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NAVFAC NW **NFGS-23 09 23.02 24 (November 2018)**
based on UFGS-23 09 23.02 (November 2015)

Preparing Activity: NAVFAC NW **Superseding**
NFGS-23 09 23.02 24 (August 2018)
Prior NFGS-23 09 23.13 24 (Sept 2016)
UFGS-23 09 23 (May 2011)
UFGS-23 09 23.13 20 (August 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2018
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SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 09 23.02 24

BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS
(NAVFAC NW)

-- End of Section Table of Contents --

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SECTION 23 09 23.02 24

BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS
(NAVFAC NW)
NAVFAC NW Version 1.0; issued 11/27/2018

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NOTE: This guide specification covers the requirements for protocol-specific requirements for a Direct Digital Control (DDC) building control system based on the ASHRAE 135 protocol, including the NAVFAC NW requirement to use the Niagara Framework.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be as a Criteria Change Request (CCR). Recommended changes pertinent to the NAVFAC NW version of this specification should be sent to Kimberly Paulson of the NAVFAC NW Capital Improvements CI4 (Design) Mechanical Engineering Branch. Please contact her at (360) 315-4451 or kimberly.paulson@navy.mil with any comments or questions.
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NOTE: The use of this UFGS, and the design of BACnet Control Systems, must be in accordance with UFC 3-410-02, DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. This specification

MUST be used in conjunction with UFGS 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC in order to specify a complete and functional system.

Edit this guide specification for project specific requirements ONLY by selecting appropriate tailoring options, choosing applicable items(s), or inserting appropriate information in bracketed items. Do not make edits outside of bracketed items without prior approval as specified in UFC 3-410-02.

When used with UFGS 23 09 00, this specification covers installation of local (building-level) controls using BACnet-based DDC. It is primarily intended for building level control systems which are to be integrated into a Utility Monitoring and Control System (UMCS) as specified in Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION (NAVFAC NW).

Template drawings in electronic format for use with this section are available in the listing for UFGS 23 09 00 online at: https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables

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PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, except for the front end which is specified in Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL (UMCS) FRONT END AND INTEGRATION (NAVFAC NW), suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and shown and in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.1.1 System Requirements

Provide a system meeting the requirements of both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section and with the following characteristics:

a. Except for Gateways, the control system must be an open implementation of BACnet technology using ASHRAE 135 and Fox as the communications protocols. The system must use standard ASHRAE 135 Objects and Properties and the Niagara Framework. The system must use Niagara Framework exclusively for communication over the network. Gateways to packaged units must communicate with other DDC hardware using ASHRAE 135 or the Fox protocol exclusively and may communicate with packaged equipment using other protocols. The control system must be installed such that any two ASHRAE 135 devices on the internetwork can communicate using standard ASHRAE 135 Services.

b. Install and configure control hardware to provide ASHRAE 135 Objects and Properties or Niagara Framework Objects as indicated and as needed to meet the requirements of this specification.

c. Use Niagara Framework hardware and software exclusively for scheduling, trending, and communication with a front end (UMCS IP) network. Use Niagara Framework for alarming. Use the Fox protocol for all communication between Niagara Framework Supervisory Gateways; use the ASHRAE 135 protocol for all other building communication. Niagara Framework Supervisory Gateway must serve web pages as specified.

e. Niagara Framework Engineering Tool version provided by the Contractor must be compatible with the version of the Niagara Operations Server at the time of commissioning.

1.1.2 Verification of Specification Requirements

Review all specifications related to the control system installation and advise the Contracting Officer of any discrepancies before performing any work. If Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC or any other Section referenced in this specification is not included in the project specifications advise the Contracting Officer and either obtain the missing Section or obtain Contracting Officer approval before performing any work.

1.2 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135	(2016) BACnet—A Data Communication Protocol for Building Automation and Control Networks

BACNET INTERNATIONAL (BTL)

BTL Guide	(v.49; 2017) BACnet Testing Laboratory Implementation Guidelines

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	(2018) Ethernet

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-485	(1998a; R 2012) Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

TRIDIUM, INC (TRIDIUM)

Niagara Framework	(2012) NiagaraAX User's Guide

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 916	(2007; Reprint Aug 2014) Standard for Energy Management Equipment

1.3 DEFINITIONS

For definitions related to this section, see Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.4 SUBMITTALS

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NOTE: Submittals related to this section are specified in UFGS 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. UFGS 23 09 00 MUST be used with this specification to have a complete specification.
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Submittal requirements related to this Section (other than those listed below) are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

SD-03 Product Data

Network UMCS Hardware and Software Inventory; G-CIO

SD-05 Design Data

Project UMCS Plan; G-CIO

PART 2 PRODUCTS

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements of both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1 NETWORK HARDWARE

2.1.1 BACnet Router

All BACnet Routers must be BACnet/IP Routers and must perform layer 3 routing of ASHRAE 135 packets over an IP network in accordance with ASHRAE 135 Annex J and Clause 6. The router must provide the appropriate connection to the IP network and connections to one or more ASHRAE 135 MS/TP networks. Devices used as BACnet Routers must meet the requirements for DDC Hardware, and except for Niagara Framework Supervisory Gateways, devices used as BACnet routers must support the NM-RC-B BIBB.

