```
**************************************************************************
USACE / NAVFAC / AFCEC          UFGS-25 10 10 (February 2019)
                                Change 1 - 05/21
                                -----------------------------------
                                Superseding
Preparing Activity:  USACE      UFGS-25 10 10 (November 2015)
```

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025
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**************************************************************************
```

SECTION TABLE OF CONTENTS

DIVISION 25 - INTEGRATED AUTOMATION

SECTION 25 10 10

UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION

02/19, CHG 1: 05/21

ATTACHMENTS:

QC Checklist

-- End of Section Table of Contents --

```
**************************************************************************
USACE / NAVFAC / AFCEC                UFGS-25 10 10 (February 2019)
                                      Change 1 - 05/21
                                      ------------------------------------
Preparing Activity:  USACE            Superseding
                                      UFGS-25 10 10 (November 2015)


              UNIFIED FACILITIES GUIDE SPECIFICATIONS

         References are in agreement with UMRL dated January 2025
**************************************************************************


                         SECTION 25 10 10

   UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION
                        02/19, CHG 1: 05/21


**************************************************************************
```

```
**************************************************************************
```

PART 1   GENERAL

<u>Protocol Tailoring Options</u>
This specification includes tailoring options for
selection of protocol, and whether the Niagara
Framework is required. There are five tailoring
options:
   1) BACNET: A (non-Niagara Framework) BACnet
      front end (using a BACnet B-AWS)

   2) LONWORKS: A LonWorks front end using LNS.

   3) NIAGARA FRAMEWORK: A Niagara Framework
      front end

   4) MODBUS: The front end must also support the
      MODBUS protocol.

   5) OPC: The front end must also support OPC.

In general, it is recommended that only one of
BACNET, LONWORKS or NIAGARA FRAMEWORK be selected.
It is also recommended neither MODBUS and OPC be
selected with BACNET.

You have currently selected the following options:

BACNET
LONWORKS
NIAGARA FRAMEWORK
MODBUS
OPC

If you don't see any text between dashes above, you
have deselected all of the protocol tailoring
options and this specification is not valid. Select
at least one of the tailoring options.

If you see more than one line of text between the
dashes above you have left multiple tailoring
options related to protocol selected. This may
result in conflicting requirements. See UFC
3-470-01 UTILITY MONITORING AND CONTROL SYSTEM
(UMCS) FRONT END AND INTEGRATION to determine if one
or more tailoring options should be deselected.

<u>Service Tailoring Option</u>
This specification also includes tailoring options
for the Service (Air Force, Army, Navy) the
specification is used for. There is a "Service
Generic" tailoring option that can also be used.
Only ONE of the four tailoring options related to
the services should be used. You have currently
selected the following options:

   AIR FORCE
   ARMY
   NAVY
   SERVICE GENERIC

1.1   SUMMARY

Provide a Utility Monitoring and Control System (UMCS) which performs supervisory monitoring and supervisory control of base-wide building control systems and utility control systems using one or more of: CEA-709.1-D (LonWorks) with LonWorks Network Services (LNS), ASHRAE 135 (BACnet), MODBUS Protocol, MODBUS TCP/IP, OPC DA, or the Niagara Framework with Fox protocol as indicated and shown. Integrate CEA-709.1-D field control systems installed per Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS into the UMCS as specified and maintain the LNS database(s) for the entire network at the UMCS Front End. Integrate field control systems installed per Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS or Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS to the UMCS via Niagara Framework Supervisory Gateways as specified. Integrate ASHRAE 135 (BACnet) field control systems installed per Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS as specified.

1.1.1   System Requirements

****
        NOTE: Select the appropriate text in the type
        specific communication system requirements to
        indicate whether or not the IP network will be
        Government furnished. If the IP network is *not*
        Government furnished be sure to include complete
        requirements for the IP network in the contract
        package. This specification does not provide
        sufficient requirements for the procurement of an IP
        network.

        Use "[an IP network as specified in [_____] and]"
        only if the contractor is expected to install an IP
        network. In this case provide the information on
        the specification for the IP network in the
        "[_____]" provided.

        For Army, coordinate with the installation (DPW and
        NEC) but the default selection will be "[the
        Government furnished IP network]"
****

Provide a UMCS as specified and indicated, and in accordance with the following characteristics:

1.1.1.1   General System Requirements

  a. The system performs supervisory monitoring and control functions including but not limited to Scheduling, Alarm Handling, Trending, Overrides, Report Generation, and Electrical Demand Limiting as specified.

  b. The system includes a Graphical User Interface which allows for graphical navigation between systems, graphical representations of systems, access to real-time data for systems, ability to override points in a system, and access to all supervisory monitoring and control functions.

  c. All software used by the UMCS and all software used to install and configure the UMCS is licensed to and delivered to the installation.

d. All necessary documentation, configuration information, configuration tools, programs, drivers, and other software is licensed to and otherwise remains with the Government such that the Government or their agents are able to repair, replace, upgrade, and expand the system without subsequent or future dependence on the Contractor. Software licenses must not require periodic fees and must be valid in perpetuity.

e. Provide sufficient documentation and data, including rights to documentation and data, such that the Government or their agents can execute work to repair, replace, upgrade, and expand the system without subsequent or future dependence on the Contractor.

