	Green		412	1,2
89	L1	2/U	Zone C, 6th Floor, Dump Box Damper Normal	White		412	3,4
90	L1	2/16	Zone C, 6th Floor, Dump Box Damper Closed	Red		412	5,6
91	L1	2/T	Zone C, 6th Floor, Dump Box Damper Fault	Yellow		412	7,8
92	L1	2/15	Zone C, 5th Floor, Ex Damper Open	Green		412	9,10
93	L1	2/S	Zone C, 5th Floor, Ex Damper Normal	White		412	11,12
94	L1	2/14	Zone C, 5th Floor, Ex Damper Closed	Red		412	13,14
95	L1	2/R	Zone C, 5th Floor, Ex Damper Fault	Yellow		412	15,16
96	L1	2/13	Zone C, 5th Floor, Fan SEF-5.2 On	Green		413	1,2
97	L1	2/P	Zone C, 5th Floor, Fan SEF-5.2 Normal	White		413	3,4
98	L1	2/12	Zone C, 5th Floor, Fan SEF-5.2 Off	Red		413	5,6
99	L1	2/N	Zone C, 5th Floor, Fan SEF-5.2 Fault	Yellow		413	7,8
100	L1	2/11	Zone C, 5th Floor, Ret Damper Open	Green		413	9,10
101	L1	2/M	Zone C, 5th Floor, Ret Damper Normal	White		413	11,12
102	L1	2/10	Zone C, 5th Floor, Ret Damper Closed	Red		413	13,14
103	L1	2/L	Zone C, 5th Floor, Ret Damper Fault	Yellow		413	15,16
104	L1	2/9	Zone C, 5th Floor, Dump Box Damper Open	Green		414	1,2

105	L1	2/K	Zone C, 5th Floor, Dump Box Damper Normal	White		414	3,4
106	L1	2/8	Zone C, 5th Floor, Dump Box Damper Closed	Red		414	5,6
107	L1	2/J	Zone C, 5th Floor, Dump Box Damper Fault	Yellow		414	7,8
108	L1	2/7	Zone C, 4th Floor, Ex Damper Open	Green		414	9,10
109	L1	2/H	Zone C, 4th Floor, Ex Damper Normal	White		414	11,12
110	L1	2/6	Zone C, 4th Floor, Ex Damper Closed	Red		414	13,14
111	L1	2/F	Zone C, 4th Floor, Ex Damper Fault	Yellow		414	15,16
112	L1	2/5	Zone C, 4th Floor, Fan SEF-4.2 On	Green		415	1,2
113	L1	2/E	Zone C, 4th Floor, Fan SEF-4.2 Normal	White		415	3,4
114	L1	2/4	Zone C, 4th Floor, Fan SEF-4.2 Off	Red		415	5,6
115	L1	2/D	Zone C, 4th Floor, Fan SEF-4.2 Fault	Yellow		415	7,8
116	L1	2/3	Zone C, 4th Floor, Ret Damper Open	Green		415	9,10
117	L1	2/C	Zone C, 4th Floor, Ret Damper Normal	White		415	11,12
118	L1	2/2	Zone C, 4th Floor, Ret Damper Closed	Red		415	13,14
119	L1	2/B	Zone C, 4th Floor, Ret Damper Fault	Yellow		415	15,16
120	L1	1/21	Zone C, 4th Floor, Dump Box Damper Open	Green		416	1,2
121	L1	1/Y	Zone C, 4th Floor, Dump Box Damper Normal	White		416	3,4
122	L1	1/20	Zone C, 4th Floor, Dump Box Damper Closed	Red		416	5,6
123	L1	1/X	Zone C, 4th Floor, Dump Box Damper Fault	Yellow		416	7,8
124	L1	1/19	Zone C, 3rd Floor, Ex Damper Open	Green		416	9,10
125	L1	1/W	Zone C, 3rd Floor, Ex Damper Normal	White		416	11,12
126	L1	1/18	Zone C, 3rd Floor, Ex Damper Closed	Red		416	13,14
127	L1	1/V	Zone C, 3rd Floor, Ex Damper Fault	Yellow		416	15,16
128	L1	1/17	Zone C, 3rd Floor, Fan SEF-3.2 On	Green		417	1,2
129	L1	1/U	Zone C, 3rd Floor, Fan SEF-3.2 Normal	White		417	3,4
130	L1	1/16	Zone C, 3rd Floor, Fan SEF-3.2 Off	Red		417	5,6
131	L1	1/T	Zone C, 3rd Floor, Fan SEF-3.2 Fault	Yellow		417	7,8
132	L1	1/15	Zone C, 3rd Floor, Ret Damper Open	Green		417	9,10
133	L1	1/S	Zone C, 3rd Floor, Ret Damper Normal	White		417	11,12
134	L1	1/14	Zone C, 3rd Floor, Ret Damper Closed	Red		417	13,14
135	L1	1/R	Zone C, 3rd Floor, Ret Damper Fault	Yellow		417	15,16
136	L1	1/13	Zone C, 3rd Floor, Dump Box Damper Open	Green		418	1,2
137	L1	1/P	Zone C, 3rd Floor, Dump Box Damper Normal	White		418	3,4
138	L1	1/12	Zone C, 3rd Floor, Dump Box Damper Closed	Red		418	5,6
139	L1	1/N	Zone C, 3rd Floor, Dump Box Damper Fault	Yellow		418	7,8
140	L1	1/11	AHU-16 Fan On	Green		418	9,10
141	L1	1/M	AHU-16 Fan Normal	White		418	11,12
142	L1	1/10	AHU-16 Fan Off	Red		418	13,14
143	L1	1/L	AHU-16 Fan Fault	Yellow		418	15,16
144	L1	1/9	Zone A, Fan AHU04 On	Green		419	1,2
145	L1	1/K	Zone A, Fan AHU04 Normal	White		419	3,4
146	L1	1/8	Zone A, Fan AHU04 Off	Red		419	5,6
147	L1	1/J	Zone A, Fan AHU04 Fault	Yellow		419	7,8
148	L1	1/7	Zone A, 6th Floor, Ex Damper Open	Green		419	9,10
149	L1	1/H	Zone A, 6th Floor, Ex Damper Normal	White		419	11,12
150	L1	1/6	Zone A, 6th Floor, Ex Damper Closed	Red		419	13,14
151	L1	1/F	Zone A, 6th Floor, Ex Damper Fault	Yellow		419	15,16
152	L1	1/5	Zone A, 6th Floor, Fan SEF-6.4 On	Green		420	1,2
153	L1	1/E	Zone A, 6th Floor, Fan SEF-6.4 Normal	White		420	3,4
154	L1	1/4	Zone A, 6th Floor, Fan SEF-6.4 Off	Red		420	5,6
155	L1	1/D	Zone A, 6th Floor, Fan SEF-6.4 Fault	Yellow		420	7,8
156	L1	1/3	Zone A, 6th Floor, Ret Damper Open	Green		420	9,10
157	L1	1/C	Zone A, 6th Floor, Ret Damper Normal	White		420	11,12
158	L1	1/2	Zone A, 6th Floor, Ret Damper Closed	Red		420	13,14
159	L1	1/B	Zone A, 6th Floor, Ret Damper Fault	Yellow		420	15,16
160	L2	2/21	Zone A, 6th Floor, Dump Box Damper Open	Green		421	1,2
161	L2	2/Y	Zone A, 6th Floor, Dump Box Damper Normal	White		421	3,4
162	L2	2/20	Zone A, 6th Floor, Dump Box Damper Closed	Red		421	5,6

163	L2	2/X	Zone A, 6th Floor, Dump Box Damper Fault	Yellow		421	7,8
164	L2	2/19	Zone A, 5th Floor, Ex Damper Open	Green		421	9,10
165	L2	2/W	Zone A, 5th Floor, Ex Damper Normal	White		421	11,12
166	L2	2/18	Zone A, 5th Floor, Ex Damper Closed	Red		421	13,14
167	L2	2/V	Zone A, 5th Floor, Ex Damper Fault	Yellow		421	15,16
168	L2	2/17	Zone A, 5th Floor, Fan SEF-5.4 On	Green		422	1,2
169	L2	2/U	Zone A, 5th Floor, Fan SEF-5.4 Normal	White		422	3,4
170	L2	2/16	Zone A, 5th Floor, Fan SEF-5.4 Off	Red		422	5,6
171	L2	2/T	Zone A, 5th Floor, Fan SEF-5.4 Fault	Yellow		422	7,8
172	L2	2/15	Zone A, 5th Floor, Ret Damper Open	Green		422	9,10
173	L2	2/S	Zone A, 5th Floor, Ret Damper Normal	White		422	11,12
174	L2	2/14	Zone A, 5th Floor, Ret Damper Closed	Red		422	13,14
175	L2	2/R	Zone A, 5th Floor, Ret Damper Fault	Yellow		422	15,16
176	L2	2/13	Zone A, 5th Floor, Dump Box Damper Open	Green		423	1,2
177	L2	2/P	Zone A, 5th Floor, Dump Box Damper Normal	White		423	3,4
178	L2	2/12	Zone A, 5th Floor, Dump Box Damper Closed	Red		423	5,6
179	L2	2/N	Zone A, 5th Floor, Dump Box Damper Fault	Yellow		423	7,8
180	L2	2/11	Zone A, 4th Floor, Ex Damper Open	Green		423	9,10
181	L2	2/M	Zone A, 4th Floor, Ex Damper Normal	White		423	11,12
182	L2	2/10	Zone A, 4th Floor, Ex Damper Closed	Red		423	13,14
183	L2	2/L	Zone A, 4th Floor, Ex Damper Fault	Yellow		423	15,16
184	L2	2/9	Zone A, 4th Floor, Fan SEF-4.4 On	Green		424	1,2
185	L2	2/K	Zone A, 4th Floor, Fan SEF-4.4 Normal	White		424	3,4
186	L2	2/8	Zone A, 4th Floor, Fan SEF-4.4 Off	Red		424	5,6
187	L2	2/J	Zone A, 4th Floor, Fan SEF-4.4 Fault	Yellow		424	7,8
188	L2	2/7	Zone A, 4th Floor, Ret Damper Open	Green		424	9,10
189	L2	2/H	Zone A, 4th Floor, Ret Damper Normal	White		424	11,12
190	L2	2/6	Zone A, 4th Floor, Ret Damper Closed	Red		424	13,14
191	L2	2/F	Zone A, 4th Floor, Ret Damper Fault	Yellow		424	15,16
192	L2	2/5	Zone A, 4th Floor, Dump Box Damper Open	Green		425	1,2
193	L2	2/E	Zone A, 4th Floor, Dump Box Damper Normal	White		425	3,4
194	L2	2/4	Zone A, 4th Floor, Dump Box Damper Closed	Red		425	5,6
195	L2	2/D	Zone A, 4th Floor, Dump Box Damper Fault	Yellow		425	7,8
196	L2	2/3	Zone A, 3rd Floor, Ex Damper Open	Green		425	9,10
197	L2	2/C	Zone A, 3rd Floor, Ex Damper Normal	White		425	11,12
198	L2	2/2	Zone A, 3rd Floor, Ex Damper Closed	Red		425	13,14
199	L2	2/B	Zone A, 3rd Floor, Ex Damper Fault	Yellow		425	15,16
200	L2	1/21	Zone A, 3rd Floor, Fan SEF-3.4 On	Green		426	1,2
201	L2	1/Y	Zone A, 3rd Floor, Fan SEF-3.4 Normal	White		426	3,4
202	L2	1/20	Zone A, 3rd Floor, Fan SEF-3.4 Off	Red		426	5,6
203	L2	1/X	Zone A, 3rd Floor, Fan SEF-3.4 Fault	Yellow		426	7,8
204	L2	1/19	Zone A, 3rd Floor, Ret Damper Open	Green		426	9,10
205	L2	1/W	Zone A, 3rd Floor, Ret Damper Normal	White		426	11,12
206	L2	1/18	Zone A, 3rd Floor, Ret Damper Closed	Red		426	13,14
207	L2	1/V	Zone A, 3rd Floor, Ret Damper Fault	Yellow		426	15,16
208	L2	1/17	Zone A, 3rd Floor, Dump Box Damper Open	Green		427	1,2
209	L2	1/U	Zone A, 3rd Floor, Dump Box Damper Normal	White		427	3,4
210	L2	1/16	Zone A, 3rd Floor, Dump Box Damper Closed	Red		427	5,6
211	L2	1/T	Zone A, 3rd Floor, Dump Box Damper Fault	Yellow		427	7,8
212	L2	1/15	Zone B, Fan AHU03 On	Green		427	9,10
213	L2	1/S	Zone B, Fan AHU03 Normal	White		427	11,12
214	L2	1/14	Zone B, Fan AHU03 Off	Red		427	13,14
215	L2	1/R	Zone B, Fan AHU03 Fault	Yellow		427	15,16
216	L2	1/13	Zone B, 6th Floor, Ex Damper Open	Green		428	1,2
217	L2	1/P	Zone B, 6th Floor, Ex Damper Normal	White		428	3,4
218	L2	1/12	Zone B, 6th Floor, Ex Damper Closed	Red		428	5,6
219	L2	1/N	Zone B, 6th Floor, Ex Damper Fault	Yellow		428	7,8
220	L2	1/11	Zone B, 6th Floor, Fan SEF-6.3 On	Green		428	9,10

221	L2	1/M	Zone B, 6th Floor, Fan SEF-6.3 Normal	White		428	11,12
222	L2	1/10	Zone B, 6th Floor, Fan SEF-6.3 Off	Red		428	13,14
223	L2	1/L	Zone B, 6th Floor, Fan SEF-6.3 Fault	Yellow		428	15,16
224	L2	1/9	Zone B, 6th Floor, Ret Damper Open	Green		429	1,2
225	L2	1/K	Zone B, 6th Floor, Ret Damper Normal	White		429	3,4
226	L2	1/8	Zone B, 6th Floor, Ret Damper Closed	Red		429	5,6
227	L2	1/J	Zone B, 6th Floor, Ret Damper Fault	Yellow		429	7,8
228	L2	1/7	Zone B, 6th Floor, Dump Box Damper Open	Green		429	9,10
229	L2	1/H	Zone B, 6th Floor, Dump Box Damper Normal	White		429	11,12
230	L2	1/6	Zone B, 6th Floor, Dump Box Damper Closed	Red		429	13,14
231	L2	1/F	Zone B, 6th Floor, Dump Box Damper Fault	Yellow		429	15,16
232	L2	1/5	Zone B, 5th Floor, Ex Damper Open	Green		430	1,2
233	L2	1/E	Zone B, 5th Floor, Ex Damper Normal	White		430	3,4
234	L2	1/4	Zone B, 5th Floor, Ex Damper Closed	Red		430	5,6
235	L2	1/D	Zone B, 5th Floor, Ex Damper Fault	Yellow		430	7,8
236	L2	1/3	Zone B, 5th Floor, Fan SEF-5.3 On	Green		430	9,10
237	L2	1/C	Zone B, 5th Floor, Fan SEF-5.3 Normal	White		430	11,12
238	L2	1/2	Zone B, 5th Floor, Fan SEF-5.3 Off	Red		430	13,14
239	L2	1/B	Zone B, 5th Floor, Fan SEF-5.3 Fault	Yellow		430	15,16
240	L3	2/21	Zone B, 5th Floor, Ret Damper Open	Green		431	1,2
241	L3	2/Y	Zone B, 5th Floor, Ret Damper Normal	White		431	3,4
242	L3	2/20	Zone B, 5th Floor, Ret Damper Closed	Red		431	5,6
243	L3	2/X	Zone B, 5th Floor, Ret Damper Fault	Yellow		431	7,8
244	L3	2/19	Zone B, 5th Floor, Dump Box Damper Open	Green		431	9,10
245	L3	2/W	Zone B, 5th Floor, Dump Box Damper Normal	White		431	11,12
246	L3	2/18	Zone B, 5th Floor, Dump Box Damper Closed	Red		431	13,14
247	L3	2/V	Zone B, 5th Floor, Dump Box Damper Fault	Yellow		431	15,16
248	L3	2/17	Zone B, 4th Floor, Ex Damper Open	Green		432	1,2
249	L3	2/U	Zone B, 4th Floor, Ex Damper Normal	White		432	3,4
250	L3	2/16	Zone B, 4th Floor, Ex Damper Closed	Red		432	5,6
251	L3	2/T	Zone B, 4th Floor, Ex Damper Fault	Yellow		432	7,8
252	L3	2/15	Zone B, 4th Floor, Fan SEF-4.3 On	Green		432	9,10
253	L3	2/S	Zone B, 4th Floor, Fan SEF-4.3 Normal	White		432	11,12
254	L3	2/14	Zone B, 4th Floor, Fan SEF-4.3 Off	Red		432	13,14
255	L3	2/R	Zone B, 4th Floor, Fan SEF-4.3 Fault	Yellow		432	15,16
256	L3	2/13	Zone B, 4th Floor, Ret Damper Open	Green		433	1,2
257	L3	2/P	Zone B, 4th Floor, Ret Damper Normal	White		433	3,4
258	L3	2/12	Zone B, 4th Floor, Ret Damper Closed	Red		433	5,6
259	L3	2/N	Zone B, 4th Floor, Ret Damper Fault	Yellow		433	7,8
260	L3	2/11	Zone B, 4th Floor, Dump Box Damper Open	Green		433	9,10
261	L3	2/M	Zone B, 4th Floor, Dump Box Damper Normal	White		433	11,12
262	L3	2/10	Zone B, 4th Floor, Dump Box Damper Closed	Red		433	13,14
263	L3	2/L	Zone B, 4th Floor, Dump Box Damper Fault	Yellow		433	15,16
264	L3	2/9	Zone B, 3rd Floor, Ex Damper Open	Green		434	1,2
265	L3	2/K	Zone B, 3rd Floor, Ex Damper Normal	White		434	3,4
266	L3	2/8	Zone B, 3rd Floor, Ex Damper Closed	Red		434	5,6
267	L3	2/J	Zone B, 3rd Floor, Ex Damper Fault	Yellow		434	7,8
268	L3	2/7	Zone B, 3rd Floor, Fan SEF-3.3 On	Green		434	9,10
269	L3	2/H	Zone B, 3rd Floor, Fan SEF-3.3 Normal	White		434	11,12
270	L3	2/6	Zone B, 3rd Floor, Fan SEF-3.3 Off	Red		434	13,14
271	L3	2/F	Zone B, 3rd Floor, Fan SEF-3.3 Fault	Yellow		434	15,16
272	L3	2/5	Zone B, 3rd Floor, Ret Damper Open	Green		435	1,2
273	L3	2/E	Zone B, 3rd Floor, Ret Damper Normal	White		435	3,4
274	L3	2/4	Zone B, 3rd Floor, Ret Damper Closed	Red		435	5,6
275	L3	2/D	Zone B, 3rd Floor, Ret Damper Fault	Yellow		435	7,8
276	L3	2/3	Zone B, 3rd Floor, Dump Box Damper Open	Green		435	9,10
277	L3	2/C	Zone B, 3rd Floor, Dump Box Damper Normal	White		435	11,12
278	L3	2/2	Zone B, 3rd Floor, Dump Box Damper Closed	Red		435	13,14

279	L3	2/B	Zone B, 3rd Floor, Dump Box Damper Fault	Yellow		435	15,16
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ADI addr	I/O crd	Con/Pin	Description	Int addr	PLC 4X reg	Reg bit
s0	S0	2/21	Lamp Test		1	1
s1	S0	2/Y	Panel Enable		1	2
s2	S0	2/20	Panel Silence		1	3
s3	S0	2/X	Zone D, Fan AHU01 On		1	4
s4	S0	2/19	Zone D, Fan AHU01 Off		1	5
s5	S0	2/W	Zone D, 6th Floor, Fan SEF-6.1 On		1	6
s6	S0	2/18	Zone D, 6th Floor, Fan SEF-6.1 Off		1	7
s7	S0	2/V	Zone D, 5th Floor, Fan SEF-5.1 On		1	8
s8	S0	2/17	Zone D, 5th Floor, Fan SEF-5.1 Off		1	9
s9	S0	2/U	Zone D, 4th Floor, Fan SEF-4.1 On		1	10
s10	S0	2/16	Zone D, 4th Floor, Fan SEF-4.1 Off		1	11
s11	S0	2/T	Zone D, 3rd Floor, Fan SEF-3.1 On		1	12
s12	S0	2/15	Zone D, 3rd Floor, Fan SEF-3.1 Off		1	13
s13	S0	2/S	Zone C, Fan AHU02 On		1	14
s14	S0	2/14	Zone C, Fan AHU02 Off		1	15
s15	S0	2/R	Zone C, 6th Floor, Fan SEF-6.2 On		1	16
s16	S0	2/13	Zone C, 6th Floor, Fan SEF-6.2 Off		2	1
s17	S0	2/P	Zone C, 5th Floor, Fan SEF-5.2 On		2	2
s18	S0	2/12	Zone C, 5th Floor, Fan SEF-5.2 Off		2	3
s19	S0	2/N	Zone C, 4th Floor, Fan SEF-4.2 On		2	4
s20	S0	2/11	Zone C, 4th Floor, Fan SEF-4.2 Off		2	5
s21	S0	2/M	Zone C, 3rd Floor, Fan SEF-3.2 On		2	6
s22	S0	2/10	Zone C, 3rd Floor, Fan SEF-3.2 Off		2	7
s23	S0	2/L	AHU-16 Fan On		2	8
s24	S0	2/9	AHU-16 Fan Off		2	9
s25	S0	2/K	Zone A, Fan AHU04 On		2	10
s26	S0	2/8	Zone A, Fan AHU04 Off		2	11
s27	S0	2/J	Zone A, 6th Floor, Fan SEF-6.4 On		2	12
s28	S0	2/7	Zone A, 6th Floor, Fan SEF-6.4 Off		2	13
s29	S0	2/H	Zone A, 5th Floor, Fan SEF-5.4 On		2	14
s30	S0	2/6	Zone A, 5th Floor, Fan SEF-5.4 Off		2	15
s31	S0	2/F	Zone A, 4th Floor, Fan SEF-4.4 On		2	16
s32	S0	2/5	Zone A, 4th Floor, Fan SEF-4.4 Off		3	1
s33	S0	2/E	Zone A, 3rd Floor, Fan SEF-3.4 On		3	2
s34	S0	2/4	Zone A, 3rd Floor, Fan SEF-3.4 Off		3	3
s35	S0	2/D	Zone B, Fan BHU04 On		3	4
s36	S0	2/3	Zone B, Fan BHU04 Off		3	5
s37	S0	2/C	Zone B, 6th Floor, Fan SEF-6.3 On		3	6
s38	S0	2/2	Zone B, 6th Floor, Fan SEF-6.3 Off		3	7

			Off			
s39	S0	2/B	Zone B, 5th Floor, Fan SEF-5.3 On		3	8
s40	S0	1/21	Zone B, 5th Floor, Fan SEF-5.3 Off		3	9
s41	S0	1/Y	Zone B, 4th Floor, Fan SEF-4.3 On		3	10
s42	S0	1/20	Zone B, 4th Floor, Fan SEF-4.3 Off		3	11
s43	S0	1/X	Zone B, 3rd Floor, Fan SEF-3.3 On		3	12
s44	S0	1/19	Zone B, 3rd Floor, Fan SEF-3.3 Off		3	13
s45	S0	1/W			3	14
s46	S0	1/18			3	15
s47	S0	1/V			3	16
s48	S0	1/17			4	1
s49	S0	1/U			4	2
s50	S0	1/16			4	3
s51	S0	1/T			4	4
s52	S0	1/15			4	5
s53	S0	1/S			4	6
s54	S0	1/14			4	7
s55	S0	1/R			4	8
s56	S0	1/13			4	9
s57	S0	1/P			4	10
s58	S0	1/12			4	11
s59	S0	1/N			4	12
s60	S0	1/11	Remote Input 1A		4	13
s61	S0	1/M	Remote Input 2A		4	14
s62	S0	1/10	Remote Input 3A		4	15
s63	S0	1/L	Remote Input 4A		4	16
s64	S0	1/9	Remote Input 5A		5	1
s65	S0	1/K	Remote Input 6A		5	2
s66	S0	1/8	Remote Input 7A		5	3
s67	S0	1/J	Remote Input 8A		5	4
s68	S0	1/7	Remote Input 9A		5	5
s69	S0	1/H	Remote Input 10A		5	6
s70	S0	1/6	Remote Input 11A		5	7
s71	S0	1/F	Remote Input 12A		5	8
s72	S0	1/5	Remote Input 13A		5	9
s73	S0	1/E	Remote Input 14A		5	10
s74	S0	1/4	Remote Input 15A		5	11
s75	S0	1/D	Remote Input 16A		5	12
s76	S0	1/3			5	13
s77	S0	1/C			5	14
s78	S0	1/2			5	15
s79	S0	1/B			5	16

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

3.01.1 BACnet/IP BACnet Interface Devices are not allowed in the Work.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.