2.1.2 BACnet Gateways

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NOTE: Tailoring options in this subpart are requirements specific to Niagara Framework. Deselect the NIAGARA FRAMEWORK tailoring if the project does not employ Niagara Framework.
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Gateways should be used only for the integration of a single piece of equipment. Gateways should not be used to permit the installation of new, non-ASHRAE 135 networks.
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In addition to the requirements for DDC Hardware, the BACnet Gateway must be a Niagara Framework Supervisory Gateway or must meet the following requirements:

a. It must perform bi-directional protocol translation from one non-ASHRAE 135 protocol to ASHRAE 135. BACnet Gateways must incorporate a network connection to an ASHRAE 135 network (BACnet over IP in accordance with Annex J is allowed only between Niagara Framework Supervisory Gateway(s) and/or between Niagara Framework Supervisory Gateway(s) and the UMCS IP network switch; otherwise, all communication shall be MS/TP) and a separate connection appropriate for the non-ASHRAE 135 protocol and media.

b. It must retain its configuration after a power loss of an indefinite time, and must automatically return to their pre-power loss state once power is restored.

c. It must allow bi-directional mapping of data between the non-ASHRAE 135 protocol and Standard Objects as defined in ASHRAE 135. It must support the DS-RP-B BIBB for Objects requiring read access and the DS-WP-B BIBB for Objects requiring write access.

d. It must support the DS-COV-B BIBB.

Although Gateways must meet DDC Hardware requirements, except for Niagara Framework Supervisory Gateways, they are not DDC Hardware and must not be used when DDC Hardware is required. (Niagara Framework Supervisory Gateways are both Gateways and DDC Hardware.)

2.2 CONTROL NETWORK WIRING

a. BACnet MS/TP communications wiring must be in accordance with ASHRAE 135. The wiring must use shielded, three wire (twisted-pair with reference) cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors must be less than 100 pF per meter 30 pF per foot. All wiring or cable used for control network wiring shall be purple (Pantone 269C).

b. Building Control Network Backbone IP Network must use Ethernet media. Ethernet cables must be CAT-6 at a minimum and meet all requirements of IEEE 802.3 [and [_____]]. Ethernet cables shall be purple (Pantone 269C).

2.3 DIRECT DIGITAL CONTROL (DDC) HARDWARE

2.3.1 General Requirements

All DDC Hardware must meet the following requirements:

a. It must be locally powered and must incorporate a light to indicate the device is receiving power.

b. It must conform to the BTL Guide.

c. It must be BACnet Testing Laboratory (BTL) Listed.

d. The Manufacturer's Product Data submittal for each piece of DDC Hardware must include the Protocol Implementation Conformance Statement (PICS) for that hardware as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

e. It must communicate and be interoperable in accordance with ASHRAE 135 and have connections for BACnet IP or MS/TP control network wiring.

f. Other than devices controlling terminal units or functioning solely as a BACnet Router, it must support DS-COV-B, DS-RPM-A and DS-RPM-B BIBBs.

g. Devices supporting the DS-RP-A BIBB must also support the DS-COV-A BIBB.

h. Application programs, configuration settings and communication information must be stored in a manner such that they persist through loss of power:

(1) Application programs must persist regardless of the length of time power is lost.

(2) Configured settings must persist for any loss of power less than 2,500 hours.

(3) Communication information, including but not limited to COV subscriptions, event reporting destinations, Notification Class Object settings, and internal communication settings, must persist for any loss of power less than 2,500 hours.

i. Internal Clocks:

(1) Clocks in DDC Hardware incorporating a Clock must continue to function for 120 hours upon loss of power to the DDC Hardware.

(2) DDC Hardware incorporating a Clock must support the DM-TS-B or DM-UTC-B BIBB.

j. It must have all functionality indicated and required to support the application (Sequence of Operation or portion thereof) in which it is used, including but not limited to providing Objects or Niagara Framework Points as specified and as indicated on the Points Schedule.

k. In addition to these general requirements and the DDC Hardware Input-Output (I/O) Function requirements, all DDC Hardware must also meet any additional requirements for the application in which it is used (e.g. scheduling, alarming, trending, etc.).

l. It must meet FCC Part 15 requirements and have UL 916 or equivalent safety listing.

m. Except for Niagara Framework Supervisory Gateways, device must support Commandable Objects to support Override requirements as detailed in PART 3 EXECUTION.

n. User interfaces which allow for modification of Properties or settings must be password-protected.