f. The UMCS interfaces directly to ASHRAE 135, CEA-709.1-D, MODBUS Protocol, MODBUS TCP/IP, OPC DA, and Niagara Framework field control systems as specified and may interface to field control systems using other protocols via an M&C Software protocol driver or a Gateway.

g. For UMCS systems with Monitoring and Control Software functionality implemented in Monitoring and Control (M&C) Controller Hardware, provide sufficient additional controller hardware to support the full capacity requirements as specified.

****
        NOTE: The following TWO list paragraphs are
        included only when the NIAGARA FRAMEWORK tailoring
        option is selected.
****

h. All Niagara Framework components have an unrestricted interoperability license with a Niagara Compatibility Statement (NiCS) following the Tridium Open NiCS Specification and have a value of "ALL" for "Station Compatibility In", "Station Compatibility Out", "Tool Compatibility In" and "Tool Compatibility Out". Note that this will result in the following entries in the license.dat file:
        accept.station.in="*"
        accept.station.out="*"
        accept.wb.in="*"
        accept.wb.out="*"

****
        NOTE: Select the required version of the Niagara
        Framework. This choice must be carefully
        coordinated with the project site.

        Niagara Framework is currently (2015) in a
        transition between two releases: "AX" and "Version
        4". A Version 4 UMCS front end (e.g. as specified
        in Section 25 10 10) will work with either an AX or
        Version 4 Niagara Framework Supervisory Gateway, but
        an AX front end will ONLY work with an AX Niagara
        Framework Supervisory Gateway.

        If this Section is being used to procure a new front
        end AND sufficient local support for Version 4
        exist, keep the bracketed text to require Version
        4. Otherwise, if this section is being used for

[i.   The version of Niagara Framework used on this project must be Version
       4.0 or later.]

1.1.1.2   LonWorks Requirements

   a.   The UMCS must communicate using CEA-709.1-D over [the Government
        furnished IP network] [an IP network as specified in [_____] and][the
        Navy PSNet] in accordance with CEA-852-C as specified and must
        interface to CEA-709.1-D building control networks using LonWorks/IP
        Routers as specified.

   b.   All communication between the UMCS and LonWorks field control networks
        must be via the CEA-709.1-D protocol over the IP network in accordance
        with CEA-852-C.

   c.   Except for communication for device commissioning, configuration, and
        programming, all communication between the M&C Software and the field
        control system devices must be via SNVT.

1.1.1.3   BACnet Requirements

   a.   The UMCS must communicate using ASHRAE 135 Annex J over [the
        Government furnished IP network][an IP network as specified in [_____]
        and][the Navy PSNet] as specified.

   b.   All communication between the UMCS and ASHRAE 135 field control
        networks must be via the ASHRAE 135 protocol over the IP network.

   c.   All communication between the M&C Software and the field control
        system devices must be via standard ASHRAE 135 services other than
        PrivateTransfer and ConfirmedPrivateTransfer except as follows:

        (1)   PrivateTransfer and ConfirmedPrivateTransfer may be used for
              device configuration and device programming.

        (2)   PrivateTransfer and ConfirmedPrivateTransfer may be used for
              communication between the M&C Software and the field control
              system if and only if both the M&C Software and the field control
              system devices automatically (without requiring reconfiguration)
              revert to the use of other standard ASHRAE 135 services when one

of the components is modified or replaced.

1.1.1.4   Modbus Requirements

****
          NOTE: This subpart is included only when the MODBUS
          tailoring option is selected.

          In addition, the reference to the Navy PSNet is
          included only when the NAVY tailoring option is
          selected.
****

The UMCS must communicate using MODBUS Protocol, MODBUS TCP/IP over [the
Government furnished IP network] [an IP network as specified in [_____]
and][the Navy PSNet] as specified.

Modbus communications must support all of the following Modbus data types:

****
          NOTE: FYI - the four standard data types in Modbus
          are:
          1) Discrete Input - a single bit (read only)
          2) Coil - a single bit
          3) Input Register - 16 bit (read only)
          4) Holding Register - 16 bit

          The Modbus standard does not define how the data is
          interpreted. For example it does not say if the 16
          bits from a Holding register are 16 different binary
          flags, or an integer, or two ASCII characters or
          something else entirely. The below requirements
          specify how to format data for some common data
          types.
****

   a. The four standard data types defined by MODBUS Protocol, MODBUS TCP/IP:
       Discrete Inputs, Coils, Input Registers, and Holding Registers. (Note
       that these four data types are included in the MODBUS Protocol,
       MODBUS TCP/IP standard. The remaining data types indicated in this
       Section are not included in the MODBUS Protocol, MODBUS TCP/IP
       standard but are defined by this Section to provide a standard for
       communication between systems.)

   b. Character: Character data using a single Input Register or single
       Holding Register where that Modbus register is interpreted as two 8
       bit ISO 8859-1 characters, with the low order bits representing the
       right-hand character.

   c. Floating Point: Floating point data using two consecutive Input
       Registers or two consecutive Holding Registers where the resulting 32
       bits are interpreted as a Binary32 (Single Precision Floating point)
       number as specified in IEEE 754. Use the first Register for the
       higher 16 bits, and the second Register for the lower 16 bits.

   d. Integer Date: Date data using three consecutive Input Registers or
       three consecutive Holding Registers where the resulting 48 bits are
       interpreted as a 48-bit unsigned big-endian integer. The value is the
       number of milliseconds, not including leap seconds, from

1970-01-01T00:00:00.000 (12AM, January 1, 1970). Use the first
Register for the highest 16 bits and the third Register for the lowest
16 bits.

e. Character Date: Date data using the format specified in ISO 8601 of
"YYYY-MM-DDTHH:MM:SS.SSS", where the individual characters are
formatted as specified for character data.

1.1.1.5 OPC Requirements