3.02.1.1 ALC Modbus RTU to BACnet MS/TP Integration Panel (All Types).

3.02.2 The Owner will arrange for the following for the BACnet MS/TP Integration Panel:

3.02.2.1 The IT department shall provide a static IP address for the BACnet/IP BAS panel supplied by the Division 25 BAS Contractor that is used to network to the ALC's BACnet MS/TP device.

3.02.2.2 The IT department will assist with the commissioning of the network connection with the Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.

3.02.2.3 The Owner shall provide the passwords and access levels required for the Work.

3.02.3 The Equipment Supplier of the BACnet Interface Device shall provide the following:

3.02.3.1 Provide a BACnet MS/TP device meet the following requirements. The device shall:

3.02.3.1.1 Operate as a Manager device on the BACnet MS/TP network.

3.02.3.1.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m [4,005 ft.].

3.02.3.1.3 Provide a separate MS/TP trunk for UL listed devices in the Work.

3.02.3.1.4 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet Interface Devices on any BACnet MS/TP network segment without requiring the use of repeaters.

3.02.3.1.5 Provide information on the baud rate used. The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.

3.02.3.1.6 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network. Devices with fixed BACnet Interface Device IDs that cannot be changed on site are not allowed in the Work.

3.02.3.1.7 Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.

3.02.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved. Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.

3.02.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.

3.02.3.4 Configure the device with the approved network number and BACnet Interface Device instance number.

3.02.3.5 The Equipment Supplier or the Division 25 BAS Contractor shall install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.

3.02.3.6 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.

3.02.3.7 Assist the Division 25 BAS Contractor to Commission the final network connection to the Owner's network.

- 3.02.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
- 3.02.3.9 Participate in the commissioning process as outlined in this Division.
- 3.02.4 Division 27 shall provide the following:
 - 3.02.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.02.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.02.5 Division 25 BAS Contractor is responsible for the following:
 - 3.02.5.1 A schedule as to when the networking requirements need to be completed. See the Division 25 section for this information to be provided as a Shop Drawing.
 - 3.02.5.2 Confirmation that the BACnet Interface Device ID and network number are unique BACnet Interface Device ID and network number are unique to the BAS Device Network.
 - 3.02.5.3 Confirmation that the BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.5.4 Create a separate BACnet MS/TP network segment for each data rate provided in the Work.
 - 3.02.5.5 Connection of the BACnet MS/TP network cable to the BACnet Interface Device.
 - 3.02.5.6 Connect a shield wire to earth or device chassis at one point along the MS/TP bus prevent ground potential differences on the BAS device network.
 - 3.02.5.7 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.
 - 3.02.5.8 A network drop from the Division 25 BAS Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.
 - 3.02.5.9 Joint commissioning the network connection to this Division 25 BAS Contractor's MS/TP network.
 - 3.02.5.10 Exposing all BACnet MS/TP devices and objects in the Division 25 BAS Contractor supplied BACnet/IP device to which the BACnet MS/TP device is connected.
 - 3.02.5.11 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.02.5.11.1 Consultant's Drawings and Specifications.
 - 3.02.5.12 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.02.5.12.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.02.5.12.2 A minimum of 1 schedule.
 - 3.02.5.12.3 A minimum of 10 Extended Trends.
 - 3.02.5.13 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
 - 3.02.5.14 See 25 15 11.01 for expected level of graphics to be provided.
 - 3.02.5.15 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.02.5.15.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.02.5.15.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches

- the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
- 3.02.5.15.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
- 3.02.5.15.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
- 3.02.5.15.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
- 3.02.5.16 Participating in the commissioning process as outlined in this Division.
- 3.02.6 The BACnet Interface Device to the Equipment Supplier's BACnet MS/TP Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
- 3.02.6.1 All parties shall each allow 16 hours of technician on-site time for this Work (excluding travel to and from the Work) for commissioning the devices in this Specification section. This is in addition to any other commissioning requirements called up in the Contract Documents.
- 3.02.6.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
- 3.02.6.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
- 3.02.6.4 The commissioning process shall be overseen by Lake County BAS Consultant.
- 3.02.6.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
- 3.02.6.6 The Work includes the following:
- 3.02.6.6.1 Complete commissioning of all network visible object types according to the procedures outlined in Section 25 08 00, using the relevant Commissioning Forms for each BACnet Object Types.
- 3.02.6.6.2 Verify all network visible BACnet Object Types correctly display the same information on the Division 25 BAS Contractor Front End as is being displayed on the equipment local interface. All network visible objects shall be commissioned.
- 3.02.6.6.3 Commission the BACnet MS/TP network connection to the Division 25 BACnet/IP device.
- 3.02.6.6.4 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
- 3.02.6.6.5 The process shall be overseen by Lake County BAS Consultant.
- 3.02.6.6.6 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
- 3.02.6.6.7 The following special provisions apply to the commissioning Work.
- 3.02.6.6.7.1 The AHU BACnet Interface Device shall be commissioned following the provisions of 25 08 03 as this equipment performs UL-listed functions. Division 25 BAS Contractor shall allow an additional 16 hours of on-site commissioning time to commission the Modbus RTU panel and the BACnet MS/TP gateway.

End of Section

**25 20 23.36.00 INTEGRATED AUTOMATION –BACNET INTERFACE DEVICE (GATEWAYS/NATIVE
BACNET DEVICES) –AIR TERMINAL UNITS (ALL TYPES)**

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 23 and Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
 - 1.01.1.1 Division 25 BAS Contractor is responsible for providing all equipment and all BACnet Interface Devices for the Air Terminal Units and is designated as the Equipment Supplier in this Specification section.
 - 1.01.1.2 The terms VAV Box Controller, ~~Fan Coil Unit~~ **CV Unit** Controller in this Division shall all refer to the Air Terminal Unit Controller.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:

1.03.1.1 Single On-board BACnet Interface Device Type:

1.03.1.1.1 This device is a single onboard BACnet Interface Device that is a UL 864 UUKL 10th Edition Device BACnet MS/TP that is provided by the Division 25 BAS Contractor.

1.03.1.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.

1.03.1.2.1 The *Basis of Design* is the Division 25 BAS Contractor's Air Terminal Unit Controller.

1.03.1.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.

1.03.1.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.

1.03.1.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAm and the BACnet WhoHas/IHave services.

1.03.1.6 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.

1.04 Work By Others for this BACnet Interface Device

1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.

1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.

1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.

1.05 Related Division 25 Sections that Apply to the Equipment Supplier

- 1.05.1 25 00 11 Integrated Automation – General Requirements – Division 25 Summary Of Work
- 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
- 1.05.3 25 00 33 Integrated Automation – General Requirements – Submittal Procedures
- 1.05.4 25 00 42 Integrated Automation – General Requirements – References
- 1.05.5 25 00 75 Integrated Automation – General Requirements – Starting & Adjusting
- 1.05.6 25 00 77 Integrated Automation – General Requirements – Closeout Procedures
- 1.05.7 25 00 78 Integrated Automation – General Requirements – Closeout Submittals
- 1.05.8 25 00 79 Integrated Automation – General Requirements – Demonstration & Training
- 1.05.9 25 05 01 Integrated Automation – Common Work Results – General
- 1.05.10 25 05 05 Integrated Automation – Common Work Results – Device Interface Integration
- 1.05.11 25 05 13 Integrated Automation – Common Work Results – Conductors & Cables
- 1.05.12 25 05 26 Integrated Automation – Common Work Results – Grounding & Bonding
- 1.05.13 25 05 28 Integrated Automation – Common Work Results – Pathways
- 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
- 1.05.15 25 06 00 Integrated Automation – Schedules
- 1.05.16 25 08 00 Integrated Automation – Controls Commissioning
- 1.05.17 25 08 03 Integrated Automation – BAS UL 864 UUKL Commissioning

2 - PRODUCTS

2.01 General

2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Division 23, 23 09 00.

2.01.2 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:

2.01.2.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.

- 2.01.2.2 Working with Lake County BAS Consultant to commission the BACnet Interface Device once it is connected to the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet MS/TP BACnet Interface Device.
- 2.02.2 Division 25 BAS Contractor is responsible for networking to this device using a Level 1 BACnet/IP BAS panel that supports up to 32 BACnet MS/TP Manager devices.
- 2.02.3 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.3.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.4 If the equipment interface is a native BACnet Interface Device, all objects shall be represented externally on the network using BACnet objects and services.
 - 2.02.4.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.5 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.5.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data shall be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.5.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.6.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.6.1.1 NONE.
- 2.02.7 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.7.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.7.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.7.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.7.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.7.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.7.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.7.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.7.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.7.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.7.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.7.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.7.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.7.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.7.14 Device Management - Restart - B (DM-R-B)
- 2.02.8 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
- 2.02.9 The BACnet Interface Device shall support the following Object types:
 - 2.02.9.1 Analog Input

- 2.02.9.2 Analog Output
- 2.02.9.3 Analog Value
- 2.02.9.4 Binary Input
- 2.02.9.5 Binary Output
- 2.02.9.6 Binary Value
- 2.02.9.7 Device Object
- 2.02.9.8 Multi-state Input
- 2.02.9.9 Multi-state Output
- 2.02.9.10 Multi-state Value
- 2.02.10 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences outlined in the Contract Documents.
- 2.03 **Air Terminal Units (VAV/~~CAV~~ CV Controllers)**
 - 2.03.1 Air Terminal Units shall refer to VAV/~~CAV~~ CV boxes and their controllers.
 - 2.03.2 ATUs shall have the capability to switch between heating and cooling modes automatically based on the difference between the space temperature setpoint and the space temperature in conjunction with an adjustable time duration. The ATU controller shall support sequential control of heating devices.
 - 2.03.3 A thermostat/sensor shall be provided to control the ATU box for each zone. They shall be wall mounted with vented cover, back box and tamper proof screws.
 - 2.03.4 The current space temperature shall be displayed on an LCD screen attached to the sensor.
 - 2.03.5 The thermostat/sensor shall include an occupancy sensor input. If the occupancy sensor is provided by another Division of this Specification, the systems shall be integrated to provide occupancy status either via hardwired input or software variable.
 - 2.03.6 The thermostat/sensor shall permit the Operator to send a signal to override the zone/AHU occupancy schedule defined in the BAS device.
 - 2.03.7 Heating and cooling control valves are considered external to the ATU Box. Division 25 BAS Contractor is responsible for providing these valves. Division 23 is responsible for installing the valves. Division 25 BAS Contractor is responsible for control wiring from the valves. Division 26 is responsible for power wiring to the valves.
 - 2.03.8 The Air Terminal Units BACnet Interface Device shall be UL 864 UUKL listed as it performs UL-listed functions.
 - 2.03.9 Provide the following points as a minimum:

BACnet Object List (Typical for each Unit)																
Aux Contact List	Mapped Object List	Read/Write	Object Type	Supply Aux Contact	Install Aux Contact	Power Aux Contact	Wire Aux Contact	Program Aux Contact	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Air Terminal Units (Variable Air Volume Boxes) See Drawings for Locations and Quantities <u>Note that this Object List applies to both VAV Boxes and CV boxes in the Work</u>																
VAV space temperature	LCB#-VAV-MMM-SpcTmp		AI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV space heating temperature setpoint	LCB#-VAV-MMM-HtgTmpSet		AI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV space cooling temperature setpoint	LCB#-VAV-MMM-ClgTmpSet		AI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV supply air temperature	LCB#-VAV-MMM-SupTmp		AI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV box occupancy override	LCB#-VAV-MMM-OccOvd		BI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV reheat valve	LCB#-VAV-MMM-RHtVlv		AO	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV Fan Start/Stop	LCB#-VAV-MMM-FanSS		AO	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV Fan Speed	LCB#-VAV-MMM-FanRpm		AI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV damper control	LCB#-VAV-MMM-Dmp		AO	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV air flow from pitot rack	LCB#-VAV-MMM-AirFlo		AI	25	25	26	25	ES	Y	TBD	TBD	25	25			
VAV Fan VFD Control Panel	(mapped points)		BACnet	25	25	26	25	ES	Y	TBD	TBD	25	25			
The control points above are typical for all variable air volume (VAV) boxes. See Schedule 2 – Room HVAC Device Matrix for additional requirements for space temperature sensors.																
Notes:																
1. In this column, ‘Program’ refers to the Equipment Supplier’s responsibility to enable the aux contact, or to set high/low limits for turning the aux contact on or off.																

BACnet Hardwired Points List (Typical for each Unit)																
Aux Contact List	Mapped Object List	Read/ Write	Object Type	Supply Aux Contact	Install Aux Contact	Power Aux Contact	Wire Aux Contact	Program' Aux Contact	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Air Terminal Units (Hydronic Fan Coils and Constant Air Volume (CAV <u>CV</u>)) See Drawings for Locations and Quantities																
Heating Valve Control	LCB#-B629-FCU-MMM-HtgVlvCtl	TBD	AO	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Cooling Valve Control	LCB#-B629-FCU-MMM-ClgVlvCtl	TBD	AO	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Supply Air Temperature	LCB#-B629-FCU-MMM-SupAirTmp	TBD	AI	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Room Occupancy Override	LCB#-B629-FCU-MMM-OccOvd	TBD	BI	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Space Temperature Setpoint	LCB#-B629-FCU-MMM-SpcTmpSet	TBD	AV	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Filter Differential Pressure	LCB#-B629-FCU-MMM-FltDP	TBD	AI	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Space Temperature	LCB#-B629-FCU-MMM-SpcTmp	TBD	AI	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Fan Start/Stop	LCB#-B629-FCU-MMM-FanSS	TBD	BO	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Fan Status	LCB#-B629-FCU-MMM-FanSta	TBD	AI	ES	ES	26	25	ES		TBD	Y	ALC	ALC			
Notes: 1. In this column, ‘Program’ refers to the Equipment Supplier’s responsibility to enable the aux contact, or to set high/low limits for turning the aux contact on or off.																

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

- 3.01.1 BACnet/IP BACnet Interface Devices are not allowed in the Work.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

- 3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.
 - 3.02.1.1 Air Terminal Units (All Types).
- 3.02.2 The Owner will arrange for the following:
 - 3.02.2.1 The IT department shall provide a static IP address for the BACnet/IP BAS panel supplied by the Division 25 BAS Contractor that is used to network to the Equipment Supplier's BACnet MS/TP device.
 - 3.02.2.2 The IT department will assist with the commissioning of the network connection with the Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.
 - 3.02.2.3 The Owner shall provide the passwords and access levels required for the Work.
- 3.02.3 The Equipment Supplier of the BACnet Interface Device shall provide the following:
 - 3.02.3.1 Provide a BACnet MS/TP device meet the following requirements. The device shall:
 - 3.02.3.1.1 Operate as a Manager device on the BACnet MS/TP network.
 - 3.02.3.1.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m [4,005 ft.].
 - 3.02.3.1.3 Provide a separate MS/TP trunk for UL listed devices in the Work.
 - 3.02.3.1.4 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet Interface Devices on any BACnet MS/TP network segment without requiring the use of repeaters.
 - 3.02.3.1.5 Provide information on the baud rate used. The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.3.1.6 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network. Devices with fixed BACnet Interface Device IDs that cannot be changed on site are not allowed in the Work.
 - 3.02.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved. Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.
 - 3.02.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.
 - 3.02.3.4 Configure the device with the approved network number and BACnet Interface Device instance number.
 - 3.02.3.5 The Equipment Supplier or the Division 25 BAS Contractor shall install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.
 - 3.02.3.6 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.

- 3.02.3.7 Assist the Division 25 BAS Contractor to Commission the final network connection to the Owner's network.
- 3.02.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
- 3.02.3.9 Participate in the commissioning process as outlined in this Division.
- 3.02.4 Division 27 shall provide the following:
 - 3.02.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.02.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.02.5 Division 25 BAS Contractor is responsible for the following:
 - 3.02.5.1 A schedule as to when the networking requirements need to be completed. See the Division 25 section for this information to be provided as a Shop Drawing.
 - 3.02.5.2 Confirmation that the BACnet Interface Device ID and network number are unique BACnet Interface Device ID and network number are unique to the BAS Device Network.
 - 3.02.5.3 Confirmation that the BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.5.4 Create a separate BACnet MS/TP network segment for each data rate provided in the Work.
 - 3.02.5.5 Connection of the BACnet MS/TP network cable to the BACnet Interface Device.
 - 3.02.5.6 Connect a shield wire to earth or device chassis at one point along the MS/TP bus prevent ground potential differences on the BAS device network.
 - 3.02.5.7 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.
 - 3.02.5.8 A network drop from the Division 25 BAS Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.
 - 3.02.5.9 Joint commissioning the network connection to this Division 25 BAS Contractor's MS/TP network.
 - 3.02.5.10 Exposing all BACnet MS/TP devices and objects in the Division 25 BAS Contractor supplied BACnet/IP device to which the BACnet MS/TP device is connected.
 - 3.02.5.11 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.02.5.11.1 Consultant's Drawings and Specifications.
 - 3.02.5.12 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.02.5.12.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.02.5.12.2 A minimum of 1 schedule.
 - 3.02.5.12.3 A minimum of 10 Extended Trends.
 - 3.02.5.13 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
 - 3.02.5.14 See 25 15 11.01 for expected level of graphics to be provided.
 - 3.02.5.15 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.02.5.15.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.

- 3.02.5.15.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
- 3.02.5.15.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
- 3.02.5.15.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
- 3.02.5.15.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
- 3.02.5.16 Participating in the commissioning process as outlined in this Division.
- 3.02.6 The BACnet Interface Device to the Equipment Supplier's BACnet MS/TP Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
 - 3.02.6.1 All parties shall each allow 2 hours of technician on-site time for this Work (excluding travel to and from the Work) for commissioning 20% of the devices in this Specification section. The 2 hour time allocation is for each device to be commissioned. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.02.6.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
 - 3.02.6.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
 - 3.02.6.4 The commissioning process shall be overseen by Lake County BAS Consultant.
 - 3.02.6.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
 - 3.02.6.6 The Work includes the following:
 - 3.02.6.6.1 Complete commissioning of all network visible object types according to the procedures outlined in Section 25 08 00, using the relevant Commissioning Forms for each BACnet Object Types.
 - 3.02.6.6.2 Verify all network visible BACnet Object Types correctly display the same information on the Division 25 BAS Contractor Front End as is being displayed on the equipment local interface. All network visible objects shall be commissioned.
 - 3.02.6.6.3 Commission the BACnet MS/TP network connection to the Division 25 BACnet/IP device.
 - 3.02.6.6.4 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
 - 3.02.6.6.5 The process shall be overseen by Lake County BAS Consultant.
 - 3.02.6.6.6 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.02.6.6.7 The following special provisions apply to the commissioning Work.
 - 3.02.6.6.7.1 The Air Terminal Unit BACnet Interfaces Device shall also be commissioned following the provisions of 25 08 03 as this equipment performs UL-listed functions.
 - 3.02.6.6.7.2 Division 25 BAS Contractor shall allow an additional 16 hours of on-site commissioning time to commission 20% of the BACnet MS/TP Air Terminal Units per the requirements of 25 08 03.

End of Section

25 20 23.73.13 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE BACNET DEVICES) – INDOOR CENTRAL STATION AHUS (ALL TYPES)

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 23 and Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
 - 1.01.1.1 Division 25 BAS Contractor is responsible for providing all equipment and all BACnet Interface Devices for the Central Station AHUs and is designated as the Equipment Supplier in this Specification section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work per the list above if this equipment comes with any packaged controls interfaces.

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:
 - 1.03.1.1 Built-up BACnet Interface Device Type:

- 1.03.1.1.1 This BACnet Interface Device has both stick-built points and networkable devices that form part of the AHU BACnet Interface Devices in the Work.
- 1.03.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.
 - 1.03.2.1 Division 25 BAS Contractor is responsible for providing all points shown in Division 23 including points for the Heat Recovery Equipment.
 - 1.03.2.2 Division 25 BAS Contractor is responsible for providing all sensors and transmitters per Division 23 requirements.
 - 1.03.2.3 Division 25 BAS Contractor is responsible for providing all control valves per Division 23 requirements.
 - 1.03.2.4 Division 25 BAS Contractor is responsible for providing all dampers per Division 23 requirements.
 - 1.03.2.5 Division 25 BAS Contractor is responsible providing and making BACnet MS/TP network connections to the following devices.
 - 1.03.2.5.1 25 20 23.36.00 Air Terminal Units,
 - 1.03.2.5.2 25 20 23.82.19 Fan Coil Units,
 - 1.03.2.5.3 25 20 23.09.02 Air Flow Measuring Stations.
 - 1.03.2.5.4 25 20 23.09.50 VFDs
 - 1.03.2.5.4.1 In addition to providing the VFD BACnet MS/TP network connection, Division 25 BAS Contractor is responsible for providing the following hard wired connections from the VFD input/output terminals to the Division 25 BAS Contractor's BAS panel.
 - 1.03.2.5.4.1.1 VFD status BI
 - 1.03.2.5.4.1.2 VFD common alarm BI
 - 1.03.2.5.4.1.3 VFD enable/disable BO
 - 1.03.2.5.4.1.4 VFD speed % AO
 - 1.03.2.5.4.1.5 -VFD Smoke signal to Firefighter override terminal BI
- 1.03.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
- 1.03.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
- 1.03.5 Division 25 BAS Contractor is responsible for all low voltage wiring required for these external devices and sensors from the Division 26 power drop to the end device.
- 1.03.6 Division 25 BAS Contractor is responsible for providing the programming to control the AHUs per the Division 23 Sequence of Operations.
- 1.03.7 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAm and the BACnet WhoHas/IHave services.
 - 1.03.7.1 Division 25 BAS Contractor shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.
- 1.04 **Work By Others for this BACnet Interface Device**
 - 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 **Related Division 25 Sections that Apply to the Equipment Supplier**
 - 1.05.1 25 00 11 Integrated Automation – General Requirements – Division 25 Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation – General Requirements – Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation – General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation – General Requirements – Starting & Adjusting

- 1.05.6 25 00 77 Integrated Automation – General Requirements – Closeout Procedures
- 1.05.7 25 00 78 Integrated Automation – General Requirements – Closeout Submittals
- 1.05.8 25 00 79 Integrated Automation – General Requirements – Demonstration & Training
- 1.05.9 25 05 01 Integrated Automation – Common Work Results – General
- 1.05.10 25 05 05 Integrated Automation – Common Work Results – Device Interface Integration
- 1.05.11 25 05 13 Integrated Automation – Common Work Results – Conductors & Cables
- 1.05.12 25 05 26 Integrated Automation – Common Work Results – Grounding & Bonding
- 1.05.13 25 05 28 Integrated Automation – Common Work Results – Pathways
- 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
- 1.05.15 25 06 00 Integrated Automation – Schedules
- 1.05.16 25 08 00 Integrated Automation – Controls Commissioning
- 1.05.17 25 08 03 Integrated Automation – BAS UL 864 UUKL Commissioning

2 - PRODUCTS

- 2.01.1 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:

- 2.01.1.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
 - 2.01.1.2 Working with this Division 25 BAS Contractor to commission the BACnet Interface Device once it is connected the Intranet at the Place of the Work.