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NOTE: Select whether to allow devices using 2-wire (twisted pair with shield) media.

The use of devices using 3-wire (twisted pair with reference and shield) MS/TP media is generally preferable, particularly where long MS/TP runs are required, or in electrically noisy environments. However, many vendors do not offer devices supporting 3-wire media, and requiring use of 3 wire media will overly limit competition.

Unless the use of 3-wire devices is specifically required for the project, keep the bracketed text to allow the use of 2-wire devices.

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o. Devices communicating BACnet MS/TP must meet the following requirements:

(1) Must have a configurable Max_Master Property.

(2) DDC Hardware other than hardware controlling a single terminal unit must have a configurable Max_Info_Frames Property.

(3) Must respond to any valid request within 50 msec with either the appropriate response or with a response of "Reply Postponed".

(4) Must use twisted pair with reference and shield (3-wire media) wiring[, or twisted pair with shield (2-wire media) wiring and use half-wave rectification].

p. Devices communicating BACnet/IP must use UDP Port 0xBAC0. Devices with configurable UDP Ports must default to 0xBAC0.

q. Device IDs, Network Numbers, and BACnet MAC addresses of devices must

be fully configurable without limitation, except MS/TP MAC addresses may be limited by ASHRAE 135 requirements.

r. Except for Niagara Framework Supervisory Gateways, DDC Hardware controlling a single terminal unit must have:

(1) Objects (including the Device Object) with an Object Name Property of at least 8 characters in length.

(2) A configurable Device Object Name.

(3) A configurable Device Object Description Property at least 16 characters in length.

r. Except for Objects in either Niagara Framework Supervisory Gateways or DDC Hardware controlling a single terminal unit, all Objects (including Device Objects) must:

(1) Have a configurable Object Name Property of at least 12 characters in length.

(2) Have a configurable Object Description Property of at least 24 characters in length.

t. For programmable DDC Hardware, provide and license to the project site all programming software required to program the Hardware in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

u. For programmable DDC Hardware, provide copies of the installed application programs (all software that is not common to every controller of the same manufacturer and model) as source code compatible with the supplied programming software in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The submitted application program must be the complete application necessary for controller to function as installed and be sufficient to allow replacement of the installed controller with another controller of the same type.

2.3.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions must meet the following requirements:

2.3.2.1 Analog Inputs

DC Hardware analog inputs (AIs) must be implemented using ASHRAE 135 Analog Input Objects and perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in Section 23 09 00. Signal conditioning including transient rejection must be provided for each analog input. Analog inputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. The AI must incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10,000 ohms.

2.3.2.2 Analog Outputs

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NOTE: PART 3 of this section and the Points Schedules may require that points have an H-O-A switch. For analog outputs these switches may be "full on, full off" overrides or may have a knob allowing for override to any value (0-100 percent). Unless the project site specifically requires that analog outputs be fully adjustable through the range 0-100 percent, keep the bracketed text allowing either option (i.e. keep "to 0 percent and to 100 percent"). Requiring fully adjustable overrides (i.e. "through the range of 0 percent to 100 percent") will likely raise the cost of the system.

****

DDC Hardware analog outputs (AOs) must be implemented using ASHRAE 135 Analog Output Objects and perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mAdc or 0-10 Vdc. Analog outputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. DDC Hardware with Hand-Off-Auto (H-O-A) switches for analog outputs must provide for overriding the output [to 0 percent and to 100 percent][through the range of 0 percent to 100 percent].

2.3.2.3 Binary Inputs

DDC Hardware binary inputs (BIs) must be implemented using ASHRAE 135 Binary Input Objects and accept contact closures and must ignore transients of less than 5 milli-second duration. Protection against a transient 50VAC must be provided.

2.3.2.4 Binary Outputs

DDC Hardware binary outputs (BOs) must be implemented using ASHRAE 135 Binary Output Objects and provide relay contact closures or triac outputs for momentary and maintained operation of output devices. DDC Hardware with H-O-A switches for binary outputs must provide for overriding the output open or closed.

2.3.2.4.1 Relay Contact Closures

Closures must have a minimum duration of 0.1 second. Relays must provide at least 180V of isolation. Electromagnetic interference suppression must be provided on all output lines to limit transients to 50 Vac. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.4.2 Triac Outputs

Triac outputs must provide at least 180 V of isolation. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.5 Pulse Accumulator

DDC Hardware pulse accumulators must be implemented using either an ASHRAE 135 Accumulator Object or an ASHRAE 135 Analog Value Object where the Present_Value is the totalized pulse count. Pulse accumulators must

accept contact closures, ignore transients less than 5 msec duration, protect against transients of 50 VAC, and accept rates of at least 20 pulses per second.