2.02 Additional requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet/IP BACnet Interface Device complete with an Annex J router to support BACnet/IP to act as a client and/or server for all BACnet information from this system to the BAS.
- 2.02.2 The device shall support use of a static IP address for remote access through the Owner's firewall. Provision of remote access is not included in the Work.
- 2.02.3 The device shall have an open Ethernet port for connection to the network infrastructure (network connection to panel by the Owner). Co-ordinate network configuration requirements with the IT department through the Owner.
- 2.02.4 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.4.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.5 If the equipment interface is a native BACnet Interface Device, all objects must be represented externally on the network using BACnet objects and services.
 - 2.02.5.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.6.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data must be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.6.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.7 The following shall apply to BACnet Interface Devices that are exposing objects in Life Safety devices (e.g., the Fire Alarm panel).
 - 2.02.7.1 The BACnet Interface Device for the AHUs shall be a UL 864 UUKL listed device for Smoke Control. The device shall permit uni-directional communications only. The device shall permit this Division 25 BAS Contractor to plot the BACnet objects in his non-UL Front End, but this

Division 25 BAS Contractor shall not be able to shut down or modify any values to any objects located the BACnet Interface Device.

- 2.02.8 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.8.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.8.1.1 NONE.
 - 2.02.9 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.9.1 Data Sharing – ReadProperty – B (DS-RP-B)
 - 2.02.9.2 Data Sharing – ReadPropertyMultiple – B (DS-RPM-B)
 - 2.02.9.3 Data Sharing – WriteProperty – B (DS-WP-B)
 - 2.02.9.4 Data Sharing – WritePropertyMultiple – B (DS-WPM-B)
 - 2.02.9.5 Alarm and Event – Notification Internal – B (AE-N-I-B)
 - 2.02.9.6 Alarm and Event – ACK – B (AE-ACK-B)
 - 2.02.9.7 Alarm and Event – Information – B (AE-INFO-B)
 - 2.02.9.8 Device Management – Dynamic Device Binding – B (DM-DDB-B)
 - 2.02.9.9 Device Management – Dynamic Object Binding – B (DM-DOB-B)
 - 2.02.9.10 Device Management – DeviceCommunicationControl – B (DM-DCC-B)
 - 2.02.9.11 Device Management – TimeSynchronization – B (DM-TS-B)
 - 2.02.9.12 Device Management – UTCTimeSynchronization – B (DM-UTC-B)
 - 2.02.9.13 Device Management – ReinitializeDevice – B (DM-RD-B)
 - 2.02.9.14 Device Management – Restart – B (DM-R-B)
 - 2.02.10 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
 - 2.02.11 The BACnet Interface Device shall support the following Object types:
 - 2.02.11.1 Analog Input
 - 2.02.11.2 Analog Output
 - 2.02.11.3 Analog Value
 - 2.02.11.4 Binary Input
 - 2.02.11.5 Binary Output
 - 2.02.11.6 Binary Value
 - 2.02.11.7 Device Object
 - 2.02.11.8 Multi-state Input
 - 2.02.11.9 Multi-state Output
 - 2.02.11.10 Multi-state Value
 - 2.02.12 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences.
- 2.03 Special Requirement for the Space and Duct Static Connections to the Existing Building SOAP device.**
- 2.03.1 The Division 25 BAS Contractor is responsible for connecting to the existing building SOAP device and the required ¼” plastic tubing to the space static sensors. Follow Air Monitor Corp requirements for equal lengths of plastic tubing.
 - 2.03.2 See Division 23 for space and duct static pressure locations.
- 2.04 All AHUs BACnet Interfaces**
- 2.04.1 The AHU shall be represented externally as a BACnet/IP device on the Division 25 BAS Contractor’s network.
 - 2.04.2 The following devices are considered external to the Air Handling Units: Return humidity; outside air dampers; airflow station devices; temperature transducers upstream of the airflow stations; chilled and hot water control valves; duct static pressure; space static pressure; and exhaust air dampers. Division 25 is responsible for providing these devices for installation by others and for installing the space static pressure sensor. Division 23 is responsible for installing all other external devices. Division 25 is

responsible for control wiring from the external devices to the Equipment Supplier's Local Control Panel.
Division 26 is responsible for power wiring to these devices.

- 2.04.3 The AHU BACnet Interface Device for both AHU05 and AHU07 shall be UL 864 UUKL 10th Edition listed devices.

2.05 BACnet Interface Device General Requirements

- 2.05.1 The Division 25 BAS Contractor is responsible for providing all the BACnet Interface Devices required for this Specification Section.
- 2.05.2 Each AHU shall have at least one BACnet/IP Level 1 panel. All the other panels can be Level 1/1A BACnet MS/TP panels.
- 2.05.3 The Air Flow Stations are Level 1A BACnet MS/TP devices.
- 2.05.4 The VFDs are Level 1A BACnet MS/TP devices.
- 2.05.5 The Air Terminal Units can be either Level 1 or Level 1A devices.
- 2.05.6 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
- 2.05.7 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences.

- 2.05.7.1 The following BACnet Interface Devices may be provided as BACnet/PTP:

2.05.7.1.1 NONE.

2.06 All AHUs BACnet Interface Devices

- 2.06.1 See Contract Documents Sequences of Operations for hardware and software points to be provided by the Division 25 BAS Contractor

2.07 All VFD BACnet Interface Devices

- 2.07.1 The unit shall be represented externally as a BACnet MS/TP device on the Owner's network.
- 2.07.2 Provide BACnet Interface Devices and Work per 25 20 26.29.23.

2.08 All Flow Meter BACnet Interface Device.

- 2.08.1 The unit shall be represented externally as a BACnet MS/TP device on the Owner's network.
- 2.08.2 Provide BACnet Interface Devices and Work per 25 20 23.05.19.

2.09 All Air Flow Monitoring Station (Ebtron Gold) BACnet Interface Device.

- 2.09.1 The unit shall be represented externally as a BACnet MS/TP device on the Owner's network.
- 2.09.2 Provide BACnet Interface Devices and Work per 25 20 23.85.

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

- 3.01.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet/IP device.

- 3.01.1.1 AHUs.
- 3.01.1.2 VFDs.
- 3.01.1.3 Air Flow Stations.

- 3.01.2 The Owner will arrange for the following:

- 3.01.2.1 The IT department shall provide a static IP address for the BACnet/IP BACnet Interface Device.
- 3.01.2.2 The IT department will assist with the commissioning of the network connection with this Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.
- 3.01.2.3 The Owner shall provide the passwords and access levels required for the Work.

- 3.01.3 The Equipment Supplier shall provide the following:

- 3.01.3.1 A fully operational BACnet/IP BACnet Interface Device that networks to all BACnet MS/TP devices provided in the Work of this section. BACnet/IP devices shall meet the following requirements:
 - 3.01.3.1.1 BACnet/IP device shall include an Annex J B/IP router to support BACnet/IP to act as a client and/or server for all BACnet information from the supplied equipment to the BAS Device Network, which is considered a “directly connected network”.
 - 3.01.3.1.2 The BAS Device Network is treated as a “remote network” that is reachable by communicating using BACnet/IP with a router supplied by others that serves the remote network.
 - 3.01.3.1.3 The BACnet/IP device shall come complete with a BBMD that will be configured to traverse IP subnets.
 - 3.01.3.1.4 The interface shall have an open Ethernet RJ-45 port for connection to the BAS device network infrastructure using communications cabling that complies with the TIA/EIA 568-B standard.
 - 3.01.3.1.5 The interface shall operate at a minimum of ten (10) Mbps, full duplex.
- 3.01.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved.
 - 3.01.3.2.1 All new Work shall be installed according to UL 864 UUKL requirements and the BAS Vendor’s product specific procedures. Provide evidence that the BAS Work has been designed to UL 864 UUKL. Division 25 BAS Contractor shall attend a meeting with the Owner, the BAS Consultant and the AHJ to seek approval for the BAS Work design. No Work shall begin until the AHJ approval has been secured.
- 3.01.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.
- 3.01.3.4 Configuration of the device with the assigned IP address.
- 3.01.3.5 Connection of the IP network cable to the BACnet Interface Device.
- 3.01.3.6 Commission the final network connection to the Owner’s network.
- 3.01.3.7 Creation and assignment of passwords and access levels within the device.
- 3.01.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
 - 3.01.3.8.2 Provision of paper documents requiring scanning and post processing by Division 25 BAS Contractor is not allowed.
- 3.01.3.9 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.01.3.9.1 Consultant’s Plans and Specifications
 - 3.01.3.9.2 Section 23 09 00.
- 3.01.3.10 Participating in the commissioning process as outlined in this Division.
- 3.01.4 Division 27 shall provide the following:
 - 3.01.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.01.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.01.5 Division 25 BAS Contractor is responsible for the following:
 - 3.01.5.1 Mapping all the BACnet Object Types approved in the Submittal process from the Equipment Supplier’s BACnet Interface Device to the Division 25 BAS Contractor supplied BACnet/IP device so the mapped points are accessible using the Division 25 BAS Contractor’s Front End.

- 3.01.5.2 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.01.5.2.1 A minimum of ten (10) alarms or an alarm for each equipment fault. Two (2) of which are considered critical.
 - 3.01.5.2.2 A minimum of one (1) schedule.
 - 3.01.5.2.3 A minimum of ten (10) Extended Trends.
- 3.01.5.3 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
- 3.01.5.4 See 25 15 11.01 for expected level of graphics to be provided.
- 3.01.5.5 The following minimum requirements apply to the BACnet Interface Device in this Section :
 - 3.01.5.5.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.5.5.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.01.5.5.3 A minimum of one (1) graphic showing the device. Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.5.5.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects that is a sub-graphic to this graphic is sufficient.
 - 3.01.5.5.5 Provide one master alarm graphic showing the Critical Alarms and all equipment fault alarms.
 - 3.01.5.5.6 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped from the BACnet Interface Device to the Division 25 BAS Contractor's Front End.
 - 3.01.5.5.7 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
- 3.01.5.6 Participating in the commissioning process as outlined in this Division.
- 3.01.6 Equipment Supplier is responsible for the following if the BACnet Interface Device is a separate device not supplied and installed by the Division 25 BAS Contractor:
 - 3.01.6.1 The BACnet Interface Device to the Equipment Supplier's BACnet, Modbus or proprietary protocol Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
 - 3.01.6.2 All parties shall each allow sixteen (16) hours of technician on-site time for this Work (excluding travel to and from the Work) for all devices. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.01.6.3 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
 - 3.01.6.4 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
 - 3.01.6.5 The commissioning process shall be overseen by the Lake County BAS Consultant.
 - 3.01.6.6 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
 - 3.01.6.7 Use the commissioning procedures outlined in this Division.
 - 3.01.6.8 Commissioning of hardwired points in the Equipment Supplier's BACnet Interface Device.
 - 3.01.6.8.1 All hardwired points shall be commissioned using the forms and procedures in 25 08 00.

- 3.01.6.9 Commissioning of network visible object types in the Equipment Supplier's BACnet Interface Device.
 - 3.01.6.9.1 Complete commissioning of a minimum of 20% and up to fifty (50) of the network visible object types selected by the Lake County BAS Consultant.
 - 3.01.6.9.2 Lake County BAS Consultant shall provide a commissioning form that will list the points to be tested and commissioned.
 - 3.01.6.9.3 If the Owner deems that there are problems with the device and/or points, the Owner reserves the right to extend the commissioning time allocation to test and commission additional points as required.
- 3.01.6.10 Verify all network visible BACnet Object Types correctly display the same information on the Front End as is being displayed on the equipment local interface.
- 3.01.6.11 Parse all equipment packaged controls alarms, trends and schedules that are represented as AV, BV and MSV BACnet Object Types by the equipment BACnet Interface Device.
- 3.01.6.12 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
- 3.01.7 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.01.7.1 The following special provisions apply to the commissioning Work.
 - 3.01.7.1.1 The Work shall be commissioned per the requirements of 25 08 00 and 25 08 03.
 - 3.01.7.1.1.1 Division 25 BAS Contractor is responsible for completing the commissioning forms shown in 25 08 00 for all hardware points in the Work.
 - 3.01.7.1.1.2 Division 25 BAS Contractor is responsible for completing the commissioning forms shown in 25 08 03 for all hardware and software points as well as any UL 864 UUKL testing procedures in the Work.
 - 3.01.7.1.1.3 The Lake County BAS Consultant shall provide and shall fill out equipment specific software point commissioning forms shown in each BACnet Interface Device Specification Section in Division 25. Division 25 BAS Contractor shall verify that the software points tested using these commissioning forms report their data responses correctly to WebCTRL.
 - 3.01.7.1.1.4 Division 25 BAS Contractor shall allow an additional 16 hours of on-site commissioning time to commission the AHU05 and AHU07 following the provisions of 25 08 03.
 - 3.01.7.1.2 The Division 25 BAS Contractor shall demonstrate to the AHJ that the BAS meets UL 864 UUKL as outlined in the BAS Division 25 BAS Contractor's documentation and the UL 864 UUKL requirements.
 - 3.01.7.2 Provide support to TAB for all Work items within this section. See 23 05 93 for Division 25 BAS Contractor responsibilities.
 - 3.01.7.3 Follow equipment start-up procedures as recommended by Manufacturer unless otherwise specified.
 - 3.01.7.3.1 TAB Subcontractor shall advise Division 25, Division 25 BAS Contractor, and Owner of any adjustments, changes, or additions required to systems.
- 3.02 **BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements**
 - 3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.
 - 3.02.1.1 VFDs (see Contract Documents for quantities). Install and commission this BACnet Interface Device per 25 20 26.29.23.
 - 3.02.1.1.1 Air Flow Stations (see Contract Documents for quantities). Install and commission this BACnet Interface Device per 25 20 23.09.00.
 - 3.02.2 The following special provisions apply to the commissioning Work.

- 3.02.2.1 The AHU BACnet Interfaces Device shall also be commissioned following the provisions of 25 08 03 as this equipment performs UL-listed functions.
- 3.02.2.2 Division 25 BAS Contractor shall allow an additional 16 hours of on-site commissioning time to commission the AHU05 and AHU07 following the provisions of 25 08 03.

End of Section

**25 20 23.82.19 INTEGRATED AUTOMATION –BACNET INTERFACE DEVICE (GATEWAYS/NATIVE
BACNET DEVICES) – DAIKIN FAN COIL UNITS (FCUS) (ALL TYPES)**

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor and the Division 23 FCU Equipment Supplier (referred to in this Specification section as the Equipment Supplier) who is responsible for the BACnet Interface Device for this equipment outlined in this section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:
 - 1.03.1.1 Single On-board BACnet Interface Device Type:
 - 1.03.1.1.1 This device is a single onboard BACnet Interface Device that is BACnet MS/TP.

- 1.03.1.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.
 - 1.03.1.2.1 The *Basis of Design* is the Daikin FCU as specified in the Consultant's Contract Documents.
- 1.03.1.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
- 1.03.1.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
- 1.03.1.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAm and the BACnet WhoHas/IHave services.
- 1.03.1.6 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device.
- 1.03.1.7 Division 25 shall create graphics, set up trends or add schedules using the mapped points from this BACnet Interface Device per the requirements in Division 25..

1.04 Work By Others for this BACnet Interface Device

- 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
- 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
- 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.

1.05 Related Division 25 Sections that Apply to the Equipment Supplier

- 1.05.1 25 00 11 Integrated Automation – General Requirements – Division 25 Summary Of Work
- 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
- 1.05.3 25 00 33 Integrated Automation – General Requirements – Submittal Procedures
- 1.05.4 25 00 42 Integrated Automation – General Requirements – References
- 1.05.5 25 00 75 Integrated Automation – General Requirements – Starting & Adjusting
- 1.05.6 25 00 77 Integrated Automation – General Requirements – Closeout Procedures
- 1.05.7 25 00 78 Integrated Automation – General Requirements – Closeout Submittals
- 1.05.8 25 00 79 Integrated Automation – General Requirements – Demonstration & Training
- 1.05.9 25 05 01 Integrated Automation – Common Work Results – General
- 1.05.10 25 05 05 Integrated Automation – Common Work Results – Device Interface Integration
- 1.05.11 25 05 13 Integrated Automation – Common Work Results – Conductors & Cables
- 1.05.12 25 05 26 Integrated Automation – Common Work Results – Grounding & Bonding
- 1.05.13 25 05 28 Integrated Automation – Common Work Results – Pathways
- 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
- 1.05.15 25 06 00 Integrated Automation – Schedules
- 1.05.16 25 08 00 Integrated Automation – Controls Commissioning
- 1.05.17 25 08 03 Integrated Automation – BAS UL 864 UUKL Commissioning

2 - PRODUCTS

2.01 General

- 2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Division 23, 23 09 00.
- 2.01.2 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:
 - 2.01.2.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
 - 2.01.2.2 Working with Lake County BAS Consultant to commission the BACnet Interface Device once it is connected to the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet MS/TP BACnet Interface Device.
- 2.02.2 Division 25 BAS Contractor is responsible for networking to this device using a Level 1 BACnet/IP BAS panel that supports up to 32 BACnet MS/TP Manager devices.
- 2.02.3 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.3.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.4 If the equipment interface is a native BACnet Interface Device, all objects shall be represented externally on the network using BACnet objects and services.
 - 2.02.4.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.5 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.5.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data shall be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.5.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.6.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.6.1.1 NONE.
- 2.02.7 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.7.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.7.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.7.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.7.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.7.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.7.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.7.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.7.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.7.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.7.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.7.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.7.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.7.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.7.14 Device Management - Restart - B (DM-R-B)
- 2.02.8 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
- 2.02.9 The BACnet Interface Device shall support the following Object types:
 - 2.02.9.1 Analog Input
 - 2.02.9.2 Analog Output
 - 2.02.9.3 Analog Value
 - 2.02.9.4 Binary Input

- 2.02.9.5 Binary Output
- 2.02.9.6 Binary Value
- 2.02.9.7 Device Object
- 2.02.9.8 Multi-state Input
- 2.02.9.9 Multi-state Output
- 2.02.9.10 Multi-state Value

2.02.10 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences outlined in the Contract Documents.

2.03 Fan Coil Unit Controllers

- 2.03.1 FCUs shall have the capability to switch between heating and cooling modes automatically based on the difference between the space temperature setpoint and the space temperature in conjunction with an adjustable time duration.
- 2.03.2 A thermostat/sensor shall be provided to control the FCU for each zone. They shall be wall mounted with vented cover, back box and tamper proof screws.
- 2.03.3 The current space temperature shall be displayed on an LCD screen attached to the sensor.
- 2.03.4 The thermostat/sensor shall include an occupancy sensor input.
- 2.03.5 The thermostat/sensor shall permit the Operator to send a signal to override the zone occupancy schedule defined in the BAS device.
- 2.03.6 Heating and cooling control valves are considered external to the FCU device. Division 25 BAS Contractor is responsible for providing these valves. Division 23 is responsible for installing the valves. Division 25 BAS Contractor is responsible for control wiring from the valves. Division 26 is responsible for power wiring to the valves.
- 2.03.7 The FCU BACnet Interface Device do not have to be UL 864 UUKL listed.

2.04 Fan Coil Units

- 2.04.1 The BACnet Interface Device shall be represented externally as a BACnet MS/TP device on the Owner's network.
- 2.04.2 Provide the following objects at a minimum. This BACnet points list is based on the Daikin FCU as specified in the Contract Documents.



COMPREHENSIVE DATA TABLES

BACnet Network Objects

Table 1 - Table 8 contain the relevant information needed to integrate the MicroTech III fan coil unit controller into the BACnet network.

Refer to the Selected Parameters Information section that follows this table for equipment configuration options that require additional explanation. Additionally, the BACnet Configuration and Commissioning, Effective Occupancy Modes, Space Temperature Setpoint Methods, and PI Loop Control Parameters sections provide helpful information not found in the main data tables.

Refer to the OM 1095 Software Downloading Procedures and Troubleshooting Guide, available on www.DaikinApplied.com, for software part number and compatibility details.

CAUTION

Please note that anytime a command is written to a configuration property, this information is stored in the unit controller's non-volatile memory. Writing to non-volatile memory is an operation that has a finite limit. For this reason, the number of writes made to BACnet objects linked to configuration properties must be limited to avoid damage to the hardware.

Table 1: Analog Inputs

Point Name	Object Type/ Instance	Read/Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
ANALOG INPUTS						
Local Space Temperature Output	AI:1	R	LocalSpaceTemp	0 to 158°F -17.77 to 70°C Default: 68°F / 20°C	N	The value of the hardwired space temperature sensor installed either in the return air or the space. Writing to Space Temp Input (AV36) does not affect Local Space Temp (AI1) but does affect Effective Space Temp ³ (AV22.)
Local Setpoint Adjust Output	AI:2	R	LocalSetpt	55 to 95°F 12.78 to 35°C Default: 32°F / 0°C	N	The reference setpoint used to determine the Effective Heating/Cooling setpoints. It is the value of the local, hardwired space temperature setpoint. It is only valid if the unit controller is configured for Long Range Setpoint Adjust and is enabled by MSV12. ³ See Effective Occupancy Modes.
Local Entering Water Temperature	AI:3	R	EWT	32 to 212°F 0 to 100°C Default: 32°F / 0°C	N	Displays the value of the entering water temperature sensor. Writing to Remote Entering Water Temperature (AV35) does not affect Local Entering Water Temperature (AI3); however, it does affect the Effective Entering Water Temperature ³ (AV20.)
Discharge Air Temperature	AI:4	R	DischAirTemp	0 to 158°F -17.77 to 70°C Default: 32°F / 0°C	N	Indicates the discharge air temperature sensor value. ³
Outdoor Air Temperature	AI:5	R	OutdoorTemp	-40 to 158°F -40 to 70°C Default: 32°F / 0°C	N	Monitors the outdoor air temperature if the unit controller is equipped with a hardwired temperature sensor. ³

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

3. Analog Null is a discrete temperature value of 621.806°F/327.67°C. Its purpose is to indicate a sensor failure condition or when the unit controller is not using that particular temperature value.