2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs

The requirements for use of ASHRAE 135 objects for hardware input and outputs includes devices where the hardware sensor or actuator is integral to the controller (e.g. a VAV box with integral damper actuator, a smart sensor, a VFD, etc.)

[2.3.2.7 Integrated H-O-A Switches

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NOTE: Even if H-O-A switches are implemented, Requiring feedback of H-O-A status may seriously limit competition and raise project costs. Unless there is a specific project requirement for H-O-A feedback, remove the bracketed text.
****

Where integrated H-O-A switches are provided on hardware outputs, controller must provide means of monitoring position or status of H-O-A switch. This feedback may be provided via the Niagara Framework or via any valid BACnet method, including the use of proprietary Objects, Properties, or Services.

]2.3.3 Expansion Modules and Tethered Hardware

A single piece of DDC Hardware may consist of a base unit and also:

a. An unlimited number of hardware expansion modules, where the individual hardware expansion modules are designed to directly connect, both mechanically and electrically, to the base unit hardware. The expansion modules must be commercially available as an optional add-on to the base unit.

b. A single piece of hardware connected (tethered) to a base unit by a single cable where the cable carries a proprietary protocol between the base unit and tethered hardware. The tethered hardware must not contain control logic and be commercially available as an optional add-on to the base unit as a single package.

   Note that this restriction on tethered hardware does not apply to sensors or actuators using standard binary or analog signals (not a communications protocol); sensors or actuators using standard binary or analog signals are not considered part of the DDC Hardware.

Hardware capable of being installed stand-alone, or without a separate base unit, is DDC Hardware and must not be used as expansion modules or tethered hardware.

2.3.4 Supervisory Control Requirements

See Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM FRONT END AND INTEGRATION (NAVFAC NW) for supervisory controller requirements.

PART 3 EXECUTION

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NOTE: Use the bracketed text for retrofit projects only. For new construction, the existing conditions survey may not be required and may be removed (be sure to remove the report from the submittals as well). Keeping it as a requirement, however, will ensure that the Contractor checks the mechanical equipment prior to beginning controls installation. This should allow problems to be caught and addressed earlier.

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3.1 CONTROL SYSTEM INSTALLATION

3.1.1 Project UMCS Plan

Provide to the Government a summary of the project's control scope including planned UMCS IP network connectivity, desired centralized command and control functionality, systems in the UMCS (HVAC/DDC, SCADA, elevator, etc.), system protocol(s), and the general plan for system control system architecture. [This submittal is also required in 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEMS FRONT-END AND INTEGRATION (NAVFAC NW). Provide only one submittal.]

3.1.2 Niagara Framework Engineering Tool

NAVFAC NW currently has the Niagara Framework Engineering Tool.

3.1.3 Building Control Network (BCN)

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NOTE: Note that the term BCN is used across multiple specification including those using different protocols, and "network" is used in the generic sense to refer to the entire system. In BACnet this is called the Internetwork but the term BCN is still used for consistency across specification.

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Install the Building Control Network (BCN) as one or more BACnet MS/TP networks. Note that in some cases there may only be a single device on the BCN Backbone.

Except for the UMCS IP Network and as permitted for the non-BACnet side of Gateways, use exclusively ASHRAE 135 networks.

3.1.3.1 BACnet MS/TP Networks

Provide MS/TP networks in accordance with ASHRAE 135 and in accordance with the ASHRAE 135 figure "Mixed Devices on 3-Conductor Cable with Shield" (Figure 9-1.4 in the 2016 version of ASHRAE 135). Note that NAVFAC NW is aware that this ASHRAE 135 reference requires a separate common ground for all variable frequency drives installed on the same communication trunk or segment and will be inspecting for this common ground. Ground the shield at the BACnet Router and at no other point. Ground the reference wire at the BACnet Router through a 100 ohm resistor and do not ground it at any

other point. In addition:

a. Provide each segment in a doubly terminated bus topology in accordance with TIA-485.

b. Provide each segment with 2 sets of network bias resistors in accordance with ASHRAE 135, with one set of resistors at each end of the MS/TP network.

****

NOTE: 3-wire media (twisted pair with reference), which is required by this section, allows for both 2-wire and 3-wire MS/TP devices to co-exist on the same bus. Please refer to ASHRAE 135 (2012), subpart 9.2.2.1.1.4.

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c. Use 3 wire (twisted pair and reference) with shield media for all MS/TP media installed inside. Use fiber optic isolation in accordance with ASHRAE 135 for all MS/TP media installed outside buildings, or between multiple buildings.

d. For 18 AWG cable, use segments with a maximum length of 1200 m4000 ft. When using greater distances or different wire gauges comply with the electrical specifications of TIA-485.

e. For each controller that does not use the reference wire provide transient suppression at the network connection of the controller if the controller itself does not incorporate transient suppression.

f. Install no more than 32 unit loads or 96 total devices on each individual MS/TP segment. Each MS/TP trunk segment shall not have more than 32 consecutive devices without a supervisory controller, global controller, or BACNet repeater between each segment of devices. Do not use MS/TP to MS/TP routers.

g. Connect each MS/TP network to the BCN backbone via a Niagara Framework Supervisory Gateway configured as a BACnet Router.

h. For BACnet Routers, configure the MAC address of the Niagara Framework Supervisory Gateway to 0. Assign the MAC address of Global BACnet routers to 1. Assign MAC Addresses to other devices consecutively beginning at 2, with no gaps.

i. Max_Master Property shall be set to one device above the highest MAC address on the MS/TP segment.

j. The baud rate of the MS/TP network are allowed to be 76800 bps (recommended) or 115200.

k. Unsanctioned routers, including "dummy routers", and multi-network routers are not authorized on the network.

3.1.3.2 Building Control Network (BCN) Installation

Provide a building control network meeting the following requirements:

a. Install all DDC Hardware connected to the Building Control Network.

b. Where multiple pieces of DDC Hardware are used to execute one sequence, install all DDC Hardware executing that sequence on a single MS/TP network dedicated to that sequence.

c. Traffic between BACnet networks must be exclusively via BACnet routers.

d. Use the Fox protocol for all traffic both originating and terminating at Niagara Framework components. Use the Fox protocol for all traffic originating or terminating at a Niagara Framework UMCS (including traffic to or from a future UMCS). All other traffic, including traffic between ASHRAE 135 devices and traffic between Niagara Framework Supervisory Gateways and ASHRAE 135 devices must be in accordance with ASHRAE 135.

3.1.4 DDC Hardware

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NOTE: Indicate whether enclosures must be lockable. Nothing in the NW cybersecurity requirements require local DDC panels to be locked. This is because BACnet is not allowed to run on an IP network (it has already been deleted from the regional version of this specification). BACnet is only allowed on an MS/TP network so the panels can be locked if desired by client/command/PWD, but otherwise do not have to be. Locked enclosures in the NW AOR are specified in RGS 25 10 10.00 24 ONLY for the switch and the supervisory controller (also called the Niagara Framework Gateway or JACE) per the NW cybersecurity posture and have intrusion detection that alarms when opened. Locking the enclosures for general DDC terminations is normal in the industry and can be chosen below without concern.

All password control should be at the Niagara Framework Supervisory Controller and passwords are covered in UFGS 25 05 11 so direction should not be provided here regarding them.

****

Install all DDC Hardware that connects to an IP network in lockable enclosure. Install other DDC Hardware that is not in suspended ceilings in [lockable]enclosures.

a. Install all Tethered Hardware as close as possible to its base unit.

b. Install and configure all BTL-Listed devices in a manner consistent with their BTL Listing such that the device as provided still meets all requirements necessary for its BTL Listing.

c. Install and configure all BTL-Listed devices in a manner consistent with the BTL Device Implementation Guidelines such that the device as provided meets all those Guidelines.

3.1.4.1 Device Identifiers, Network Addresses, and IP addresses

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NOTE: Each device requires a unique DeviceID and each network requires a unique Network Number; a

BACnet system will not operate if there are duplicates. While it is a simple matter to ensure unique IDs for a single project, there is no mechanism in BACnet to avoid duplicates when a project is later integrated into an existing basewide UMCS.

The installation must manually track and manage DeviceIDs and Network Numbers among all their BACnet systems, networks, and devices. The UFC has information on suggested strategies. Coordinate with the installation and either instruct the contractor to coordinate with the installation, or provide ranges for DeviceIDs and Network Numbers. BACnet allows DeviceIDs in the range 0 - 4,194,302 and Network Numbers in the range 1 - 65,534.

Coordinate IP addresses with the installation or instruct the contractor to do so.

****

a. Do not use any Device Identifier or Network Number already used by another BACnet system at the project site. Coordinate Device IDs and Network Numbers with the installation via the Network UMCS Hardware and Software Inventory form. The Government will provide addresses specific to the control protocol for non-IP (MSTP, etc.) network devices. The Contractor shall submit the Network UMCS Hardware and Software Inventory spreadsheet (see 25 50 00.00 20 CYBERSECURITY OF FACILITY-RELATED CONTROL SYSTEMS for information) to CIO with the request for network addresses. The Government will return the spreadsheet to the Contractor with network addresses within 10 business days.[This submittal is also required in 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEMS FRONT-END AND INTEGRATION (NAVFAC NW). Provide only one submittal.]