Table 2: Analog Values

Point Name	Object Type/ Instance	Read/Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
ANALOG VALUES						
Occupancy Temperature Setpoint (AV1 to AV6) General Interaction Rules						Defines the Space Temperature Heating and Cooling Setpoints for different occupancy modes. See Effective Occupancy Modes and Space Temperature Setpoint Methods. The occupancy temperature setpoints must be kept in ascending order as follows: AV6 <= AV5 <= AV4 <= AV1 <= AV2 <= AV3
Occupied Cooling Setpoint	AV:1	W	cpOccupied_Cool_Setpt	50 to 95°F 10 to 35°C Default: 75°F / 23.88°C	Y	Defines the Space Temperature Setpoint for the Occupied Cooling Setpoint. ³ Interaction Rule AV1 > (AV4 + AV33)
Standby Cool Setpoint	AV:2	W	cpStandby_Cool_Setpt	50 to 95°F 10 to 35°C Default: 77°F / 25°C	Y	Defines the Space Temperature Setpoint for the Standby Cool Setpoint. ³ Interaction Rule: AV2 > (AV5 + AV33)



COMPREHENSIVE DATA TABLES

Point Name	Object Type/ Instance	Read/Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
ANALOG VALUES						
Unoccupied Cool Setpoint	AV:3	W	cpUnoccupied_Cool_Setpt	50 to 95°F 10 to 35°C Default: 85°F / 29.44°C	Y	Defines the Space Temperature setpoint for the Unoccupied Cool Setpoint. ³ Interaction Rule: AV3 > (AV6 + AV39)
Occupied Heat Setpoint	AV:4	W	cpOccupied_Heat_Setpt	50 to 95°F 10 to 35°C Default: 70°F / 21.11°C	Y	Defines the Space Temperature Setpoint for the Occupied Heat Setpoint. ³ Interaction Rule: AV4 < (AV1 – AV33)
Standby Heat Setpoint	AV:5	W	cpStandby_Heat_Setpt	50 to 95°F 10 to 35°C Default: 66°F / 18.88°C	Y	Defines the Space Temperature Setpoint for the Standby Heat Setpoint. ³ Interaction Rule: AV5 < (AV2 – AV33)
Unoccupied Heat Setpoint	AV:6	W	cpUnoccupied_Heat_Setpt	50 to 95°F 10 to 35°C Default: 60°F / 15.55°C	Y	Defines the Space Temperature Setpoint for the Unoccupied Heat Setpoint. ³ Interaction Rule: AV6 < (AV3 – AV39)
Cooling Enable Differential	AV:7	W	cpCoolEnDiff	2 to 10°F 1.11 to 5.56°C Default: 5°F / 2.77°C	Y	The Effective Room Temperature minus the Effective Entering Water Temperature must be greater than this configuration property in order for the cooling valve to operate. Applies to two-pipe systems only.
Cooling Interstage Timer	AV:8	W	cpCoolIntStgTmr	120 to 1200 sec Default: 300 sec	Y	A countdown timer that defines the minimum period of time between turn-on of the cooling stages.
Cooling Valve Deadband	AV:9	W	cpCoolVlVDB	3 to 100% Default: 3%	Y	Adjusts the deadband for the cooling valve control outputs. The outputs remain off as long as the input to the valve control algorithm falls within the deadband.
Cooling Valve Stroke Time	AV:10	W	cpCoolVlVStroke	15 to 600 sec Default: 180 sec	Y	Specifies the time required for the cooling valve to travel from fully open to fully closed or vice-versa.
Economizer Maximum Discharge Air Setpoint	AV:11	W	cpMaxDASpt	50 to 80°F 10 to 26.67°C Default: 75°F / 23.88°C	Y	Specifies the discharge air setpoint where the economizer DASP (Discharge Air Sensor Position) PI loop output is at 0%. It must be a value greater than or equal to the minimum setting.
Economizer Minimum Discharge Air Setpoint	AV:12	W	cpMinDASpt	50 to 80°F 10 to 26.67°C Default: 55°F / 12.77°C	Y	Specifies the discharge air setpoint where the economizer DASP PI loop output is at 100%. It must be a value less than or equal to the maximum setting.
Economizer Outdoor Air Enable Differential	AV:13	W	cpEconOaEnDiff	1 to 12°F 0.55 to 6.67°C Default: 2°F / 1.11°C	Y	The Indoor Air Temp minus the Outdoor Air Temp must be greater than this configuration property value in order for the economizer to be used for free cooling. This ensures outdoor air is cold enough to provide cooling.
Economizer Outdoor Air Enable Setpoint	AV:14	W	cpEconOaEn	40 to 80°F 4.44 to 26.67°C Default: 50°F / 10°C	Y	The Outdoor Air Temperature must be greater than this value in order for economizer to be used for free cooling. This ensures the outdoor air is not too cold to cause freezing.
Economizer Min Position at Fan Low	AV:15	W	cpEconLowMin	0 to 100% Default: 10%	Y	Specifies the economizer minimum position when the fan is running at low speed. This only applies when the economizer is enabled.
Economizer Min Position at Fan Med	AV:16	W	cpEconMedMin	0 to 100% Default: 10%	Y	Specifies the economizer minimum position when the fan is running at medium speed. This only applies when the economizer is enabled.
Economizer Min Position at Fan High	AV:17	W	cpEconHighMin	0 to 100% Default: 10%	Y	Specifies the economizer minimum position when the fan is running at high speed. This only applies when the economizer is enabled.
Economizer Position Deadband	AV:18	W	cpEconDB	3 to 100% Default: 3%	Y	Adjusts the deadband for the economizer position control outputs. The outputs remain off as long as the input to the valve control algorithm falls within the deadband.
Economizer Stroke Time	AV:19	W	cpEconStroke	15 to 600 sec Default: 66 sec	Y	Specifies the time required for the economizer to travel from fully open to fully closed or vice-versa.
Effective Entering Water Temperature	AV:20	R	EffectEWT	32 to 212°F 0 to 100°C Default: 621.806°F 327.67°C	N	Monitors the effective Entering Water Temperature that the fan coil uses for control. AV20 uses the AI3 local sensor unless the AV35 network override is a valid value. ⁶
Effective Setpoint Output	AV:21	R	EffectSetpt	50 to 95°F 10 to 35°C Default: 621.806°F 327.67°C	N	Effective Heating or Cooling Setpoint the unit controller is attempting to maintain, which is dependent upon Effective Occupancy (MSV5). ⁸ See Space Temperature Setpoint Methods .
Effective Space Temperature Output	AV:22	R	EffectSpaceTemp	0 to 158°F -17.77 to 70°C Default: 621.806°F 327.67°C	N	Monitors the space temperature that the unit controller uses for control. AV22 uses the AI1 local sensor unless the AV36 network override is a valid value. ⁸



COMPREHENSIVE DATA TABLES

Point Name	OK/Write Instance	Read/Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
ANALOG VALUES						
Entering Water Temperature Flow Sample Delay Timer	AV:23	W	cpEWTFlowTmr	60 to 600 sec Default: 120 sec	Y	Specifies the amount of time the unit controller waits after opening the hydronic valve before sampling the Entering Water Temperature to determine if hydronic heating or cooling is allowed. This point only applies to systems requiring EWT sampling.
Entering Water Temperature Sample Interval Timer	AV:24	W	cpEWTSampleTmr	0, 20 to 120 min Default: 120 min	Y	Specifies the time between sampling the Entering Water Temperature. The value of 0 disables the EWT sampling feature. This point only applies to systems requiring EWT sampling.
Fan Minimum OFF Timer	AV:25	W	cpFanMinOffTmr	120 to 1200 sec Default: 180 sec	Y	Sets the minimum amount of time the fan must remain off once it has stopped. The timer counts down from the specified value until it reaches zero, signaling that the fan is available to run.
Fan Minimum ON Timer	AV:26	W	cpFanMinOnTmr	120 to 1200 sec Default: 180 sec	Y	Sets the minimum amount of time the fan must remain on once it has started. The timer counts down from the specified value until it reaches zero, signaling that the fan may be turned off during normal operation. The timer value is ignored in the event of a shutdown alarm.
Heating Enable Differential	AV:27	W	cpHeatEnDiff	2 to 10°F 1.11 to 5.56°C Default: 5°F / 2.77°C	Y	The Effective Entering Water Temperature minus the Effective Room Temperature must be greater than this configuration property in order for the heating valve to operate. Applies to two-pipe systems only.
Heating Interstage Timer	AV:28	W	cpHeatIntStgTmr	120 to 1200 sec Default: 300 sec	Y	A countdown timer that defines the minimum period of time between turn-on of the heating stages.
Heating Valve Deadband	AV:29	W	cpHeatDB	3 to 100% Default: 3%	Y	Adjusts the deadband for the heating valve control outputs. The outputs remain off as long as the input to the valve control algorithm falls within the deadband.
Heating Valve Stroke Time	AV:30	W	cpHeatVlvStroke	15 to 600 sec Default: 180 sec	Y	Specifies the time required for the heating valve to travel from fully open to fully closed or vice-versa.
Local Bypass Time Setpoint	AV:31	W	cpBypassTime	0, 30 to 120 min Default: 120 min	Y	Defines the amount of time that the unit can be in the bypass mode initiated by the timed override button. Pressing the Timed Override button from 4-9 seconds sets the bypass timer to the maximum AV31 value. The value of 0 disables this feature.
Setpoint Shift Output	AV:32	R	SetpointShift	-5 to 5°F -2.78 to 2.78°C Init: 0°F	N	This value represents the Occupied and Standby as well as Heating and Cooling setpoint offsets. It is valid when configured for Short Range Setpoint Adjust.
Occupied Setpoint Differential	AV:33	W	cpOccDiff	1 to 5°F 0.55 to 2.78°C Default: 1°F / 0.55°C	Y	This value represents the Occupied and Standby Setpoint hysteresis to determine the Effective OFF setpoints.
Receive Heartbeat	AV:34	W	cpRcvHrtBt	0 to 6553.4 sec Default: 0 (Disabled)	Y	Specifies the maximum amount of time the supported overrides must be refreshed (i.e. written) before the unit reverts back to the default value. Each point supported by Receive Heartbeat has a separate timer associated with it. Only use this feature in v1.1 BACnet software and newer. The value of 0 disables this feature. The supported Receive Heartbeat points are: • AV 35 • AV 36 • AV 38 • MSV 7 • MSV 8 • MSV 9 • MSV 10 • MSV 11 • MSV 13
Remote Entering Water Temperature	AV:35	C	Network_EWT	32 to 212°F 0 to 100°C Default: 621.806°F 327.67°C	N	Provides the Entering Water Temperature value from the network instead of using the local temperature sensor. ^{6,7} The network override will revert back to its default value upon unit controller reboot.
Space Temperature Input	AV:36	C	Network_SpaceTemp	14 to 122°F -10 to 50°C Default: 621.806°F 327.67°C	N	Provides the Space Temperature value from the network instead of using the local temperature sensor. ^{6,7} The network override will revert back to its default value upon unit controller reboot.
Temperature Setpoint Input	AV:37	C	Setpoint	50 to 95°F 10 to 35°C Default: 621.806°F 327.67°C	N	Allows the network to set the reference setpoint in the Occupied and Standby Occupancy modes. Local setpoint operation must be disabled by MSV12. AV37 always retains the last valid value after power-up. ⁶ The network override will revert back to its default value upon unit controller reboot. See <i>Space Temperature Setpoint Methods</i> .



COMPREHENSIVE DATA TABLES

Point Name	Object Type/ Instance	Read/Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
ANALOG VALUES						
Temperature Setpoint Offset Input	AV:38	C	SetptOffset	-18 to +18°F -10 to +10°C Default: 0°	N	Shifts the Occupied and Standby Effective Setpoints via the network. The Unoccupied Effective Setpoints are not affected. This is the Short Range Setpoint used when a room sensor Setpoint Adjust is disabled. ⁷ The network override will revert back to its default value upon unit controller reboot. See Space Temperature Setpoint Methods .
Unoccupied Setpoint Differential	AV:39	W	cpUnoccDiff	2 to 10°F 1.11 to 5.56°C Default: 2°F / 1.11°C	Y	Sets the Unoccupied Setpoint hysteresis to determine the Effective OFF setpoints.
Terminal Load Output	AV:40	R	TerminalLoad	-100 to +100%	N	Indicates the current heat/cool energy demand of the unit. Positive values indicate that the unit requires cooling energy. Negative values indicate that the unit requires heating energy.
Long Range Setpoint Adjust Maximum	AV:41	W	cpSptAdjMax	55 to 95°F 12.78 to 35°C Default: 95°F / 35°C	Y	Limits the maximum value of the Long Range Setpoint Adjust temperature setting. This setpoint must be greater than or equal to the minimum setting.
Long Range Setpoint Adjust Minimum	AV:42	W	cpSptAdjMin	55 to 95°F 12.78 to 35°C Default: 55°F/12.78°C	Y	Limits the minimum value of the Long Range Setpoint Adjust temperature setting. This setpoint must be greater than or equal to the maximum setting.
Air Filter Change Timer	AV:43	W	cpFiltrChangeHrs	0, 360 to 4320 hours Default: 1440 hours	Y	Defines the amount of time that the fan can operate before a dirty air filter alarm is generated. This timer is only used when it is set to a non-zero value and the dirty air filter binary input is disabled through the equipment configuration settings. A value of 0 disables this feature.
MAC Address / Address Switch	AV:411	W	MacAddress (S3 Address Switch set to 255 - factory default setting)	1 to 127	Y	The function of AV411 depends on the setting of the BACnet communication module physical Address Switch (S3). When the physical address switch is set to a value of 255, the dynamic MAC addressing algorithm is used to commission the BACnet communication module. This variable represents the unit's MAC Address that can be written through the network or through the configuration serial port. When the physical address switch is not set to a value of 255, it represents the setting of the physical address switch and is read-only.
		R	MacAddressSwitch (S3 Address Switch not physically set to 255)			
System Minimum Instance ^{4,5}	AV:412	W	SystemMinInstance	0 to 4194302 Default: 3101000	Y	Value of this setting is added to the MAC Address to determine the final BACnet Device Name and Device Instance Number. Example: the default Instance Number = 3101007 when the MAC = 7.

- Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.
- R = Read Only, W = Writeable, C = Commandable
- The values of the individual Occupancy Temperature Setpoints (AV1 to AV6) must be kept in ascending order as follows: AV6 <= AV5 <= AV4 <= AV1 <= AV2 <= AV3.
- AV412 has an ObjectName of SystemMinInstance, the Present Value is writeable, and it has a default value of 3101000. During the commissioning process, the present value of AV412 is added to the MAC Address to determine the Device Instance Number. In order to change the value of AV412 on the BACnet communication module in the unconfigured state, the BAS must broadcast a new present value to AV412 using the BACnet service (BIBB – BACnet Interface Building Block) called "Unconfirmed COV" with a ProcessID value of 1. This prevents unauthorized unconfirmed writes, or changes, to AV412. Note that this change affects the AV412 present value for every fan coil BACnet communication module on the trunk.
- The auto-addressing feature was designed for units communicating to a MicroTech Integrated System (MIS) controller. However, any BAS can configure a MicroTech III fan coil unit controller with BACnet communication module for auto-addressing. AV412 can be set via the BAS using auto-addressing, but this feature is intended primarily for the MIS controller. See the MicroTech System Manager Operation Manual, OM 1092, and the MicroTech III BACnet MS/TP Communication Module Installation Manual, IM 1013, both available on www.daikinapplied.com, for complete details on using auto-addressing with the MIS controller.
- Analog Null is a discrete temperature value of 621.806°F/327.67°C. Its purpose is to indicate a sensor failure condition or when the unit controller is not using that particular temperature value.
- When Receive Heartbeat is enabled, this variable reverts to the default (non-override) value if it is not refreshed often enough through a network command or if communication is disabled (i.e. BACnet device communication control = disable).



COMPREHENSIVE DATA TABLES

Table 3: Binary Inputs

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
BINARY INPUTS						
Binary Input Status	BI:1	R	BinaryIn (Description Property)	16 bits	N	Monitors the digital inputs of the unit controller for diagnostic purposes. Each item is reported as a bit so that multiple inputs can be viewed simultaneously. The Present Value reflects the first status bit (b0), which is the "Freeze Fault Detection" state. All the status bits are returned in the BI1 description property, high bit on the left and low bit on the right. Ex: 0000000000000001 shows the Freeze Fault input is true. See Selected Parameters Information for bit descriptions.

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.
2. R = Read Only, W = Writeable, C = Commandable

Table 4: Binary Values

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
BINARY VALUES						
Clear Alarm	BV:1	W	ClearAlarm	0 to 1 Default: 0	N	Clears the Current Alarm. The alarm that is cleared moves to the Previous Alarm buffer. Value automatically clears after a clear alarm command is issued. 0 = Normal 1 = Clear Alarm
Binary Output Status	BV:2	R	BinaryOut (Description Property)	16 bits	N	Monitors the digital outputs of the unit controller for diagnostic purposes. Each item is reported as a bit so that multiple outputs can be viewed simultaneously. The Present Value reflects the first status bit (b0), which is the "Baseboard Fan Low Speed" state. All the status bits are returned in the BV2 description property, high bit on the left and low bit on the right. Ex: 0000000000000001 shows the fan is at low speed. Array index NULL returns Bit Number 0. See Selected Parameters Information for bit descriptions.
Unit Application Status	BV:3	R	UnitAppStatus (Description Property)	16 bits	N	Monitors various application status flags of the unit controller for diagnostic purposes. Each item is reported as a bit so that multiple flags can be viewed simultaneously. The Present Value reflects the first status bit (b0), which is the "Heating Valve Enabled" state. All the status bits are returned in the BV3 description property, high bit on the left and low bit on the right. Ex: 0000000000000001 shows the Heating Valve is enabled. See Selected Parameters Information for bit descriptions.
Unit Faults	BV:4	R	UnitFaults (Description Property)	16 bits	N	Monitors faults of the unit controller for diagnostic purposes. Each fault is reported as a bit so that multiple faults can be viewed simultaneously. The Present Value reflects the first status bit (b0), which is the "Invalid Equipment Configuration" state. All the status bits are returned in the BV4 description property, high bit on the left and low bit on the right. Ex: 0000000000000001 shows the Invalid Equipment Configuration is true. See Selected Parameters Information for bit descriptions.
Equipment Configuration (Available in v1.1 and higher)	BV:5	R	SoftJumpers (Description Property)	32 bits	N	Sets unit controller and I/O expansion module configuration. This property is pre-configured, but may need to be changed if field options are installed or if the unit controller is replaced. All 32 configuration status bits are returned in the BV5 description property, high bit on the left and low bit on the right. The equipment configuration must be set using the BACnet configuration menu. It cannot be set through the BAS. See Selected Parameters Information and BACnet Configuration and Commissioning for details.

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.
2. R = Read Only, W = Writeable, C = Commandable



COMPREHENSIVE DATA TABLES

Table 5: Multi-State Inputs

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
MULTI-STATE INPUTS						
Fan Mode/Speed Status	MSI:1	R	FanModeSpdSw	1 to 6	N	Monitors the fan switch that has priority over the continuous/cycling fan option. The option setting is used when the switch is in the Auto position. 1 = Off 2 = Low 3 = Med 4 = High 5 = Auto 6 = Null (no switch present)
System Mode Switch (Heat/Cool/Auto) Status	MSI:2	R	HeatCoolAuto	1 to 5	N	Displays the room sensor System Mode switch (Heat/Cool/Auto) position. 1 = Off 2 = Heat 3 = Cool 4 = Auto 5 = Null (no switch present)

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

Table 6: Multi-State Values

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
MULTI-STATE VALUES						
Current Alarm	MSV:1	R	CurrentAlarm	1 to 12	N	Displays the current highest active alarm. 1 = No Alarms 2 = Invalid Equipment Configuration 3 = Emergency Shutdown 4 = Freeze Fault 5 = EWT Sensor Failure 6 = Room Temperature Sensor Failure 7 = IO Expansion Board Com Failure 8 = Condensate Overflow 9 = Outdoor Air Temp Sensor Failure 10 = Discharge Air Temp Sensor Failure 11 = Dirty Air Filter 12 = BB Serial EEPROM Corrupted
Previous Alarm	MSV:2	R	PreviousAlarm	1 to 12	N	Indicates the previous unit fault. 1 = No Alarms 2 = Invalid Equipment Configuration 3 = Emergency Shutdown 4 = Freeze Fault 5 = EWT Sensor Failure 6 = Room Temperature Sensor Failure 7 = IO Expansion Board Com Failure 8 = Condensate Overflow 9 = Outdoor Air Temp Sensor Fail 10 = Discharge Air Temp Sensor Fail 11 = Dirty Air Filter 12 = Serial EEPROM Corrupted
Fan Speed Output	MSV:3	R	Fan Speed	1 to 5	N	Displays the commanded fan speed. 1 = Off 2 = Low 3 = Medium 4 = High 5 = On

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

3. When Receive Heartbeat is enabled, this variable reverts to the default (non-override) value if it is not refreshed often enough through a network command or if communication is disabled (i.e. BACnet device communication control = disable).



COMPREHENSIVE DATA TABLES

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
MULTI-STATE VALUES						
McQuay FCU Status	MSV:4	R	McQFcuStatus	1 to 9	N	Indicates the unit's operating state. 1 = Off Alarm 2 = Off 3 = Start 4 = Fan Only 5 = Heating 6 = Economizer 7 = Cooling 8 = Dehumid 9 = Null
Effective Occupancy Output	MSV:5	R	EffectOccup	1 to 5	N	The Occupancy mode being used by the unit controller. The mode depends on Occupancy Schedule, Occupancy Schedule Override and/or an Occupancy Sensor. MSV5 uses the local sensor unless the MSV6, MSV7, or MSV8 network overrides are not in a Null state. See Effective Occupancy Modes. 1 = Occupied 2 = Unoccupied 3 = Bypass 4 = Standby 5 = Null
Occupancy Override Input	MSV:6	C	OccManCmd	1 to 5 Default: 5	N	Overrides the Occupancy Schedule. Occupancy Schedule Override has priority over the Occupancy Schedule and Remote Occupancy Sensor. It is also where a local timed override hardwired input is monitored and used to place the unit in the Occupied mode during the amount of time declared in Timed Override Setpoint using Schedule Override and/or an Occupancy Sensor. The network override will revert back to its default value upon unit controller reboot. See Effective Occupancy Modes. 1 = Occupied 2 = Unoccupied 3 = Bypass 4 = Standby 5 = Null
Occupancy Scheduler Input	MSV:7	C	OccSchedule	1 to 4 Default: 4	N	Commands the fan coil unit into different occupancy modes. A scheduler or a supervisory controller typically sends the command using Schedule Override. ³ The network override will revert back to its default value upon unit controller reboot. See Effective Occupancy Modes. 1 = Occupied 2 = Unoccupied 3 = Standby 4 = Null
Occupancy Sensor Input	MSV:8	C	OccSensor	1 to 3 Default: 3	N	Indicates the presence of occupants in the space (motion detection). ³ The network override will revert back to its default value upon unit controller reboot. See Effective Occupancy Modes. 1 = Occupied 2 = Unoccupied 3 = Null

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

3. When Receive Heartbeat is enabled, this variable reverts to the default (non-override) value if it is not refreshed often enough through a network command or if communication is disabled (i.e. BACnet device communication control = disable).



COMPREHENSIVE DATA TABLES

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
MULTI-STATE VALUES						
Application Mode Input	MSV:9	C	ApplicMode	1 to 8 Default: 8	N	Sets the unit in an application mode (Auto, Off, Heat, Cool, Dehumidification, or Fan Only). Application Mode does not "force" the unit into any state. However, it does disable certain unit operations. Examples: 1) Application Mode of Cool disables heating, 2) Heat disables cooling and dehumidification, and 3) Fan Only disables heating, cooling, and dehumidification.³ MSV9 overrides the local room sensor's System Mode Switch (Heat/Cool/Auto). The local System Mode Switch is only used when MSV9 is set to 7 (Null). The network override will revert back to its default value upon unit controller reboot. 1 = Auto 2 = Heat 3 = Cool 4 = Off 5 = Fan Only 6 = Economy 7 = Dehumid 8 = Null
Auxiliary Heat Enable Input	MSV:10	C	AuxHeatEnable	1 to 3 Default: 3	N	Enables or disables auxiliary heat for units with electric heat. Electric heat is always enabled when it is the only source of heating, and is unaffected by this variable. The default state is Null, in which case auxiliary heat is enabled.³ The network override will revert back to its default value upon unit controller reboot. 1 = Disabled 2 = Enabled 3 = Null
Energy Hold Off Input	MSV:11	C	EnergyHoldOff	1 to 3 Default: 3	N	When the unit is in the Energy Hold Off mode, the unit uses Standby setpoints. This command has priority over Effective Occupancy.³ The network override will revert back to its default value upon unit controller reboot. 1 = Normal 2 = Energy Hold Off 3 = Null
Room Sensor Setpoint Adjust Enable/Disable	MSV:12	W	cpLocSpEnable	1 to 2 Default: 2	Y	Enables or disables the local hardwired setpoint adjustment. If the value of MSV12 is set to 1, this disables the setpoint control from a room sensor and enables the setpoint control from the network. 1 = Disabled 2 = Enabled
Economizer Enable Input	MSV:13	C	EconEnable	1 to 3 Default: 3	N	Enables or disables the economizer for cooling purposes, and only applies to models with an economizer. The default state is Null, in which case the economizer is enabled.³ The network override will revert back to its default value upon unit controller reboot. 1 = Disabled 2 = Enabled 3 = Null
Units (English / Metric)	MSV:14	W	Units	1 to 2 Default: 1	Y	Both English and Metric units of measure for temperature conversion are supported. This menu selection changes the units for all the appropriate properties in the device. From the network MSV14, presentvalue changes it. Select either "E" for English; or "M" for Metric units from the BACnet configuration menu. See BACnet Configuration and Commissioning. 1 = English (E) 2 = Metric (M)

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

3. When Receive Heartbeat is enabled, this variable reverts to the default (non-override) value if it is not refreshed often enough through a network command or if communication is disabled (i.e. BACnet device communication control = disable).



COMPREHENSIVE DATA TABLES

Table 7: Loop Objects

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
LOOP OBJECTS						
Heating Valve PI Loop - See PI Loop Control Parameters section and OM 1111						
Present Value (Heating Valve Position Output)	Loop:1	R	Heat Valve Loop (Present_Value)	0 to 100%	N	Monitors the hydronic heating valve commanded position.
Proportional Constant	Loop:1	W	Heat Valve Loop (Proportional_Constant)	5 to 160% Default: 25%	Y	The proportional gain (Kp) value of the loop algorithm used to control heating valve.
Integral Constant	Loop:1	W	Heat Valve Loop (Integral_Constant)	0 to 1200 sec Default: 20	Y	The integral offset (Ki) value of the loop algorithm used to control the heating valve. The value of 0 disables this feature.
Cooling Valve PI Loop - See PI Loop Control Parameters section and OM 1111						
Present Value (Cooling Valve Position)	Loop:2	R	Cool Valve Loop (Present_Value)	0 to 100%	N	Monitors the hydronic cooling valve commanded position.
Proportional Constant	Loop:2	W	Cool Valve Loop (Proportional_Constant)	5 to 160% Default: 40%	Y	The proportional gain (Kp) value of the loop algorithm used to control the cooling valve.
Integral Constant	Loop:2	W	Cool Valve Loop (Integral_Constant)	0 to 1200 sec Default: 30	Y	The integral offset (Ki) value of the loop algorithm used to control the cooling valve. The value of 0 disables this feature.
Economizer DASP PI Loop - See PI Loop Control Parameters section and OM 1111						
Present Value (Economizer Position Output)	Loop:3	R	DASP_Loop (Present_Value)	0 to 100%	N	Monitors the economizer commanded position. It shares the same value as Economizer Actuator Position Output.
Proportional Constant	Loop:3	W	DASP_Loop (Proportional_Constant)	5 to 160% Default: 40%	Y	The proportional gain (Kp) value of the loop algorithm used to control the Economizer DASP.
Integral Constant	Loop:3	W	DASP_Loop (Integral_Constant)	0 to 1200 sec Default: 20 sec	Y	The integral offset (Ki) value of the loop algorithm used to control the Economizer DASP. The value of 0 disables this feature.
Economizer Position PI Loop - See PI Loop Control Parameters section and OM 1111						
Present Value (Economizer Actuator Position Output)	Loop:4	R	EconPos_Loop (Present_Value)	0 to 100%	N	Monitors the economizer commanded position.
Proportional Constant	Loop:4	W	EconPos_Loop (Proportional_Constant)	5 to 160% Default: 90%	Y	The proportional gain (Kp) value of the loop algorithm used to control the Economizer position.
Integral Constant	Loop:4	W	EconPos_Loop (Integral_Constant)	0 to 1200 sec Default: 10	Y	The integral offset (Ki) of the loop algorithm used to control the Economizer position. The value of 0 disables this feature.

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

Table 8: Device Objects

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
DEVICE						
Description	Device	W	Description	32 Characters	Y	Text string; can be changed through BACnet configuration menu or BAS. See BACnet Configuration.
Instance	Device	W	Object_Identifier	1 to 4194302	Y	Unique instance number or object-identifier assigned by integrator. See BACnet Configuration.
Location	Device	W	Location	32 Characters	Y	Text string that can be changed through BACnet configuration menu or BAS. See BACnet Configuration.

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable



COMPREHENSIVE DATA TABLES

Point Name	Object Type/ Instance	Read/ Write Access ²	BACnet Object Name	Range/Default (in Units)	Non-volatile Memory ¹	Description
DEVICE						
Name	Device	W	Object_Name	32 Characters	Y	The following applies when changes are made through the BACnet configuration menu: If a period "." is entered as the first character then the name is set to "MTIIIUC_FCU_0000000" and the zeros are set to the device instance. If a space character is entered as the first character, then the Device Instance is automatically filled in at the first 0 (zero) character in the name. For example: Assume the Instance has been changed to 321. If the name was previously "FCU_0000300" and a space is entered at the name prompt, the new name automatically fills in as "FCU_0000321". If a period is entered at the name prompt, the new name changes to "MTIIIUC_FCU_0000321."
Software Identification	Device	R	Firmware_Revision	32 Characters	N	The software version of the communication module firmware.
Unit Application Version	Device	R	Application_Software_Version	32 Characters	N	The software version of the unit controller.
MaxMasters	Device	W	Max_Master	1 to 127 Default: 127	Y	MaxMasters should be set to the highest address of a MS/TP master on the network segment. The default value is 127 for maximum compatibility. Setting this to the highest address of an MS/TP master device on the network reduces the MS/TP token traffic and decreases the response time of the unit controller. MaxMasters can be set from the BAS or from the BACnet configuration menu. See BACnet Configuration.
MS/TP Baud Rate	NA	NA	NA	9600, 19200, 38400, 76800 Default: 38400	Y	Set the baud rate to match the speed of the BACnet network. Speeds above 38400 should be avoided unless the network wiring has been tested and verified to meet the required speed. The baud rate must be set using the BACnet configuration menu. See BACnet Configuration.

1. Parameter is stored in FLASH / EEPROM (non-volatile memory) in either the communication module or in the unit controller. If Non-volatile Memory = Y, then the value is saved through a power cycle. Writes to this parameter must be limited. If Non-volatile Memory = N, the value is not saved through a power cycle.

2. R = Read Only, W = Writeable, C = Commandable

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

- 3.01.1 BACnet/IP BACnet Interface Devices are not allowed in the Work.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

- 3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.

- 3.02.1.1 Fan Coil Units (All Types).

- 3.02.2 The Owner will arrange for the following:

- 3.02.2.1 The IT department shall provide a static IP address for the BACnet/IP BAS panel supplied by the Division 25 BAS Contractor that is used to network to the Equipment Supplier's BACnet MS/TP device.

- 3.02.2.2 The IT department will assist with the commissioning of the network connection with the Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.

- 3.02.2.3 The Owner shall provide the passwords and access levels required for the Work.

- 3.02.3 The Equipment Supplier of the BACnet Interface Device shall provide the following:

- 3.02.3.1 Provide a BACnet MS/TP device meet the following requirements. The device shall:

- 3.02.3.1.1 Operate as a Manager device on the BACnet MS/TP network.

- 3.02.3.1.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m [4,005 ft.].

- 3.02.3.1.3 Provide a separate MS/TP trunk for non-UL listed devices in the Work.

- 3.02.3.1.4 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet Interface Devices on any BACnet MS/TP network segment without requiring the use of repeaters.

- 3.02.3.1.5 Provide information on the baud rate used. The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.

- 3.02.3.1.6 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network. Devices with fixed BACnet Interface Device IDs that cannot be changed on site are not allowed in the Work.

- 3.02.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved. Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.

- 3.02.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.

- 3.02.3.4 Configure the device with the approved network number and BACnet Interface Device instance number.

- 3.02.3.5 The Equipment Supplier or the designated Division 25 BAS Contractor shall install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.

- 3.02.3.6 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.

- 3.02.3.7 Assist the Division 25 BAS Contractor to Commission the final network connection to the Owner's network.
- 3.02.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
- 3.02.3.9 Participate in the commissioning process as outlined in this Division.
- 3.02.4 Division 27 shall provide the following:
 - 3.02.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.02.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.02.5 Division 25 BAS Contractor is responsible for the following:
 - 3.02.5.1 A schedule as to when the networking requirements need to be completed. See the Division 25 section for this information to be provided as a Shop Drawing.
 - 3.02.5.2 Confirmation that the BACnet Interface Device ID and network number are unique BACnet Interface Device ID and network number are unique to the BAS Device Network.
 - 3.02.5.3 Confirmation that the BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.5.4 Create a separate BACnet MS/TP network segment for each data rate provided in the Work.
 - 3.02.5.5 Connection of the BACnet MS/TP network cable to the BACnet Interface Device.
 - 3.02.5.6 Connect a shield wire to earth or device chassis at one point along the MS/TP bus prevent ground potential differences on the BAS device network.
 - 3.02.5.7 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.
 - 3.02.5.8 A network drop from the Division 25 BAS Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.
 - 3.02.5.9 Joint commissioning the network connection to this Division 25 BAS Contractor's MS/TP network.
 - 3.02.5.10 Exposing all BACnet MS/TP devices and objects in the Division 25 BAS Contractor supplied BACnet/IP device to which the BACnet MS/TP device is connected.
 - 3.02.5.11 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.02.5.11.1 Consultant's Drawings and Specifications.
 - 3.02.5.12 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.02.5.12.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.02.5.12.2 A minimum of 1 schedule.
 - 3.02.5.12.3 A minimum of 10 Extended Trends.
 - 3.02.5.13 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
 - 3.02.5.14 See 25 15 11.01 for expected level of graphics to be provided.
 - 3.02.5.15 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.02.5.15.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.

- 3.02.5.15.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
- 3.02.5.15.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
- 3.02.5.15.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
- 3.02.5.15.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
- 3.02.5.16 Participating in the commissioning process as outlined in this Division.
- 3.02.6 The BACnet Interface Device to the Equipment Supplier's BACnet MS/TP Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
 - 3.02.6.1 All parties shall each allow 2 hours of technician on-site time for this Work (excluding travel to and from the Work) for commissioning 20% of the devices in this Specification section. The 2 hour time allocation is for each device to be commissioned. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.02.6.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
 - 3.02.6.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
 - 3.02.6.4 The commissioning process shall be overseen by Lake County BAS Consultant.
 - 3.02.6.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
 - 3.02.6.6 The Work includes the following:
 - 3.02.6.6.1 Complete commissioning of all network visible object types according to the procedures outlined in Section 25 08 00, using the relevant Commissioning Forms for each BACnet Object Types.
 - 3.02.6.6.2 Verify all network visible BACnet Object Types correctly display the same information on the Division 25 BAS Contractor Front End as is being displayed on the equipment local interface. All network visible objects shall be commissioned.
 - 3.02.6.6.3 Commission the BACnet MS/TP network connection to the Division 25 BACnet/IP device.
 - 3.02.6.6.4 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
 - 3.02.6.6.5 The process shall be overseen by Lake County BAS Consultant.
 - 3.02.6.6.6 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.02.6.6.7 The following special provisions apply to the commissioning Work.
 - 3.02.6.6.7.1 NONE

End of Section

25 20 23.85 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE BACNET DEVICES) – AIR FLOW MEASURING STATIONS (ALL TYPES)

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division and Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
 - 1.01.1.1 Division 25 BAS Contractor is responsible for providing all equipment and all BACnet Interface Devices for the air flow stations and is designated as the Equipment Supplier in this Specification section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work per the list above.

1.03 BACnet Interface Device Type

- 1.03.1 Single On-board BACnet Interface Device Type:
 - 1.03.1.1 This device is a single onboard BACnet Interface Device that is BACnet MS/TP.

- 1.03.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.
 - 1.03.2.1 The *Basis of Design* is GOLD SERIES GTx116e-Pwith alarming support.
- 1.03.3 The demarcation of Work responsibilities between Division 25 BAS C Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
- 1.03.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
- 1.03.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAM and the BACnet WhoHas/IHave services.
 - 1.03.5.1 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.03.5.2 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.
- 1.04 **Work By Others for this BACnet Interface Device**
 - 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 **Related Division 25 Sections that Apply to the Work of this Specification Section**
 - 1.05.1 25 00 11 Integrated Automation – General Requirements – Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation - General Requirements - Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation - General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation - General Requirements - Starting & Adjusting
 - 1.05.6 25 00 77 Integrated Automation - General Requirements - Closeout Procedures
 - 1.05.7 25 00 78 Integrated Automation - General Requirements - Closeout Submittals
 - 1.05.8 25 00 79 Integrated Automation – General Requirements - Demonstration & Training
 - 1.05.9 25 05 01 Integrated Automation - Common Work Results - General
 - 1.05.10 25 05 05 Integrated Automation - Common Work Results - Device Interface Integration
 - 1.05.11 25 05 13 Integrated Automation - Common Work Results - Conductors & Cables
 - 1.05.12 25 05 26 Integrated Automation - Common Work Results - Grounding & Bonding
 - 1.05.13 25 05 28 Integrated Automation - Common Work Results - Pathways
 - 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
 - 1.05.15 25 06 00 Integrated Automation – Schedules
 - 1.05.16 25 08 00 Integrated Automation - Controls Commissioning

2 - PRODUCTS

2.01 General

- 2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Division 23, 23 09 00.
- 2.01.2 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:
 - 2.01.2.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
 - 2.01.2.2 Working with Lake County BAS Consultant to commission the BACnet Interface Device once it is connected to the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet MS/TP BACnet Interface Device.
- 2.02.2 Division 25 BAS Contractor is responsible for networking to this device using a Level 1 BACnet/IP BAS panel that supports up to 32 BACnet MS/TP Manager devices.
- 2.02.3 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.3.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.4 If the equipment interface is a native BACnet Interface Device, all objects shall be represented externally on the network using BACnet objects and services.
 - 2.02.4.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.5 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.5.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data shall be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.5.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.6.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.6.1.1 NONE.
- 2.02.7 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.7.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.7.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.7.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.7.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.7.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.7.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.7.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.7.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.7.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.7.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.7.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.7.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.7.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.7.14 Device Management - Restart - B (DM-R-B)
- 2.02.8 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
- 2.02.9 The BACnet Interface Device shall support the following Object types:
 - 2.02.9.1 Analog Input
 - 2.02.9.2 Analog Output
 - 2.02.9.3 Analog Value
 - 2.02.9.4 Binary Input
 - 2.02.9.5 Binary Output

- 2.02.9.6 Binary Value
- 2.02.9.7 Device Object
- 2.02.9.8 Multi-state Input
- 2.02.9.9 Multi-state Output
- 2.02.9.10 Multi-state Value

2.02.10 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences outlined in the Contract Documents.

2.03 Air Flow Measuring Stations

- 2.03.1 The BACnet Interface Device shall be represented externally as a BACnet MS/TP device on the Owner's network.
- 2.03.2 Provide the following objects at a minimum:

Analog Inputs

Analog Values

Type, ID	Name	Default Units	
Device	GTC116		
AI, 1	Average Flow	CFM	
AI, 2	Average Temperature	°F	
AI, 3	Alarm Status	0: No alarm, 1: High Alarm, 2: Low Alarm, 3: Both	
AV, 1	Area	sq.ft.	
AV, 2	Traverse Data Status		0=None, 1=Flow, 2=Temp, 3=Both
AV, 3	Flow Traverse	FPM	
↕	↕	↕	
AV, 18	Flow Traverse	FPM	
AV, 19	Temperature Traverse	°F	
↕	↕	↕	
AV, 34	Temperature Traverse	°F	
Notes: 1. Flow and Temp traverse must be enabled through AV2. 2. User Executed Services Supported: Subscribe COV, Read Property, Write Property, Device Communication Control, Who-Is.			

BACnet MS/TP

Function	Address	Type	Units	Description	Range/Value
2	10001	Boolean		Trouble Status	0:OK, 1:Trbl
4	30001-30002	float	FPM	Average Airflow	0 to 15,000
4	30003-30004	float	°F	Average Temperature	-20 to 160
4	30005	word		Number of Inserts	0 to 16

4	30006	word		0	
4	30007	word		Alarm Status	0: No alarm 1: High Alarm 2: Low Alarm 3: Both
4	30008	word		Connector C1 Sensors	0 to 8
4	30009	word		Connector C2 Sensors	0 to 8
4	30010	word		Connector C3 Sensors	0 to 8
4	30011	word		Connector C4 Sensors	0 to 8
4	30012-30043	float	FPM	Airflow Flow Traverse	0 to 15,000
	30012-30013			Insert 1 Flow	
	↕			↕	
	30042-30043			Insert 16 Flow	
4	30044-30075	float	°F	Temperature Traverse	-20 to 160
	30044-30045			Insert 1 Temp	
	↕			↕	
	30074-30075			Insert 16 Temp	
4	30076-30077	float	Sq.Ft.	Area	0 to 100
4	300202	word		Float word order	0: high word first; 1: low word first

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

3.01.1 BACnet/IP BACnet Interface Devices are not allowed in the Work.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.

3.02.1.1 Air Flow Measuring Stations

3.02.2 The Owner will arrange for the following:

3.02.2.1 The IT department shall provide a static IP address for the BACnet/IP BAS panel supplied by the Division 25 BAS Contractor that is used to network to the Equipment Supplier's BACnet MS/TP device.

3.02.2.2 The IT department will assist with the commissioning of the network connection with the Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.

- 3.02.2.3 The Owner shall provide the passwords and access levels required for the Work.
- 3.02.3 The Equipment Supplier of the BACnet Interface Device shall provide the following:
 - 3.02.3.1 Provide a BACnet MS/TP device meet the following requirements. The device shall:
 - 3.02.3.1.1 Operate as a Manager device on the BACnet MS/TP network.
 - 3.02.3.1.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m [4,005 ft.].
 - 3.02.3.1.3 Provide a separate MS/TP trunk for non-UL listed devices in the Work.
 - 3.02.3.1.4 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet Interface Devices on any BACnet MS/TP network segment without requiring the use of repeaters.
 - 3.02.3.1.5 Provide information on the baud rate used. The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.3.1.6 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network. Devices with fixed BACnet Interface Device IDs that cannot be changed on site are not allowed in the Work.
 - 3.02.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved. Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.
 - 3.02.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.
 - 3.02.3.4 Configure the device with the approved network number and BACnet Interface Device instance number.
 - 3.02.3.5 The Equipment Supplier or the Division 25 BAS Contractor shall install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.
 - 3.02.3.6 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.
 - 3.02.3.7 Assist the Division 25 BAS Contractor to commission the final network connection to the Owner's network.
 - 3.02.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
 - 3.02.3.9 Participate in the commissioning process as outlined in this Division.
- 3.02.4 Division 27 shall provide the following:
 - 3.02.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.02.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.02.5 Division 25 BAS Contractor is responsible for the following:
 - 3.02.5.1 A schedule as to when the networking requirements need to be completed. See the Division 25 section for this information to be provided as a Shop Drawing.
 - 3.02.5.2 Confirmation that the BACnet Interface Device ID and network number are unique BACnet Interface Device ID and network number are unique to the BAS Device Network.

- 3.02.5.3 Confirmation that the BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
- 3.02.5.4 Create a separate BACnet MS/TP network segment for each data rate provided in the Work.
- 3.02.5.5 Connection of the BACnet MS/TP network cable to the BACnet Interface Device.
- 3.02.5.6 Connect a shield wire to earth or device chassis at one point along the MS/TP network prevent ground potential differences on the BAS device network.
- 3.02.5.7 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.
- 3.02.5.8 A network drop from the Division 25 BAS Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.
- 3.02.5.9 Joint commissioning the network connection to this Division 25 BAS Contractor's MS/TP network.
- 3.02.5.10 Exposing all BACnet MS/TP devices and objects in the Division 25 BAS Contractor supplied BACnet/IP device to which the BACnet MS/TP device is connected.
- 3.02.5.11 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.02.5.11.1 Consultant's Drawings and Specifications.
- 3.02.5.12 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.02.5.12.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.02.5.12.2 A minimum of 1 schedule.
 - 3.02.5.12.3 A minimum of 10 Extended Trends.
- 3.02.5.13 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
- 3.02.5.14 See 25 15 11.01 for expected level of graphics to be provided.
- 3.02.5.15 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.02.5.15.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.02.5.15.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
 - 3.02.5.15.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
 - 3.02.5.15.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
- 3.02.5.16 Participating in the commissioning process as outlined in this Division.
- 3.02.6 The BACnet Interface Device to the Equipment Supplier's BACnet MS/TP Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
 - 3.02.6.1 All parties shall each allow 8 hours of technician on-site time for this Work (excluding travel to and from the Work) for all devices. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.02.6.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.

- 3.02.6.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
- 3.02.6.4 The commissioning process shall be overseen by Lake County BAS Consultant.
- 3.02.6.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
- 3.02.6.6 The Work includes the following:
 - 3.02.6.6.1 Complete commissioning of all network visible object types according to the procedures outlined in Section 25 08 00, using the relevant Commissioning Forms for each BACnet Object Types.
 - 3.02.6.6.2 Verify all network visible BACnet Object Types correctly display the same information on the Division 25 BAS Contractor Front End as is being displayed on the equipment local interface. All network visible objects shall be commissioned.
 - 3.02.6.6.3 Commission the BACnet MS/TP network connection to the Division 25 BACnet/IP device.
 - 3.02.6.6.4 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
 - 3.02.6.6.5 The process shall be overseen by Lake County BAS Consultant.
 - 3.02.6.6.6 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.02.6.6.7 The following special provisions apply to the commissioning Work.
 - 3.02.6.6.7.1 The Air Flow Measuring Station BACnet Interface Device is not a UL-listed device. It does not need to be commissioned following the provisions of 25 08 03.