3.1.4.2 ASHRAE 135 Object Name Property and Object Description Property

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NOTE: Tailoring options in this subpart are requirements specific to Niagara Framework. Deselect the NIAGARA FRAMEWORK tailoring if the project does not employ Niagara Framework.

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Configure the Object_Names and Object_Descriptions properties of all ASHRAE 135 Objects (including Device Objects) as indicated on the Points Schedule (Point Name and Point Description) and as specified in accordance with Appendix D of 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM FRONT-END AND INTEGRATION (NAVFAC NW). At a minimum:

a. Except for DDC Hardware controlling a single terminal unit, configure the Object_Name and Object_Description properties of all Objects (including Device Objects) as indicated on the Points Schedule and as specified.

b. In DDC Hardware controlling a single terminal unit, configure the Device Object_Name and Device Object_Description as indicated on the Points Schedule and as specified.

3.1.4.3 Niagara Framework Point Names and Descriptions

Configure the names and descriptions of all Points in Niagara Framework Supervisory Gateways per Appendix D of Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM FRONT-END AND INTEGRATION (NAVFAC NW).

3.1.4.4 Niagara Station IDs

Niagara Station IDs are issued by NAVFAC NW CIO in response to submitting the IP-Based UMCS Hardware and Software Inventory submittal in Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM FRONT-END AND INTEGRATION (NAVFAC NW).

[3.1.4.5 Hand-Off-Auto (H-O-A) Switches

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NOTE: See also DDC Hardware in PART 2.

NW has chosen to bracket this entire section as H-O-A switches should only be used when the requirement is absolutely necessary. If this section is kept, be sure the design drawings call out the HOA's specifically. It is best practice to use overrides in lieu of H-O-A switches. If H-O-A switches are specifically required by the project site it is best to indicate which points require H-O-A switches on the Points Schedules.

Note that many sequences already have H-O-A switch requirements for motors independent of any other H-O-A requirements.

Select the desired capability for external switches for analog outputs.

HOA switches deemed necessary for "critical" systems or systems with high security requirements, consider keeping the bracketed section requiring them to be in a locked enclosure with intrusion detection alarms similar to the supervisory controller in 25 10 10.00 24.

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Provide Hand-Off-Auto (H-O-A) switches as specified and as indicated on the Points Schedule. Provide H-O-A switches that are integral to the controller hardware, an external device co-located with (in the same enclosure as) the controller, integral to the controlled equipment, or an external device co-located with (in the same enclosure as) the controlled equipment.

a. For H-O-A switches integral to DDC Hardware, meet the requirements specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE.

b. For external H-O-A switches used for binary outputs, provide for overriding the output open or closed.

c. For eternal H-O-A switches used for analog outputs, provide for overriding [to 0 percent or 100 percent][through the range of 0 percent to 100 percent].

[d. Enclose H-O-A switches in a lockable enclosure with an intrusion detection alarm.

]]3.1.4.6 MS/TP Slave Devices

Configure all MS/TP devices as Master devices. Do not configure any devices to act as slave devices.

3.1.4.7 Change of Value (COV) and Read Property

a. To the greatest extent possible, configure all devices to support the SubscribeCOV service (the DS-COV-B BIBB). At a minimum, all devices supporting the DS-RP-B BIBB, other than devices controlling only a single terminal unit, must be configured to support the DS-COV-B BIBB.

b. Whenever supported by the server side, configure client devices to use the DS-COV-A BIBB.

3.1.4.8 Engineering Units

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NOTE: Coordinate with site and select either English or SI units for the building control system devices based on the standard used at the project site. Units must NOT be changed between BACnet projects at a site as units MUST be standardized across the entire UMCS. Also note that this choice affects how values are stored and/communicated in the system, not necessarily how they are displayed at the front end.

Keep the first section of bracketed text for SI (Metric) units, and the second for IP (English) units.

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[Configure devices to use SI (Metric) units as follows:

a. Temperature in degrees C

b. Air or natural gas flows in Liters per Second (LPS)

c. Water flow in Liters per Second (LPS)

d. Steam flow in kilograms per second (kg/s)

e. Differential Air pressures in Pascals (Pa)

f. Water, steam and natural gas pressures in kiloPascals (kPa)

g. Enthalpy in kiloJoules per kilogram (kJ/kg)

h. Heating and Cooling Energy in kilowatt-hours (kWh)

i. Heating and Cooling load in kilowatts (kW)

j. Electrical Power: kilowatts (kW)

k. Electrical Energy: kilowatt-hours (kWh)

][Configure devices to use English (Inch-Pound) engineering units as follows:

a. Temperature in degrees F

b. Air or natural gas flows in cubic feet per minute (CFM)

c. Water in gallons per minute (GPM)

d. Steam flow in pounds per hour (pph)

e. Differential Air pressures in inches of water column (IWC)

f. Water, steam, and natural gas pressures in PSI

g. Enthalpy in BTU/lb

h. Heating and cooling energy in MBTU (1MBTU = 1,000,000 BTU))

i. Cooling load in tons (1 ton = 12,000 BTU/hour)

j. Heating load in MBTU/hour (1MBTU = 1,000,000 BTU)

k. Electrical Power: kilowatts (kW)

l. Electrical Energy: kilowatt-hours (kWh)

]3.1.4.9 Use of BACnet Objects

Except as specifically indicated for Niagara Framework Objects, Use only standard non-proprietary ASHRAE 135 Objects and services to accomplish the project scope of work as follows:

a. Use Analog Input or Analog Output Objects for all analog hardware I/O. Do not use Analog Value Object for analog hardware I/O).

b. Use Binary Input or Binary Output Objects for all binary hardware I/O. Do not use Binary Value Objects for binary hardware I/O.

c. Use Analog Value Objects for analog setpoints.

d. Use Accumulator Objects or Analog Value Objects for pulse inputs.

e. For occupancy modes, use Multistate Value Objects and the correspondence between value and occupancy mode specified in paragraph OCCUPANCY MODES.

f. Use a combination of Niagara Framework Alarm Extensions and Alarm Services,Intrinsic Alarming, and Notification Class Objects for alarm generation.

g. For all other points shown on the Points Schedule as requiring an ASHRAE 135 Object, use the Object type shown on the Points Schedule or, if no Object Type is shown, use a standard Object appropriate to the point.

3.1.4.9.1 Niagara Framework Objects

Points in the Niagara Framework Supervisory Gateway, even if used in a

sequence or are shown on the Points Schedule, are not required to be exposed as BACnet Objects unless they are required to be trended or available on the network by another device or sequence of operation (i.e. there is some other reason they are needed).

Use a Niagara Framework Supervisory Gateway as specified for all scheduling and trending. Use a Niagara Framework Supervisory Gateway as specified for all alarming except for intrinsic alarming.

3.1.4.10 Use of Standard BACnet Services

Except as noted in this paragraph, for all DDC Hardware (including Niagara Frameworks Supervisory Gateways when communicating with non-Niagara Framework DDC Hardware) use Standard BACnet Services as defined in this specification (which excludes some ASHRAE 135 services) exclusively for application control functionality and communication.

3.1.4.11 Device Application Configuration

a. For every property, setting or value shown on the Points Schedule or otherwise indicated as Configurable, provide a value that is retained through loss of power and can be changed via one or more of:

(1) BACnet services (including proprietary services)

(2) Hardware settings on the device

(3) Niagara Framework

b. For every property, setting or value in non-Niagara Framework Hardware shown on the Points Schedule or otherwise indicated as Operator Configurable, provide a value that is retained through loss of power and can be changed via one or more of:

(1) A Writeable Property of a standard BACnet Object

(2) A Property of a standard BACnet Object that is Writeable when Out_Of_Service is TRUE and Out_Of_Service is Writeable.

(3) Using some other method supported by a Niagara Framework Supervisory Gateway

c. Configure Niagara Framework Supervisory Gateways such that the property, setting or value is configurable from a Niagara Framework Front End.

d. For every property, setting or value in a Niagara Framework Supervisory Gateway which is shown on the Points Schedule or otherwise indicated as Operator Configurable, configure the value to be configurable from within the Niagara Framework such that it can be configured from a system graphic page at a Niagara Framework Front End.

3.1.4.12 Niagara Framework Engineering Tool

Use the Niagara Framework Engineering Tool to fully discover the field control system and make all field control system information available to the Niagara Framework Supervisory Gateway. Ensure that all points on the points schedule; used in the Sequence of Operation or for trending are brought in to the front end via the Fox protocol.

3.1.4.13 Graphics and Web Pages

Provide a graphical user interface in accordance with Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM FRONT END AND INTEGRATION.

3.1.5 Scheduling, Alarming, Trending, and Overrides

3.1.5.1 Scheduling

Configure schedules in Niagara Framework Supervisory Gateway using Niagara Schedule Objects as indicated on the Points Schedule and as specified. When the schedule is controlling occupancy modes in DDC Hardware other than a Niagara Framework Supervisory Gateway use the indicated correspondence between value and occupancy mode.