End of Section

25 20 26.28.16 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE BACNET DEVICES) – ENCLOSED SWITCHES AND CIRCUIT BREAKERS (ALL TYPES))

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 26 and Panelboard Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).
 - 1.01.8.1 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.01.8.2 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work per the list above.

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:

- 1.03.1.1 Single On Board BACnet Interface Device Type:
 - 1.03.1.1.1 This device has a Single BACnet Interface that is networked to Modbus devices.
 - 1.03.1.1.2 There is no BACnet Interface Device on a Molded Case Circuit Breaker. The BACnet Interface Device is provided by the Trip Unit.
- 1.03.2 Equipment Supplier is responsible for providing and installing this BACnet Interface Device.
 - 1.03.2.1 The *Basis of Design* product is the RTA Automation BACnet/IP gateway between the Modbus device network and the BACnet/IP BACnet Interface Device (see <http://www.rtaautomation.com/products/460/mmbs.html>).
 - 1.03.2.2 The device shall act as a Modbus RTU Master and shall support up to 31 Modbus RTU Subordinate devices.
 - 1.03.2.3 Equipment Supplier is responsible for determining the number of Modbus devices in the building that need to be networked and integrated to BACnet. Each RTA Automation BACnet/IP device can integrate up to 31 devices together. Equipment Supplier shall supply a quantity of RTA Automation BACnet/IP devices sufficient to network all Modbus devices to BACnet.
 - 1.03.2.4 The device shall come with an onboard embedded Linux Webserver to permit configuration of the devices using a web browser.
- 1.03.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
- 1.03.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
- 1.03.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAM and the BACnet WhoHas/IHave services.
 - 1.03.5.1 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
- 1.04 **Work By Others for this BACnet Interface Device**
 - 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 **Related Division 25 Sections that Apply to the Work of this Specification Section**
 - 1.05.1 25 00 11 Integrated Automation – General Requirements – Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation - General Requirements - Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation - General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation - General Requirements - Starting & Adjusting
 - 1.05.6 25 00 77 Integrated Automation - General Requirements - Closeout Procedures
 - 1.05.7 25 00 78 Integrated Automation - General Requirements - Closeout Submittals
 - 1.05.8 25 00 79 Integrated Automation – General Requirements - Demonstration & Training
 - 1.05.9 25 05 01 Integrated Automation - Common Work Results - General
 - 1.05.10 25 05 05 Integrated Automation - Common Work Results - Device Interface Integration
 - 1.05.11 25 05 13 Integrated Automation - Common Work Results - Conductors & Cables
 - 1.05.12 25 05 26 Integrated Automation - Common Work Results - Grounding & Bonding
 - 1.05.13 25 05 28 Integrated Automation - Common Work Results - Pathways
 - 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
 - 1.05.15 25 06 00 Integrated Automation - Schedules
 - 1.05.16 25 08 00 Integrated Automation - Controls Commissioning

2 - PRODUCTS

2.01 General

- 2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Division 26, 23 09 00.
- 2.01.2 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:
 - 2.01.2.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
 - 2.01.2.2 Working with Lake County BAS Consultant to commission the BACnet Interface Device once it is connected the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet/IP BACnet Interface Device complete with an Annex J router to support BACnet/IP to act as a client and/or server for all BACnet information from this system to the BAS.
- 2.02.2 The device shall support use of a static IP address for remote access through the Owner's firewall. Provision of remote access is not included in the Work.
- 2.02.3 The device shall have an open Ethernet port for connection to the network infrastructure (network connection to panel by the Owner). Co-ordinate network configuration requirements with the IT department through the Owner.
- 2.02.4 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.4.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.5 If the equipment interface is a native BACnet Interface Device, all objects must be represented externally on the network using BACnet objects and services.
 - 2.02.5.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.6.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data must be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.6.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.7 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.7.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.7.1.1 NONE.
- 2.02.8 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.8.1 Data Sharing – ReadProperty – B (DS-RP-B)
 - 2.02.8.2 Data Sharing – ReadPropertyMultiple – B (DS-RPM-B)
 - 2.02.8.3 Data Sharing – WriteProperty – B (DS-WP-B)
 - 2.02.8.4 Data Sharing – WritePropertyMultiple – B (DS-WPM-B)
 - 2.02.8.5 Alarm and Event – Notification Internal – B (AE-N-I-B)
 - 2.02.8.6 Alarm and Event – ACK – B (AE-ACK-B)
 - 2.02.8.7 Alarm and Event – Information – B (AE-INFO-B)
 - 2.02.8.8 Device Management – Dynamic Device Binding – B (DM-DDB-B)
 - 2.02.8.9 Device Management – Dynamic Object Binding – B (DM-DOB-B)

- 2.02.8.10 Device Management – DeviceCommunicationControl – B (DM-DCC-B)
- 2.02.8.11 Device Management – TimeSynchronization – B (DM-TS-B)
- 2.02.8.12 Device Management – UTCTimeSynchronization – B (DM-UTC-B)
- 2.02.8.13 Device Management – ReinitializeDevice – B (DM-RD-B)
- 2.02.8.14 Device Management – Restart – B (DM-R-B)
- 2.02.9 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
- 2.02.10 The BACnet Interface Device shall support the following Object types:
 - 2.02.10.1 Analog Input
 - 2.02.10.2 Analog Output
 - 2.02.10.3 Analog Value
 - 2.02.10.4 Binary Input
 - 2.02.10.5 Binary Output
 - 2.02.10.6 Binary Value
 - 2.02.10.7 Device Object
 - 2.02.10.8 Multi-state Input
 - 2.02.10.9 Multi-state Output
 - 2.02.10.10 Multi-state Value
- 2.02.11 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences.
- 2.03 **Power Meter Standard of Acceptance**
 - 2.03.1 This section applies to any Power Meters or to the metering components of the Trip Units provided in the Work.
 - 2.03.2 Meter shall conform to ANSI C12.1 metering accuracy standards.
 - 2.03.3 Meter and included CT(s) shall be factory assembled and calibrated collectively as a system.
 - 2.03.4 System accuracy shall be $\pm 1\%$ from 2 % to 100 % of the rated current over a temperature range of 0-50 C [32-120 F], and require no annual recalibration by Operators in the field.
 - 2.03.5 Meter shall derive operating power from its metering connections, and shall not require a separate control power connection.
 - 2.03.6 The meter shall automatically correct for CT phase reversal.
 - 2.03.7 Meter shall have a backlit LCD display that is direct read without the need for multipliers, conversion, etc. The LCD display shall continuously show accumulated kWh consumption and scroll through the display of Amps, Voltage, PF, KVAR, KVA, kW Real Power on an ongoing basis.
 - 2.03.8 The information and capabilities provided by the meter shall include the following:
 - 2.03.8.1 Current, per phase & three-phase total
 - 2.03.8.2 Voltage, per phase & three-phase total, phase-to-phase & phase-neutral
 - 2.03.8.3 Real Power (kW), per phase & three-phase total
 - 2.03.8.4 Reactive Power (kVAR), three-phase total
 - 2.03.8.5 Apparent Power (kVA), three-phase total
 - 2.03.8.6 Power Factor, per-phase & three-phase total
 - 2.03.8.7 Real Energy (kWh), three-phase total
 - 2.03.9 The meter shall directly accept any voltage input from 120-480 VAC, and be internally isolated to 2500 VAC.
 - 2.03.10 The meter shall have models available for amperage ranges of 100-2400 Amps.
 - 2.03.11 The meter shall be networkable via an Ethernet or RS/TP connection to a BACnet network.
 - 2.03.12 The Energy Meter shall have a N.O. pulse output with selectable pulse output rates of 0.10, 0.25, 0.50, or 1.00 kWh per pulse.
 - 2.03.13 The Energy Meter shall have a N.C. phase-loss alarm output operating at one hundred (100)mA @ twenty four (24) VAC/DC.
- 2.04 **Current Measurement (Amps) Standard of Acceptance**
 - 2.04.1 Current measurement shall be by a combination current transformer and a current transducer.

- 2.04.2 A split core current transformer shall be provided to monitor motor amps. The transformer shall have the following characteristics:
 - 2.04.2.1 Operating frequency of 50 to 400 Hz
 - 2.04.2.2 Insulation – 0.6 kV class 10 kV BIL
 - 2.04.2.3 UL recognized
 - 2.04.2.4 Five amp secondary
 - 2.04.2.5 Select current ratio as appropriate for application
- 2.04.3 A current to voltage or current to mA transducer shall be provided. The current transducer shall have the following characteristics:
 - 2.04.3.1 6X input over amp rating for AC inrushes of up to 120 amps
 - 2.04.3.2 Manufactured to UL 1244
 - 2.04.3.3 Accuracy: +0.5%, Ripple +1%
 - 2.04.3.4 Minimum load resistance 30 k Ω
 - 2.04.3.5 Input 0-20 Amps
 - 2.04.3.6 Output 4-20 mA
 - 2.04.3.7 Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%)
- 2.05 **Molded Case Circuit Breaker (Trip Unit) BACnet Interface for the Trip Units.**
 - 2.05.1 The BACnet Interface Device shall be represented externally as a BACnet/IP device on the Owner's network.
 - 2.05.2 The BACnet Interface Device shall support use of a static IP address for remote access through the Owner's firewall. The BACnet Interface Device shall have an Annex J router to support BACnet/IP.
 - 2.05.3 The Trip Units BACnet Interface Device does not have to be UL 864 UUKL listed as it performs no UL functions.
 - 2.05.4 Provide the following objects at a minimum:

BACnet Molded Case Circuit Breaker (Trip Unit) Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Vendor Name	LCB#-LVSwtg-MMM-VendorName	R	ASCII	E S	E S	E S	E S	E S			N					no-units
Model Name	LCB#-LVSwtg-MMM-ModelName	R	ASCII	E S	E S	E S	E S	E S			N					no-units
Display Name	LCB#-LVSwtg-MMM-DisplayName	R	ASCII	E S	E S	E S	E S	E S			N					no-units
Device Type	LCB#-LVSwtg-MMM-DeviceType	R	ASCII	E S	E S	E S	E S	E S			N					no-units
Field Replacement Unit	LCB#-LVSwtg-MMM-FldRepU	R	UINT1 6	E S	E S	E S	E S	E S			N					no-units
Status	LCB#-LVSwtg-MMM-Status	R	UINT1 7	E S	E S	E S	E S	E S			Y					no-units
Status Reason	LCB#-LVSwtg-MMM-StaReason	R	UINT1 8	E S	E S	E S	E S	E S			N					no-units
Event Count	LCB#-LVSwtg-MMM-EventCount	R	UINT1 9	E S	E S	E S	E S	E S			N					no-units
Status Secondary	LCB#-LVSwtg-MMM-StaSec	R	UINT2 0	E S	E S	E S	E S	E S			N					no-units
Secondary Status Code	LCB#-LVSwtg-MMM-SecStaCode	R	UINT2 1	E S	E S	E S	E S	E S			N					no-units
Vab	LCB#-LVSwtg-MMM-Vab	R	AV	E S	E S	E S	E S	E S			N				V	volts
Vbc	LCB#-LVSwtg-MMM-Vbc	R	AV	E S	E S	E S	E S	E S			N				V	volts
Vca	LCB#-LVSwtg-MMM-Vca	R	AV	E S	E S	E S	E S	E S			N				V	volts
Ia	LCB#-LVSwtg-MMM-Ia	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Ib	LCB#-LVSwtg-MMM-Ib	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Ic	LCB#-LVSwtg-MMM-Ic	R	AV	E S	E S	E S	E S	E S			N				A	amperes

BACnet Molded Case Circuit Breaker (Trip Unit) Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Ig	LCB#-LVSwtg-MMM-Ig	R	AV	E S	E S	E S	E S	E S			N				A	amperes
In	LCB#-LVSwtg-MMM-In	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Demand Ia Peak	LCB#-LVSwtg-MMM-DmdIaPeak	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Demand Ib Peak	LCB#-LVSwtg-MMM-DmdIbPeak	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Demand Ic Peak	LCB#-LVSwtg-MMM-DmdIcPeak	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Demand Ia	LCB#-LVSwtg-MMM-DemandIa	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Demand Ib	LCB#-LVSwtg-MMM-DemandIb	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Demand Ic	LCB#-LVSwtg-MMM-DemandIc	R	AV	E S	E S	E S	E S	E S			N				A	amperes
Real Power	LCB#-LVSwtg-MMM-RealPwr	R	AV	E S	E S	E S	E S	E S			N				W	watts
Apparent Power	LCB#-LVSwtg-MMM-AptPwr	R	AV	E S	E S	E S	E S	E S			N				V A	volt-amperes
Reactive Power	LCB#-LVSwtg-MMM-ReActPwr	R	AV	E S	E S	E S	E S	E S			N				V A	volt-amperes
PF Displacement	LCB#-LVSwtg-MMM-PFDisp	R	AV	E S	E S	E S	E S	E S			N				PF	power-factor
PF Apparent	LCB#-LVSwtg-MMM-PFApparent	R	AV	E S	E S	E S	E S	E S			N				PF	power-factor
Forward Real Energy	LCB#-LVSwtg-MMM-FwdRIEne	R	AV	E S	E S	E S	E S	E S			N				W h	watt-hours
Reverse Real Energy	LCB#-LVSwtg-MMM-RvsRIEne	R	AV	E S	E S	E S	E S	E S			N				W h	watt-hours

BACnet Molded Case Circuit Breaker (Trip Unit) Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Apparent Energy	LCB#-LVSwtg-MMM-AptEne	R	AV	E S	E S	E S	E S	E S			N				V Ah	volt-ampere-hours
Crest Factor Ia	LCB#-LVSwtg-MMM-CrtFctIa	R	AV	E S	E S	E S	E S	E S			N					no-units
Crest Factor Ib	LCB#-LVSwtg-MMM-CrtFctIb	R	AV	E S	E S	E S	E S	E S			N					no-units
Crest Factor Ic	LCB#-LVSwtg-MMM-CrtFctIc	R	AV	E S	E S	E S	E S	E S			N					no-units
Crest Factor Ig	LCB#-LVSwtg-MMM-CrtFctIg	R	AV	E S	E S	E S	E S	E S			N					no-units
Crest Factor In	LCB#-LVSwtg-MMM-CrtFctIn	R	AV	E S	E S	E S	E S	E S			N					no-units
Percent THD Ia	LCB#-LVSwtg-MMM-PctTHDIa	R	AV	E S	E S	E S	E S	E S			N				%	percent
Percent THD Ib	LCB#-LVSwtg-MMM-PctTHDIb	R	AV	E S	E S	E S	E S	E S			N				%	percent
Percent THD Ic	LCB#-LVSwtg-MMM-PctTHDIc	R	AV	E S	E S	E S	E S	E S			N				%	percent
Percent THD In	LCB#-LVSwtg-MMM-PctTHDIIn	R	AV	E S	E S	E S	E S	E S			N				%	percent
Percent THD Ig	LCB#-LVSwtg-MMM-PctTHDIg	R	AV	E S	E S	E S	E S	E S			N				%	percent
Maximum Temperature	LCB#-LVSwtg-MMM-MaxTmp	R	AV	E S	E S	E S	E S	E S			N				°C	degrees-Celsius
IST SDT Faults	LCB#-LVSwtg-MMM-ISTSDTFau	R	UINT16	E S	E S	E S	E S	E S			N					no-units
LDT GFT Faults	LCB#-LVSwtg-MMM-LDTGFTFau	R	UINT16	E S	E S	E S	E S	E S			N					no-units

BACnet Molded Case Circuit Breaker (Trip Unit) Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Phase Instantaneous Overcurrent	LCB#-LVSwtg-MMM-PhaInttOvc	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Phase Inverse Time Overcurrent	LCB#-LVSwtg-MMM-PhaIvrTOvc	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Neutral Inverse Time Overcurrent	LCB#-LVSwtg-MMM-NeuIvrTOvc	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Over Voltage	LCB#-LVSwtg-MMM-OvrVtg	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Under Voltage	LCB#-LVSwtg-MMM-UdrVtg	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Under Frequency	LCB#-LVSwtg-MMM-UdrFrq	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Over Frequency	LCB#-LVSwtg-MMM-OvrFrq	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Amperes Out of Balance	LCB#-LVSwtg-MMM-AmpOutBal	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Voltage Out of Balance	LCB#-LVSwtg-MMM-VtgOutBal	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Low Power Factor	LCB#-LVSwtg-MMM-LoPwrFct	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Power Demand	LCB#-LVSwtg-MMM-PwrDmd	R	UINT16	ES	ES	ES	ES	ES			N					no-units
VA Demand	LCB#-LVSwtg-MMM-VADmd	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Total Harmonic Distortion	LCB#-LVSwtg-MMM-TotHrmDtt	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Operation Counts	LCB#-LVSwtg-MMM-OpCounts	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Communications	LCB#-LVSwtg-MMM-Communication	R	UINT16	ES	ES	ES	ES	ES			N					no-units

BACnet Molded Case Circuit Breaker (Trip Unit) Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
RAM Error	LCB#-LVSwtg-MMM-RAMError	R	UINT16	ES	ES	ES	ES	ES			N					no-units
EEROM Error	LCB#-LVSwtg-MMM-EEROMError	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Watchdog	LCB#-LVSwtg-MMM-Watchdog	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Long Delay	LCB#-LVSwtg-MMM-LongDly	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Short Delay	LCB#-LVSwtg-MMM-ShortDly	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Discriminator	LCB#-LVSwtg-MMM-Discriminator	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Bad/Missing Rating Plug	LCB#-LVSwtg-MMM-BadMisRPlug	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Reverse Power	LCB#-LVSwtg-MMM-RvsPwr	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Override	LCB#-LVSwtg-MMM-Override	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Reverse Phase	LCB#-LVSwtg-MMM-RvsPha	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Phase Rotation	LCB#-LVSwtg-MMM-PhaRot	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Phase Current Loss	LCB#-LVSwtg-MMM-PhaCurLos	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Alarm Active	LCB#-LVSwtg-MMM-AlmAct	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Bad Frame	LCB#-LVSwtg-MMM-BadFrame	R	UINT16	ES	ES	ES	ES	ES			N					no-units
High Load	LCB#-LVSwtg-MMM-HighLoad	R	UINT16	ES	ES	ES	ES	ES			N					no-units

BACnet Molded Case Circuit Breaker (Trip Unit) Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Lockout	LCB#-LVSwtg-MMM-Lockout	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Making Current Release	LCB#-LVSwtg-MMM-MkCurRls	R	UINT16	ES	ES	ES	ES	ES			N					no-units
High Instantaneous	LCB#-LVSwtg-MMM-HiIntt	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Setpoint Error	LCB#-LVSwtg-MMM-SetErr	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Over Temperature	LCB#-LVSwtg-MMM-OvrTmp	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Accessory Bus	LCB#-LVSwtg-MMM-AcsBus	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Neutral	LCB#-LVSwtg-MMM-Neutral	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Historical Data	LCB#-LVSwtg-MMM-HstData	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Ground Fault	LCB#-LVSwtg-MMM-GndFau	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Earth Fault	LCB#-LVSwtg-MMM-EarthFau	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Earth Fault	LCB#-LVSwtg-MMM-EarthFau	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Trip Blocked	LCB#-LVSwtg-MMM-TripBlk	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Frequency Out of Bounds	LCB#-LVSwtg-MMM-FrqOutBou	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Check Aux Switch	LCB#-LVSwtg-MMM-ChkAuxSwt	R	UINT16	ES	ES	ES	ES	ES			N					no-units
Receive Date and Time	LCB#-LVSwtg-MMM-RcvTimeDate	R	Time	ES	ES	ES	ES	ES			N					no-units

[illegible]

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

- 3.01.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet/IP device.
- 3.01.2 Trip Units Modbus to BACnet Device Network.
 - 3.01.2.1 The IT department shall provide a static IP address for the BACnet/IP BACnet Interface Device.
 - 3.01.2.2 The IT department will assist with the commissioning of the network connection with this Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.
 - 3.01.2.3 The Owner shall provide the passwords and access levels required for the Work.
- 3.01.3 The Equipment Supplier shall provide the following:
 - 3.01.3.1 A fully operational BACnet/IP BACnet Interface Device that networks to all BACnet MS/TP devices provided in the Work of this section (if any MS/TP devices are provided). BACnet/IP devices shall meet the following requirements:
 - 3.01.3.1.1 BACnet/IP device shall include an Annex J B/IP router to support BACnet/IP to act as a client and/or server for all BACnet information from the supplied equipment to the BAS Device Network, which is considered a "directly connected network".
 - 3.01.3.1.2 The BAS Device Network is treated as a "remote network" that is reachable by communicating using BACnet/IP with a router supplied by others that serves the remote network.
 - 3.01.3.1.3 The BACnet/IP device shall come complete with a BBMD that will be configured to traverse IP subnets.
 - 3.01.3.1.4 The interface shall have an open Ethernet RJ-45 port for connection to the BAS device network infrastructure using communications cabling that complies with the TIA/EIA 568-B standard or the requirements of Division 27.
 - 3.01.3.1.5 The interface shall operate at a minimum of 10 Mbps, full duplex.
 - 3.01.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved.
 - 3.01.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.
 - 3.01.3.4 Configuration of the device with the assigned IP address.
 - 3.01.3.5 Connection of the IP network cable to the BACnet Interface Device.
 - 3.01.3.6 Commission the final network connection to the Owner's network.
 - 3.01.3.7 Creation and assignment of passwords and access levels within the device.
 - 3.01.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
 - 3.01.3.8.2 Provision of paper documents requiring scanning and post processing by the Division 25 BAS Contractor is not allowed.
 - 3.01.3.8.3 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents shown on the Consultant's Plans and Specifications.
 - 3.01.3.9 Participating in the commissioning process as outlined in this Division.
- 3.01.4 Division 27 shall provide the following:
 - 3.01.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 BAS Contractor Submittal section for this information to be provided as a Shop Drawing.

- 3.01.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.01.5 Division 25 BAS Contractor is responsible for the following:
 - 3.01.5.1 Mapping all the BACnet Object Types approved in the Submittal process from the Equipment Supplier's BACnet Interface Device to the Division 25 BAS Contractor's supplied BACnet/IP device so the mapped points are accessible using the Division 25 BAS Contractor's Front End.
 - 3.01.5.2 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.01.5.2.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.01.5.2.2 A minimum of 1 schedule.
 - 3.01.5.2.3 A minimum of 10 Extended Trends.
 - 3.01.5.3 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
 - 3.01.5.4 See 25 15 11.01 for expected level of graphics to be provided.
 - 3.01.5.5 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.01.5.5.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.5.5.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.01.5.5.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.5.5.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
 - 3.01.5.5.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
 - 3.01.5.5.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
 - 3.01.5.5.7 Provide a link in the graphic to the embedded Webserver if Equipment Supplier provides this device.
 - 3.01.5.6 Participating in the commissioning process as outlined in this Division.
- 3.01.6 Equipment Supplier is responsible for the following:
 - 3.01.6.1 Equipment Supplier is responsible for mapping all the points approved in the Submittal process to BACnet object types into an Equipment Supplier supplied BACnet Interface Device.
 - 3.01.6.2 Equipment Supplier is responsible for commissioning this device by ensuring the device and its objects can be discovered by using BACnet services.
 - 3.01.6.3 Participating in the commissioning process as outlined in this Division.
- 3.01.7 The BACnet Interface Device to the Equipment Supplier's BACnet, Modbus or proprietary protocol Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
 - 3.01.7.1 All parties shall each allow sixteen (16) hours of technician on-site time for this Work (excluding travel to and from the Work) for all devices. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.01.7.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
 - 3.01.7.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.

- 3.01.7.4 The commissioning process shall be overseen by the Lake County BAS Consultant.
 - 3.01.7.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
 - 3.01.7.6 Use the commissioning procedures outlined in this Specification section.
 - 3.01.7.7 Commissioning of hardwired points in the Equipment Supplier's BACnet Interface Device.
 - 3.01.7.7.1 All hardwired points shall be commissioned using the forms and procedures in 25 08 00.
 - 3.01.7.8 Commissioning of network visible object types in the Equipment Supplier's BACnet Interface Device.
 - 3.01.7.8.1 Complete commissioning of a minimum of 20% and up to fifty (50) of the network visible object types selected by the Lake County BAS Consultant.
 - 3.01.7.8.2 Lake County BAS Consultant shall provide a commissioning form that will list the points to be tested and commissioned.
 - 3.01.7.8.3 If the Owner deems that there are problems with the device and/or points, the Owner reserves the right to extend the commissioning time allocation to test and commission additional points as required.
 - 3.01.7.9 Verify all network visible BACnet Object Types correctly display the same information on the Front End as is being displayed on the equipment local interface.
 - 3.01.7.10 Parse all equipment packaged controls alarms, trends and schedules that are represented as AV, BV and MSV BACnet Object Types by the equipment BACnet Interface Device.
 - 3.01.7.11 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
 - 3.01.7.12 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.01.7.13 The following special provisions apply to the commissioning Work.
 - 3.01.7.13.1 NONE.
- 3.02 **BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements.**
- 3.02.1 BACnet MS/TP BACnet Interface Devices are not allowed in the Work.

End of Section

**25 20 26.29.23 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE
BACNET DEVICES) – VARIABLE FREQUENCY DRIVES (ALL TYPES)**

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 23 and Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
 - 1.01.1.1 Division 25 BAS Contractor is responsible for providing all equipment and all BACnet Interface Devices for the VFDs and is designated as the Equipment Supplier in this Specification section.
 - 1.01.1.2 The terms VFC and VFD are used interchangeably in this Specification.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).
 - 1.01.8.1 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.01.8.2 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work per the list above.
- 1.03 **BACnet Interface Device Type**
 - 1.03.1 This BACnet Interface Device shall be provided as:
 - 1.03.1.1 Single On-board BACnet Interface Device Type:
 - 1.03.1.1.1 This device is a single onboard BACnet Interface Device that is BACnet MS/TP.
 - 1.03.2 Division 25 BAS Contractor is responsible for providing the following equipment and where required, network connections. See Mechanical Drawings and Specifications for locations, sizes and quantities.
 - 1.03.2.1 The Basis of Design is ABB ACH 580 complete with Eclipse Electronic Bypass and Firefighter's Override.
 - 1.03.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
 - 1.03.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
 - 1.03.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAM and the BACnet WhoHas/IHave services.
 - 1.03.5.1 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
- 1.04 **Work By Others for this BACnet Interface Device**
 - 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 **Related Division 25 Sections that Apply to the Work of this Specification Section**
 - 1.05.1 25 00 11 Integrated Automation – General Requirements – Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation - General Requirements - Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation - General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation - General Requirements - Starting & Adjusting
 - 1.05.6 25 00 77 Integrated Automation - General Requirements - Closeout Procedures
 - 1.05.7 25 00 78 Integrated Automation - General Requirements - Closeout Submittals
 - 1.05.8 25 00 79 Integrated Automation – General Requirements - Demonstration & Training
 - 1.05.9 25 05 01 Integrated Automation - Common Work Results - General
 - 1.05.10 25 05 05 Integrated Automation - Common Work Results - Device Interface Integration
 - 1.05.11 25 05 13 Integrated Automation - Common Work Results - Conductors & Cables
 - 1.05.12 25 05 26 Integrated Automation - Common Work Results - Grounding & Bonding
 - 1.05.13 25 05 28 Integrated Automation - Common Work Results - Pathways
 - 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification
 - 1.05.15 25 06 00 Integrated Automation – Schedules
 - 1.05.16 25 08 00 Integrated Automation - Controls Commissioning
 - 1.05.17 25 08 03 Integrated Automation – BAS UL 864 UUKL Commissioning (Firefighter's Override connection only).

2 - PRODUCTS

2.01 General

- 2.01.1 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:

- 2.01.1.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
- 2.01.1.2 Working with the Lake County BAS Consultant to commission the BACnet Interface Device once it is connected the Intranet at the Place of the Work.
- 2.02 BACnet Interface Device General Requirements**
 - 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet MS/TP BACnet Interface Device.
 - 2.02.2 Division 25 BAS Contractor is responsible for networking to this device using a Level 1 BACnet/IP BAS panel that supports up to 32 BACnet MS/TP Manager devices.
 - 2.02.3 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.3.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
 - 2.02.4 If the equipment interface is a native BACnet Interface Device, all objects shall be represented externally on the network using BACnet objects and services.
 - 2.02.4.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
 - 2.02.5 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.
 - 2.02.5.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data shall be represented externally on the network as BACnet objects and services. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.5.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
 - 2.02.6 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.6.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.6.1.1 NONE.
 - 2.02.7 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.7.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.7.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.7.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.7.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.7.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.7.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.7.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.7.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.7.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.7.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.7.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.7.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.7.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.7.14 Device Management - Restart - B (DM-R-B)
 - 2.02.8 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
 - 2.02.9 The BACnet Interface Device shall support the following Object types:

- 2.02.9.1 Analog Input
- 2.02.9.2 Analog Output
- 2.02.9.3 Analog Value
- 2.02.9.4 Binary Input
- 2.02.9.5 Binary Output
- 2.02.9.6 Binary Value
- 2.02.9.7 Device Object
- 2.02.9.8 Multi-state Input
- 2.02.9.9 Multi-state Output
- 2.02.9.10 Multi-state Value
- 2.02.10 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences outlined in the Contract Documents.
- 2.03 **Variable Speed Drives**
 - 2.03.1 The BACnet Interface Device shall be represented externally as a BACnet MS/TP device on the Owner's network.
 - 2.03.2 The VFD BACnet Interface Device does not need to be a listed device if the VFD comes with a Firefighter's Override terminal to which the Division 25 BAS Contractor can control the VFD speed via this hardwired connection.
 - 2.03.2.1.1.1 In addition to providing the VFD BACnet MS/TP network connection, Division 25 BAS Contractor is responsible for providing the following hard wired connections from the VFD input/output terminals to the Division 25 BAS Contractor's BAS panel.
 - 2.03.2.1.1.1.1 VFD status BI
 - 2.03.2.1.1.1.2 VFD common alarm BI
 - 2.03.2.1.1.1.3 VFD enable/disable BO
 - 2.03.2.1.1.1.4 VFD speed % AO
 - 2.03.2.1.1.1.5 VFD Smoke signal to Firefighter override terminal BI
 - 2.03.2.1.2 Provide the following objects at a minimum:

BACnet Variable Frequency Drives Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
VFD																
Ready State	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Indicates whether the drive is ready or not
Run/Stop State	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Indicates whether the drive is running or stopped
Fwd/Rev State	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Indicates the rotation direction of the motor
Fault State	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Indicates if a fault is active
Warning State	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Indicates if a warning is active
At Setpoint	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Ref. Frequency reached
At Zero Speed	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Motor Running at zero speed
General 0	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 1	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 2	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 3	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 4	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 5	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 6	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
General 7	LCB#-VFDMMM -VendorName	R	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific bit from drives General Status Word
Run/Stop CMD	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Command to start drive (FB control is active)
Fwd/Rev CMD	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Command to change rotational direction (FB control is active)
Reset Fault	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Command to reset Active Fault from drive
FBFixedControlWord Bit_3	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control

BACnet Variable Frequency Drives Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
																Word
FBFixedControlWord Bit_4	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_5	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_6	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_7	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_8	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_9	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_10	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_11	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_12	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_13	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_14	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
FBFixedControlWord Bit_15	LCB#-VFDMMM -VendorName	R/W	BV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application Specific bit from the Fixed Control Word
Frequency Setpoint	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		Hz	Frequency Setpoint
Output Frequency	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		Hz	Output Frequency
Motor Speed	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		rpm	Motor Speed
Load (power)	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		Hp	Motor Shaft Power
Kilowatt Hours total	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		kWh	Megawatt Hour Counter (Total)
Motor Current	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		A	Motor Current

BACnet Variable Frequency Drives Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
DC link Voltage	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		V	DC link Voltage
Motor Voltage	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		V	Motor Voltage
Unit Temperature	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		°C	Heatsink Temperature NOT IN SLX -series
Motor Torque	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		%	In % of motor nominal Torque
Operating Days	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		Da ys	Operating Days (resettable)
Operating Hours	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		h	Operating Hours (resettable)
Kilowatt Hours	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		k W h	Kilowatt Hours (resettable)
Torque Reference	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		N m	Torque Reference NOT IN SLX - series
Temperature Rise	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		%	Calculated motor temperature 100,0% = nominal temperature of motor NOT IN SLX -series
FBProcessDataOut1	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut2	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut3	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut4	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut5	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut6	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut7	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataOut8	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
Active Fault Code	LCB#-VFDMMM -VendorName	R	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Active Fault Code
Speed Reference	LCB#-VFDMMM -VendorName	R/W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		%	Speed Reference, percentage of nominal speed
Current Limit	LCB#-VFDMMM -VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Current Limit
Min Frequency	LCB#-VFDMMM -VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		Hz	Minimum Frequency

BACnet Variable Frequency Drives Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Maximum Frequency	LCB#-VFDMMM –VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		Hz	Maximum Frequency
Accel Time	LCB#-VFDMMM –VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		s	Acceleration Time
Decel Time	LCB#-VFDMMM –VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25		s	Deceleration Time
FBProcessDataIN 1	LCB#-VFDMMM –VendorName	R/W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataIN 2	LCB#-VFDMMM –VendorName	R/W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataIN 3	LCB#-VFDMMM –VendorName	R/W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
FBProcessDataIN 4	LCB#-VFDMMM –VendorName	R/W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Application specific
AnyParam ID	LCB#-VFDMMM –VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			ID number that is used in AV35
AnyParam Value	LCB#-VFDMMM –VendorName	W	AV	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Value of ID defined by AV34
Motor Current	LCB#-VFDMMM –VendorName		AI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports motor current in bypass or drive mode (bypass parameter 1.01).
Last Fault	LCB#-VFDMMM –VendorName		AI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports last bypass fault (bypass parameter 4.01).
Alarm Word 1	LCB#-VFDMMM –VendorName		AI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports alarm word 1 bitfield (bypass parameter 3.08).
Alarm Word 2	LCB#-VFDMMM –VendorName		AI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports alarm word 2 bitfield (bypass parameter 3.09).
Bypass Mode	LCB#-VFDMMM –VendorName		AI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports bypass operating mode (0 = Off, 1 = Hand, 2 = Auto).
Bypass Run Delay	LCB#-VFDMMM –VendorName		AO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Sets additional pick-up delay for bypass contactor when switching from drive to bypass mode (bypass parameter 16.14).
System Ready	LCB#-VFDMMM –VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System is ready to accept start command (either mode).
System Enabled	LCB#-VFDMMM –VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System is enabled to start motor (either mode).
System Started	LCB#-VFDMMM –VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System start enables are made and start command has

BACnet Variable Frequency Drives Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
																been received (either mode). Motor runs if run enable is active.
System Running	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Motor is running (either mode).
Fieldbus Local	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System is under fieldbus local control (either mode).
Bypass Fault	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass is faulted.
Bypass Alarm	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass is alarming.
Comm Control	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System is configured for control in the comm channel.
Bypass Override	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass override 2 status.
DI 1 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass digital input 1 status.
DI 2 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass digital input 2 status.
DI 3 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass digital input 3 status.
DI 4 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass digital input 4 status.
DI 5 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass digital input 5 status.
DI 6 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass digital input 6 status.
RO 1 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 1 status.
RO 2 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 2 status.
RO 3 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 3 status.
RO 4 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 4 status.
RO 5 Status	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 5 status.
Bypass Select	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			1 = Bypass mode, 0 = Drive mode
System Underload	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports system underload status (either mode).
System Fault	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports system fault status (either mode).

BACnet Variable Frequency Drives Object list (Typical for each Unit)																
Object List	Mapped Object List	Read/ Write	Object Type	Supply Device	Install Device	Power Device	Wire Device	Pgm Device	Alarmable	Alarm Limit	Alarm Type	Graphic	Trend	Com'd	Units	Description (acceptable value range)
Bypass Run	LCB#-VFDMMM -VendorName		BI	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Reports motor running status in bypass mode.
System Start	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System start command (either mode).
System Run Enable	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System run enable command (either mode).
System Reset	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System fault reset command (either mode).
Bypass Override	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass override 2 command.
RO 1 Command	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 1 command.
RO 2 Command	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 2 command.
RO 3 Command	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 3 command.
RO 4 Command	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 4 command.
RO 5 Command	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			Bypass relay output 5 command.
System Start Enable 1	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System start enable 1 (either mode).
System Start Enable 2	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System start enable 2 (either mode).
System Start Enable 3	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System start enable 3 (either mode).
System Start Enable 4	LCB#-VFDMMM -VendorName		BO	ES	ES	ES	ES	ES	Y	TB D	TB D	25	25			System start enable 4 (either mode).

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

3.01.1 BACnet/IP BACnet Interface Devices are not allowed in the Work.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

3.02.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet MS/TP device.

3.02.1.1 Variable Frequency Drives

3.02.2 The Owner will arrange for the following:

- 3.02.2.1 The IT department shall provide a static IP address for the BACnet/IP BAS panel supplied by the Division 25 BAS Contractor that is used to network to the Equipment Supplier's BACnet MS/TP device.
- 3.02.2.2 The IT department will assist with the commissioning of the network connection with the Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.
- 3.02.2.3 The Owner shall provide the passwords and access levels required for the Work.
- 3.02.3 The Equipment Supplier of the BACnet Interface Device shall provide the following:
 - 3.02.3.1 Provide a BACnet MS/TP device meet the following requirements. The device shall:
 - 3.02.3.1.1 Operate as a Manager device on the BACnet MS/TP network.
 - 3.02.3.1.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m [4,005 ft.].
 - 3.02.3.1.3 Provide a separate MS/TP trunk for UL listed devices in the Work.
 - 3.02.3.1.4 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet Interface Devices on any BACnet MS/TP network segment without requiring the use of repeaters.
 - 3.02.3.1.5 Provide information on the baud rate used. The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.3.1.6 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network. Devices with fixed BACnet Interface Device IDs that cannot be changed on site are not allowed in the Work.
 - 3.02.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved. Size the device to provide all the objects listed in the Equipment Supplier's approved Submittal.
 - 3.02.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.
 - 3.02.3.4 Configure the device with the approved network number and BACnet Interface Device instance number.
 - 3.02.3.5 The Equipment Supplier or the Division 25 BAS Contractor shall install and wire the devices connected to the BACnet MS/TP device as shown in the Consultant's Plans and Specifications.
 - 3.02.3.6 Creation and assignment of passwords and access levels within the device based on instructions from the Owner.
 - 3.02.3.7 Assist the Division 25 BAS Contractor to Commission the final network connection to the Owner's network.
 - 3.02.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for Division 25 BAS Contractor to add as graphic links in the Front End.
 - 3.02.3.9 Participate in the commissioning process as outlined in this Division.
- 3.02.4 Division 27 shall provide the following:
 - 3.02.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 Submittal section for this information to be provided as a Shop Drawing.
 - 3.02.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.

- 3.02.5 Division 25 BAS Contractor is responsible for the following:
- 3.02.5.1 A schedule as to when the networking requirements need to be completed. See the Division 25 section for this information to be provided as a Shop Drawing.
 - 3.02.5.2 Confirmation that the BACnet Interface Device ID and network number are unique BACnet Interface Device ID and network number are unique to the BAS Device Network.
 - 3.02.5.3 Confirmation that the BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.
 - 3.02.5.4 Create a separate BACnet MS/TP network segment for each data rate provided in the Work.
 - 3.02.5.5 Connection of the BACnet MS/TP network cable to the BACnet Interface Device.
 - 3.02.5.6 Connect a shield wire to earth or device chassis at one point along the MS/TP bus prevent ground potential differences on the BAS device network.
 - 3.02.5.7 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.
 - 3.02.5.8 A network drop from the Division 25 BAS Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.
 - 3.02.5.9 Joint commissioning the network connection to this Division 25 BAS Contractor's MS/TP network.
 - 3.02.5.10 Exposing all BACnet MS/TP devices and objects in the Designated Controls Division 25 BAS Contractor supplied BACnet/IP device to which the BACnet MS/TP device is connected.
 - 3.02.5.11 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.02.5.11.1 Consultant's Drawings and Specifications.
 - 3.02.5.12 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.02.5.12.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.02.5.12.2 A minimum of 1 schedule.
 - 3.02.5.12.3 A minimum of 10 Extended Trends.
 - 3.02.5.13 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
 - 3.02.5.14 See 25 15 11.01 for expected level of graphics to be provided.
 - 3.02.5.15 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.02.5.15.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.02.5.15.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.02.5.15.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
 - 3.02.5.15.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
 - 3.02.5.15.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
 - 3.02.5.16 Participating in the commissioning process as outlined in this Division.
- 3.02.6 The BACnet Interface Device to the Equipment Supplier's BACnet MS/TP Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:

- 3.02.6.1 All parties shall each allow 8 hours of technician on-site time for this Work (excluding travel to and from the Work) for all devices. This is in addition to any other commissioning requirements called up in the Contract Documents.
- 3.02.6.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
- 3.02.6.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
- 3.02.6.4 The commissioning process shall be overseen by Lake County BAS Consultant.
- 3.02.6.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
- 3.02.6.6 The Work includes the following:
 - 3.02.6.6.1 Complete commissioning of all network visible object types according to the procedures outlined in Section 25 08 00, using the relevant Commissioning Forms for each BACnet Object Types.
 - 3.02.6.6.2 Verify all network visible BACnet Object Types correctly display the same information on the Division 25 BAS Contractor Front End as is being displayed on the equipment local interface. All network visible objects shall be commissioned.
 - 3.02.6.6.3 Commission the BACnet MS/TP network connection to the Division 25 BACnet/IP device.
 - 3.02.6.6.4 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
 - 3.02.6.6.5 The process shall be overseen by Lake County BAS Consultant.
 - 3.02.6.6.6 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.02.6.6.7 The following special provisions apply to the commissioning Work.
 - 3.02.6.6.7.1 Commission the Firefighter's Override Connection as part of the UL-864 UUKL commissioning Work per 25 08 03.

End of Section

25 20 28.31.11 INTEGRATED AUTOMATION – BACNET INTERFACE DEVICE (GATEWAYS/NATIVE BACNET DEVICES) – JCI/SIMPLEX FIRE DETECTION AND ALARM (ALL TYPES)

1 - GENERAL

1.01 Scope of Work

- 1.01.1 This Specification section outlines the Work requirements for the Division 25 BAS Contractor, Division 26 and JCI/Simplex Fire Alarm Equipment Supplier (referred to in this Specification section as the Equipment Supplier) responsible for the BACnet Interface Device for this equipment outlined in this section.
- 1.01.2 The General Contractor shall convene a meeting with all other Division 25 BAS Contractors (and/or Manufacturer's representative) who are supplying equipment to coordinate Work for this BACnet Interface Device.
- 1.01.3 The Owner or his designated representative shall be present at this meeting. Division 25 BAS Contractor shall attend this meeting.
- 1.01.4 Each Division 25 BAS Contractor and/or Equipment Supplier providing BACnet Interface Device(s) in this section shall provide the Owner and all other effected Division 25 BAS Contractors, with details of the proposed interface, including:
 - 1.01.4.1 PICS for BACnet equipment detailed the BACnet BIBBs, BACnet Object Types and BACnet services supported.
 - 1.01.4.2 If a gateway provide details on the proprietary protocol used in the Equipment Supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.
 - 1.01.4.3 Hardware and software object list using the object list in this section as a guide. This would include object instances for BACnet, register mapping numbers for Modbus, SNVTs for LonMark or other identifiers.
 - 1.01.4.4 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.
 - 1.01.4.5 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).
 - 1.01.4.6 Equipment installation and mounting requirements if the device is not integral to the Equipment Supplier's equipment.
 - 1.01.4.7 AutoCAD files to be used to create the BAS graphics.
 - 1.01.4.8 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.
- 1.01.5 Once this information is reviewed and approved, the Equipment Supplier shall provide a formal Submittal on the BACnet Interface Device via the Shop Drawing process.
- 1.01.6 Submittals for these products shall not be approved prior to the completion of this meeting.
- 1.01.7 If the Equipment Supplier is providing a BACnet gateway device from an OEM Equipment Supplier that maps proprietary points to BACnet Object Types, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.
- 1.01.8 The BACnet Interface Device shall permit Division 25 BAS Contractor to plot the BACnet objects into a graphic on his non-UL Front End. The Owner shall be able to monitor alarms and events and will be able to have control over objects as permitted by the Equipment Supplier of the BACnet Interface Device(s).

1.02 Shop Drawings

- 1.02.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS device network in the Work per the list above.

1.03 BACnet Interface Device Type

- 1.03.1 This BACnet Interface Device shall be provided as:
 - 1.03.1.1 Single On-board BACnet Interface Device Type:
 - 1.03.1.1.1 This device has a Single BACnet Interface that represents the network of Modbus devices as virtual BACnet devices.