Provide a separate schedule for each heating, ventilating, or air-conditioning system including it's associated central equipment and zone control. Provide the ability to have separate schedules for the zone equipment (terminal units, fan coils, etc.) from the central equipment.

3.1.5.2 Alarm Configuration

Configure alarm generation and management as indicated on the Points Schedule and in accordance with Appendix E of Section 25 10 10.00 24 UTILITY MONITORING AND CONTROL SYSTEM FRONT END AND INTEGRATION. Configure alarm generation in Niagara Framework Supervisory Gateways using Niagara Framework Alarm Extensions and Alarm Services or in other DDC Hardware (not Niagara Framework Supervisory Gateways) using ASHRAE 135 Intrinsic Alarming. Configure alarm management and routing for all alarms, including those generated via intrinsic alarming in other devices, in the Niagara Framework Supervisory Gateway such that the alarms are able to be accessed from the Niagara Framework Front End.

Where Intrinsic Alarming is used, configure intrinsic alarming as specified in paragraph "Configuration of ASHRAE 135 Intrinsic Alarm Generation". Configure a Niagara Framework Supervisory Gateway to provide a means to configure the intrinsic alarm parameters such that the Intrinsic Alarm is configurable from the front end via the Niagara Framework.

3.1.5.3 Trending

Perform all trending using a Niagara Framework Supervisory Gateway using Niagara Framework History Extensions and Niagara Framework History Service exclusively.

3.1.5.4 Overrides

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DESIGNER NOTE: The strongly preferred method of Overrides is through Commandable Objects. Consider carefully before approving the other method specified here, and do not approve any other method of Overriding.

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Provide an override for each point shown on the Points Schedule as requiring an override in Niagara Framework Supervisory Gateways. For overrides to other points, provide an override to a point in a Niagara

Framework Supervisory Gateway via the Niagara Framework where the Niagara Framework Supervisory Gateway overrides the other point as specified.

Unless otherwise approved, provide Commandable Objects to support all Overrides in non-Niagara Framework Supervisory Gateway DDC Hardware. With specific approval from the contracting officer, Overrides for points which are not hardware outputs and which are in DDC hardware controlling a single terminal unit may support overrides via an additional Object provided for the override. No other means of implementing Overrides may be used.

a. Where Commandable Objects are used, ensure that WriteProperty service requests with a Priority of 10 or less take precedence over the SEQUENCE VALUE and that WriteProperty service request with a priority of 11 or more have a lower precedence than the SEQUENCE VALUE.

b. For devices implementing overrides via additional Objects, provide Objects which are NOT Written to as part of the normal Sequence of Operations and are Writeable when Out_Of_Service is TRUE and Out_Of_Service is Writeable. Use this point as an Override of the normal value when Out_Of_Service is TRUE and the normal value otherwise. Note these Objects may be modified as part of the sequence via local processes, but must not be modified by local processes when Out_Of_Service is TRUE.

3.1.6 BACnet Gateways

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NOTE: The intent of this is to allow the use of gateways to packaged equipment controllers not procured under the scope of the project this specification is used for and, to not allow the installation of a non-BACnet network connected to a BACnet network via a gateway.

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The requirements in this paragraph do not permit the installation of hardware not meeting the other requirements of this section. All control hardware installed under this project must meet the requirements of this specification, including control hardware provided as part of a package unit or as part of equipment specified under another section. Only use gateways to connect to pre-existing control devices.

Provide BACnet Gateways to non-BACnet control hardware as required to connect existing non-BACnet packaged units and in accordance with the following:

a. Each gateway must communicate with and perform protocol translation for non-BACnet control hardware controlling one and only one package unit.

b. Connect one network port on the gateway to the Building Control Backbone BACnet MS/TP network and the other port to the single piece of controlled equipment.

c. Configure gateways to map writeable data points in the controlled equipment to Writeable Properties of Standard Objects or to Niagara Framework points as indicated in the Points Schedule and as specified.

d. Configure gateway to map readable data points in the controlled equipment to Readable Properties of Standard Objects or to Niagara

Framework points as indicated in the Points Schedule and as specified.

e. Configure gateway to support the DS-COV-B BIBB for all points mapped to BACnet Objects.

f. Do not use non-BACnet control hardware for controlling built-up units or any other equipment that was not furnished with factory-installed controls. (Note: A Niagara Framework Supervisory Gateway is BACnet control hardware.)

g. Do not use non-BACnet control hardware for system scheduling functions.

h. Non-BACnet network wiring connecting the gateway to the package unit must not exceed 3 meters 10 feet in length and must connect to exactly two devices: the controlled equipment (packaged unit) and the gateway.

-- End of Section --