- 1.03.2 Equipment Supplier is responsible for updating this BACnet Interface Device with new or altered Fire Alarm BACnet objects required for the new Work.
 - 1.03.2.1 The *Basis of Design* is the Simplex 4100U UL864 UUKL Listed FieldServer.
 - 1.03.2.1.1 The Owner prefers that all panel and field device (zone) points are available on one BACnet Interface Device. If the points from the network of main fire alarm control panels are only available in that device and are not passed on the proprietary fire alarm panel network, Supplier shall provide a BACnet Interface Device at each fire alarm control panel.
 - 1.03.2.1.2 All references in this section to Equipment Supplier shall be to Simplex Chicago Branch who is responsible for providing updates to the existing building Fire Alarm system in the Work.
 - 1.03.2.1.3 The Equipment Supplier's device shall only permit one-way outbound communications as the network connection is a non-UL connection.
- 1.03.3 The demarcation of Work responsibilities between Division 25 BAS Contractor and other Divisions for this device shall be as outlined in the BACnet Single Line Diagram and Responsibility Matrix.
- 1.03.4 Division 26 is responsible for providing power to this device alone or to multiple devices if power cannot be provided via a single point of connection.
- 1.03.5 The Lake County BAS Consultant shall verify network connectivity to the device. Verifying network connectivity only includes the requirement to check that the device responds correctly to the BACnet WhoIs/IAm and the BACnet WhoHas/IHave services.
- 1.03.6 Division 25 BAS Contractor shall map the added or altered points from the JCI/Simplex BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.03.6.1 Division 25 BAS Contractor shall map the points from this BACnet Interface Device to BACnet AVs, BVs and MSVs into a BAS device so graphics, trends, alarms and schedules can be provided for these mapped points.
 - 1.03.6.2 Division 25 shall create graphics, set up trends or add schedules for this BACnet Interface Device per the requirements in Division 25.
- 1.03.7 JCI/Simplex shall work with ALC and JCI to connect Simplex Zone 09 from JCI's existing BAS panel to ALC's new BAS panel that controls AHU05.
- 1.03.8 JCI/Simplex shall work with ALC and JCI to connect Simplex Zone 10 from JCI's existing BAS panel to ALC's new BAS panel that controls AHU07.
- 1.04 **Work By Others for this BACnet Interface Device**
 - 1.04.1 References to Division 23 shall be interpreted to mean Divisions 21, 22 and 23 or the Mechanical Contractor.
 - 1.04.2 References to Division 26 shall be interpreted to mean Divisions 26, 27 and 28 or the Electrical Contractor.
 - 1.04.3 References to other MasterFormat Latest Edition Divisions shall be interpreted to mean the Contractor responsible for supplying and installing the equipment for this Division.
- 1.05 **Related Division 25 Sections that Apply to the Work of this Specification Section**
 - 1.05.1 25 00 11 Integrated Automation – General Requirements – Summary Of Work
 - 1.05.2 25 00 13 Integrated Automation – General Requirements – All Trades Work Responsibilities
 - 1.05.3 25 00 33 Integrated Automation - General Requirements - Submittal Procedures
 - 1.05.4 25 00 42 Integrated Automation - General Requirements – References
 - 1.05.5 25 00 75 Integrated Automation - General Requirements - Starting & Adjusting
 - 1.05.6 25 00 77 Integrated Automation - General Requirements - Closeout Procedures
 - 1.05.7 25 00 78 Integrated Automation - General Requirements - Closeout Submittals
 - 1.05.8 25 00 79 Integrated Automation – General Requirements - Demonstration & Training
 - 1.05.9 25 05 01 Integrated Automation - Common Work Results - General
 - 1.05.10 25 05 05 Integrated Automation - Common Work Results - Device Interface Integration
 - 1.05.11 25 05 13 Integrated Automation - Common Work Results - Conductors & Cables
 - 1.05.12 25 05 26 Integrated Automation - Common Work Results - Grounding & Bonding
 - 1.05.13 25 05 28 Integrated Automation - Common Work Results - Pathways
 - 1.05.14 25 05 53 Integrated Automation – Common Work Results – Identification

- 1.05.15 25 06 00 Integrated Automation – Schedules
- 1.05.16 25 08 00 Integrated Automation - Controls Commissioning
- 1.05.17 25 08 03 Integrated Automation – BAS UL 864 UUKL Commissioning

2 - PRODUCTS

2.01 General

- 2.01.1 All sensors and transmitters provided in the Work by the Equipment Supplier shall meet the accuracy requirements of Division 26, 23 09 00.
- 2.01.2 Division 25 BAS Contractor (and/or Manufacturer's representative) equipment that comes with a BACnet Interface Device (a gateway or a native BACnet Interface Device), is responsible for the following:
 - 2.01.2.1 Configuration, programming, start-up and testing of the BACnet Interface Device to comply with this Section.
 - 2.01.2.2 Working with the Lake County BAS Consultant to commission the BACnet Interface Device once it is connected the Intranet at the Place of the Work.

2.02 BACnet Interface Device General Requirements

- 2.02.1 The BACnet Interface Device Equipment Supplier shall provide a BACnet/IP BACnet Interface Device complete with an Annex J router that to act as a client and/or server for all BACnet information from this device to the BAS.
- 2.02.2 The device shall support use of a static IP address for remote access through the Owner's firewall. Provision of remote access is not included in the Work.
- 2.02.3 The device shall have an open Ethernet port for connection to the network infrastructure (network connection to panel by the Owner). Co-ordinate network configuration requirements with the IT department through the Owner.
- 2.02.4 The BACnet Interface Device shall be a product that is manufactured directly by the Equipment Supplier or may be an OEM product that is supported by the Equipment Supplier.
 - 2.02.4.1 If the BACnet Interface Device Equipment Supplier is providing a device from an OEM Equipment Supplier, both Equipment Suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.
- 2.02.5 If the equipment interface is a native BACnet Interface Device, all objects shall be represented externally on the network using BACnet objects and services.
 - 2.02.5.1 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.6 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Equipment Supplier shall provide a network visible BACnet gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV, BV and MSV objects.
 - 2.02.6.1 Device data may be represented internally in the interface as Modbus register mappings, Lon SNVTs or proprietary points, but the data shall be represented externally on the network as BACnet objects that use standard BACnet services that comply with the BACnet Interoperability Building Blocks (BIBBs) listed in this Specification section. Device interfaces using proprietary protocols, LonWorks or Modbus are acceptable only on this basis.
 - 2.02.6.2 The exception is objects that are used by the Equipment Supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.
- 2.02.7 The following shall apply to BACnet Interface Devices that are exposing objects in Life Safety devices (e.g., the Fire Alarm panel).
 - 2.02.7.1 The JCI/Simplex BACnet Interface Device shall be a UL 864 listed device. The device shall present the BACnet objects in a UL 864 manner. The device shall permit uni-directional communications only.
 - 2.02.7.2 The JCI/Simplex device shall permit this Division 25 BAS Contractor to plot the BACnet objects in his non-UL Front End. The Division 25 BAS Contractor shall not be able to shut down or modify any values to any objects located the BACnet Interface Device.

- 2.02.8 BACnet/PTP devices used as gateways are not allowed in the Work without the written permission of the Owner.
 - 2.02.8.1 The following BACnet Interface Devices may be provided as BACnet/PTP:
 - 2.02.8.1.1 NONE.
 - 2.02.9 The BACnet Interface Device shall support the following BACnet Interoperability Building Blocks (BIBBs):
 - 2.02.9.1 Data Sharing - ReadProperty - B (DS-RP-B)
 - 2.02.9.2 Data Sharing - ReadPropertyMultiple - B (DS-RPM-B)
 - 2.02.9.3 Data Sharing - WriteProperty - B (DS-WP-B)
 - 2.02.9.4 Data Sharing - WritePropertyMultiple - B (DS-WPM-B)
 - 2.02.9.5 Alarm and Event - Notification Internal - B (AE-N-I-B)
 - 2.02.9.6 Alarm and Event - ACK - B (AE-ACK-B)
 - 2.02.9.7 Alarm and Event - Information - B (AE-INFO-B)
 - 2.02.9.8 Device Management - Dynamic Device Binding - B (DM-DDB-B)
 - 2.02.9.9 Device Management - Dynamic Object Binding - B (DM-DOB-B)
 - 2.02.9.10 Device Management - DeviceCommunicationControl - B (DM-DCC-B)
 - 2.02.9.11 Device Management - TimeSynchronization - B (DM-TS-B)
 - 2.02.9.12 Device Management - UTCTimeSynchronization - B (DM-UTC-B)
 - 2.02.9.13 Device Management - ReinitializeDevice - B (DM-RD-B)
 - 2.02.9.14 Device Management - Restart - B (DM-R-B)
 - 2.02.10 All BACnet Interface Devices shall utilize the BACnet standard profile fault codes enumerated for the applicable device. The fault code values between zero and two fifty five (0 and 255) are reserved for BACnet standard fault codes and all values above two fifty five (255) are open to Manufacturer value added codes.
 - 2.02.11 The BACnet Interface Device shall support the following Object types:
 - 2.02.11.1 Analog Input
 - 2.02.11.2 Analog Output
 - 2.02.11.3 Analog Value
 - 2.02.11.4 Binary Input
 - 2.02.11.5 Binary Output
 - 2.02.11.6 Binary Value
 - 2.02.11.7 Device Object
 - 2.02.11.8 Multi-state Input
 - 2.02.11.9 Multi-state Output
 - 2.02.11.10 Multi-state Value
 - 2.02.12 The BACnet Interface Device shall support the required optional properties to comply with the Specification requirements and Control Sequences outlined in the Contract Documents.
 - 2.02.13 Division 25 BAS Contractor is responsible for providing an account and a password to the Equipment Supplier of any BACnet MS/TP or IP device provided as part of the Work so the Equipment Supplier can view and change parameters of objects for that device. Access is restricted to the graphics, trends, alarms and schedules created for the device or devices provided in the Work. Division 25 BAS Contractor shall provide an audit log of any transactions for review by the Owner. Division 25 BAS Contractor is not responsible for any equipment damage or problems as a result of the actions taken by the Equipment Supplier.
 - 2.02.14 Equipment Supplier shall provide up to five (5) accounts and passwords to Owner to access the BACnet Interface Device, including one account that give administrative rights.
- 2.03 **Requirements for mapping Fire Alarm points from the Simplex Fieldserver to the ALC Fire Alarm BACnet Interface Device.**
- 2.03.1 The Interface Device Equipment Supplier shall map the following points generated by this typical sequence as BACnet objects to the Fire Alarm Panel BACnet gateway. The Controls Division 25 BAS Contractor responsible for creating graphics shall use the existing floor plan graphics for the building to show the location of the Fire Alarm control panels and devices as installed in the building. Fire Alarm Division 25 BAS Contractor shall co-operate with this Division 25 BAS Contractor to provide the required information on Fire Alarm Panels and devices. These requirements represent the minimum

requirements. The Interface Device Equipment Supplier shall provide a final version of points to be mapped to the gateway as a Shop Drawing.

- 2.03.1.1 Abnormal circuit conditions as required for the class and style of the circuit that initiate a "trouble" condition at the control panels and remote annunciators for that specific circuit.
- 2.03.1.2 Devices in an abnormal state that initiate a "trouble" condition at the control panels and remote annunciators for that specific device. The "trouble" indication that describes the nature of the condition, shall pass the specific address and alpha-numeric description of the device affected.
- 2.03.1.3 The closed position of a sprinkler system control valve that indicates a valve specific "supervisory" condition at the control panels and remote annunciators.
- 2.03.1.4 Activation of any pull station, duct smoke detector, space smoke detector, heat detector, device monitoring water-flow in the sprinkler system, or device monitoring activation of any suppression system that initiates a device specific "alarm" condition at the control panels and remote annunciators by device address and by device location label.
- 2.03.1.5 The activation of any smoke detector that causes the Fire Alarm Control Panel (FACP) to begin an alarm verification cycle. The FACP delays the activation of the alarm for a specified period of time. During this alarm delay, the activation of any other smoke detector or any manual station, heat detector or sprinkler flow (or pressure) switch
- 2.03.1.6 will confirm the alarm. If a second device does not activate during the delay, the FACP will reset and begin a confirmation cycle. During this confirmation cycle, the activation of any device shall activate and alarm the system. Alarm signals are "locked-in."
- 2.03.1.7 Activation of any supply duct smoke detector and/or return duct smoke detector shall shut down the affected HVAC unit. The Division 25 BAS Contractor shall use this alarm to shut down the HVAC unit in software to mirror the hardwired shutdown.
- 2.03.1.8 Activation of any water-flow monitoring device shall activate a local audible alarm in accordance with NFPA 13. The Division 25 BAS Contractor shall use this alarm to generate a critical alarm on the BAS.
- 2.03.1.9 Activation of a heat detector in an elevator machine room or elevator shaft where such areas are protected by automatic sprinklers will shut down of the power to the affected elevator controllers.
- 2.03.1.10 Adjacent floor operation includes audible and visual alarms and voice commands to the floor where the initiating device is located and to the floor above and the floor below. Smoke control signals shall be provided for smoke evacuation on the floor of the alarm and pressurization of the floor above and the floor below. The Division 25 BAS Contractor shall use this alarm to shut down the HVAC unit in software to mirror the hardwired shutdown.
- 2.03.1.11 The manual microphone in the will select notification device speakers on individual floors, individual stairs, elevator banks or all floors simultaneously by means of clearly labelled toggle switches in the control panel. Three pairs of communication wires (for 1-way and 2-way communications) shall be routed from the fire control panel to each elevator machine room under the Fire Alarm Work.
- 2.03.1.12 Activation of the fire pump run, or fire pump trouble inputs will indicate an address specific "supervisory" condition at the FACP and remote annunciators and shall transmit a general "supervisory" condition to a UL listed central station.
- 2.03.1.13 Activation of the following devices will be recognized and annunciated by the system as fire alarms:
 - 2.03.1.13.1 System-type smoke detectors, including in-duct smoke detectors.
 - 2.03.1.13.2 Manual fire alarm pull stations
 - 2.03.1.13.3 Heat detectors.
 - 2.03.1.13.4 Waterflow switches.
 - 2.03.1.13.5 Devices monitoring actuation of special fire suppression systems.
- 2.03.1.14 Supervisory Signals
 - 2.03.1.14.1 The following conditions shall be recognized and annunciated by the system as supervisory signals:
 - 2.03.1.14.1.1 Sprinkler control valve supervisory switch actuation.
 - 2.03.1.14.1.2 Fire pump supervisory signals (pump running, AC power loss, phase reversal and pump fail).

- 2.03.1.14.1.3 Emergency generator running.
- 2.03.1.14.1.4 Emergency generator failure.
- 2.03.1.15 The FACP will recognize and annunciate initiating device and signalling line circuit trouble conditions for the style of circuits utilized. All other fire alarm and two-way telephone communication circuits shall be supervised for opens or grounds.
- 2.03.1.16 The system shall also recognize and annunciate the following trouble conditions:
 - 2.03.1.16.1 Power supply trouble conditions as required by Specification.
 - 2.03.1.16.2 Remote annunciation device trouble conditions as required by Specification.
- 2.03.1.17 Silencing of integral audible devices will be recognized and annunciated by the system as operator acknowledgement of the signal(s) displayed.
- 2.03.2 See Contract Documents and Simplex Fire Alarm Submittal for the changes to the existing fire alarm system points that need to be mapped to the existing FieldServer BACnet gateway as BACnet AV, BV and MSV objects by Simplex. Division 25 BAS Contractor shall use this Points List as a guide when submitting the proposed points list as a Shop Drawing for approval by the Owner.
- 2.03.3 Allow for mapping an additional 100 new or altered points to an ALC device from the Simplex Fieldserver.
- 2.03.4 The ALC device that maps in these new and existing Fire Alarm points from the Simplex Fieldserver installed in the Babcox Justice Complex shall be a UL 864 UUKL 10th Edition listed device.

3 - EXECUTION

3.01 BACnet Interface Device Installation and Commissioning: BACnet/IP requirements

- 3.01.1 The following BACnet Interface Devices described in this Section shall reside on the Owner's network as a BACnet/IP device.
 - 3.01.1.1 Simplex Fire Alarm Panel BACnet Interface Device updates to the existing FieldServer gateway.
- 3.01.2 The Owner will arrange for the following:
 - 3.01.2.1 The IT department shall provide a static IP address for the BACnet/IP BACnet Interface Device.
 - 3.01.2.2 The IT department will assist with the commissioning of the network connection with this Division 25 BAS Contractor and the BACnet Interface Device Equipment Supplier. The Owner and designated personnel are only responsible for providing the termination to the building switch in the Comms room and for ensuring that the IP connection to the Intranet is operational.
 - 3.01.2.3 The Owner shall provide the passwords and access levels required for the Work.
- 3.01.3 The Equipment Supplier shall provide the following:
 - 3.01.3.1 A fully operational BACnet/IP BACnet Interface Device that networks to all BACnet MS/TP devices provided in the Work of this section (if any MS/TP devices are provided). BACnet/IP devices shall meet the following requirements:
 - 3.01.3.1.1 BACnet/IP device shall include an Annex J B/IP router to support BACnet/IP to act as a client and/or server for all BACnet information from the supplied equipment to the BAS Device Network, which is considered a "directly connected network".
 - 3.01.3.1.2 The BAS Device Network is treated as a "remote network" that is reachable by communicating using BACnet/IP with a router supplied by others that serves the remote network.
 - 3.01.3.1.3 The BACnet/IP device shall come complete with a BBMD that will be configured to traverse IP subnets.
 - 3.01.3.1.4 The interface shall have an open Ethernet RJ-45 port for connection to the BAS device network infrastructure using communications cabling that complies with the TIA/EIA 568-B standard or the requirements of Division 27.
 - 3.01.3.1.5 The interface shall operate at a minimum of 10 Mbps, full duplex.

- 3.01.3.2 A complete BACnet Interface Device Submittal for approval by the Lake County BAS Consultant. The equipment order will not be released to production until the BACnet Interface Device Submittal is approved.
- 3.01.3.3 BACnet objects shall follow the naming convention outlined in 25 05 53 Identification. Cryptic object names and devices that do not support the addition of the Lake County object name prefix will not be allowed in the Work.
- 3.01.3.4 Configuration of the device with the assigned IP address.
- 3.01.3.5 Connection of the IP network cable to the BACnet Interface Device.
- 3.01.3.6 Commission the final network connection to the Owner's network.
- 3.01.3.7 Creation and assignment of passwords and access levels within the device.
- 3.01.3.8 Provide material so Division 25 BAS Contractor can create a graphic that matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.3.8.1 Provide manuals and troubleshooting guides in pdf format suitable for ALC Chicago to add as graphic links in the Front End.
 - 3.01.3.8.2 Provision of paper documents requiring scanning and post processing by Division 25 BAS Contractor is not allowed.
- 3.01.3.9 Provide the necessary programming in the BACnet/IP device per the Sequences of Operations documents:
 - 3.01.3.9.1 Consultant's Plans and Specifications.
- 3.01.3.10 Participating in the commissioning process as outlined in this Division.
- 3.01.4 Division 27 shall provide the following:
 - 3.01.4.1 A schedule as to when the networking requirements need to be completed. See the Division 25 BAS Contractor Submittal section for this information to be provided as a Shop Drawing.
 - 3.01.4.2 A network drop from the designated Comms closet to within 1 m [3 ft.] of the BACnet Interface Device location. Install and test cable per this Division.
- 3.01.5 Division 25 BAS Contractor is responsible for the following:
 - 3.01.5.1 Mapping all the BACnet Object Types approved in the Submittal process from the Equipment Supplier's BACnet Interface Device to the Division 25 BAS Contractor's Division 25 BAS Contractor supplied BACnet/IP device so the mapped points are accessible using the Division 25 BAS Contractor's Front End.
 - 3.01.5.2 Creating, displaying and testing the alarms, schedules and trends. The following minimums apply to this Section:
 - 3.01.5.2.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.
 - 3.01.5.2.2 A minimum of 1 schedule.
 - 3.01.5.2.3 A minimum of 10 Extended Trends.
 - 3.01.5.3 Creating the Front End graphics using the object list and other materials provided by the Equipment Supplier.
 - 3.01.5.4 See 25 15 11.01 for expected level of graphics to be provided.
 - 3.01.5.5 The following minimum requirements apply to the BACnet Interface Device in this Section:
 - 3.01.5.5.1 Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.5.5.2 Provide one master alarm graphic showing the critical alarms and all equipment fault alarms.
 - 3.01.5.5.3 Use the graphics material provided by the Equipment Supplier or create a graphic from the Division 25 BAS Contractor's available graphics library that most closely matches the device. Emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS Front End.
 - 3.01.5.5.4 Provide an additional sub-graphic for each group of fifty (50) BACnet Object Types to be mapped from the BACnet Interface Device to the Front End. Providing this

- information as a table of BACnet objects complete with their Present_Values that is a sub-graphic to this graphic is sufficient.
- 3.01.5.5.5 Where a table of Object Types is not provided in this section, allow for a minimum of one hundred (100) objects to be mapped.
 - 3.01.5.5.6 Provide ten (10) points to be used by Owner to monitor energy and power information. Lake County BAS Consultant will designate the points for this Work.
 - 3.01.5.5.7 Provide a link in the graphic to the embedded Webserver if Equipment Supplier provides this device.
- 3.01.5.6 Participating in the commissioning process as outlined in this Division.
- 3.01.6 Equipment Supplier is responsible for the following:
- 3.01.6.1.1 Equipment Supplier is responsible for mapping all the points approved in the Submittal process to BACnet object types into an Equipment Supplier supplied BACnet Interface Device.
 - 3.01.6.1.2 Equipment Supplier is responsible for commissioning this device by ensuring the device and its objects can be discovered by using BACnet services.
 - 3.01.6.1.3 Participating in the commissioning process as outlined in this Division.
- 3.01.7 The BACnet Interface Device to the Equipment Supplier's BACnet, Modbus or proprietary protocol Device shall be jointly commissioned by Equipment Supplier, Division 25 BAS Contractor and Lake County BAS Consultant to the satisfaction of the Owner. The Work includes the following:
- 3.01.7.1 All parties shall each allow sixteen (16) hours of technician on-site time for this Work (excluding travel to and from the Work) for all devices. This is in addition to any other commissioning requirements called up in the Contract Documents.
 - 3.01.7.2 Equipment Supplier shall provide written confirmation that the BACnet Interface Device is ready for commissioning.
 - 3.01.7.3 The purpose of this BACnet Interface Device commissioning process is to verify communications with the BACnet Interface Device, not to verify equipment operation. This commissioning process shall be done after the equipment Verification Report has been accepted.
 - 3.01.7.4 The commissioning process shall be overseen by the Lake County BAS Consultant.
 - 3.01.7.5 Provide confirmation via the Shop Drawing process before the Work starts. Any variations shall be approved via the Shop Drawing process.
 - 3.01.7.6 Use the commissioning procedures outlined in this Division.
 - 3.01.7.7 Commissioning of hardwired points in the Equipment Supplier's BACnet Interface Device.
 - 3.01.7.7.1 All hardwired points shall be commissioned using the forms and procedures in 25 08 00.
 - 3.01.7.8 Commissioning of network visible object types in the Equipment Supplier's BACnet Interface Device.
 - 3.01.7.8.1 Complete commissioning of a minimum of 20% and up to fifty (50) of the network visible object types selected by the Lake County BAS Consultant.
 - 3.01.7.8.2 Lake County BAS Consultant shall provide a commissioning form that will list the points to be tested and commissioned.
 - 3.01.7.8.3 If the Owner deems that there are problems with the device and/or points, the Owner reserves the right to extend the commissioning time allocation to test and commission additional points as required.
 - 3.01.7.9 Verify all network visible BACnet Object Types correctly display the same information on the Front End as is being displayed on the equipment local interface.
 - 3.01.7.10 Parse all equipment packaged controls alarms, trends and schedules that are represented as AV, BV and MSV BACnet Object Types by the equipment BACnet Interface Device.
 - 3.01.7.11 Assist Division 25 BAS Contractor to integrate this system into the building-wide BACnet Internetwork.
 - 3.01.7.12 Other duties as deemed necessary by the Owner to complete the Work within the allocated hours of technician time.
 - 3.01.7.13 The following special provisions apply to the commissioning Work.

- 3.01.7.13.1 The commissioning process shall include the verification of Fire Alarm zones added and/or modified as part of the Work. The Simplex representative shall test these points to verify that the original 2009 sequence that required the BAS to respond to a space smoke detector in alarm works to the satisfaction of the AHJ.
- 3.01.7.13.2 This Work shall be done after the Fire Alarm Verification Report has been accepted.
- 3.01.7.13.3 The Fire Alarm Contractor and the Division 25 BAS Contractor shall jointly participate in the commissioning process.
- 3.01.7.13.4 The process shall be overseen by Lake County BAS Consultant.

3.02 BACnet Interface Device Installation and Commissioning: BACnet MS/TP requirements

- 3.02.1 BACnet MS/TP BACnet Interface Devices are not allowed in the Work.

End of Section