```
**************************************************************************
          NOTE:   This subpart is included only when the OPC
          tailoring option is selected.
**************************************************************************
```

The UMCS must communicate using OPC DA over [the Government furnished IP
network] [an IP network as specified in [_____] and][the Navy PSNet] as
shown and specified.

1.1.1.6 Niagara Framework Requirements

```
**************************************************************************
          NOTE:  This subpart is included only when the
          NIAGARA FRAMEWORK tailoring option is selected.

          In addition, this subpart used services tailoring
          options:
          1) the reference to the Navy PSNet is included only
          when the NAVY tailoring option is selected.
          2) The HTTP requirement is bracketed when the AIR
          FORCE, ARMY or SERVICE GENERIC tailoring options are
          selected.
**************************************************************************
```

```
**************************************************************************
          NOTE:  For the Navy, keep the bracketed text "and
          HTTP".

          For other services keep the bracketed text "and
          HTTP" if the Niagara Framework Supervisory Gateways
          will be permitted to serve web pages.  Remove the
          bracketed text "and HTTP" otherwise.

          In general, for the Army remove the "and HTTP" text.
**************************************************************************
```

The UMCS must use the Niagara Framework and must communicate with
Niagara Framework field control systems using the Fox protocol[and HTTP]
over [the Government furnished IP network] [an IP network as specified in
[_____] and][the Navy PSNet] as indicated and specified.

1.1.2 Symbols, Definition and Abbreviations

Use symbols, definitions, and engineering unit abbreviations indicated in
the contract drawings for displays, submittals and reports. For symbols,
definitions and abbreviations not in the contract drawings use terms
conforming at a minimum to IEEE Stds Dictionary and the ASHRAE FUN SI
ASHRAE FUN IP, as applicable.

1.1.3   System Units and Accuracy

Use [metric (SI)] [English (inch-pound)] units for displays, print-outs
and calculations. Perform calculations with an accuracy of at least three
significant figures. For displays and printouts present values to at
least three significant figures.

1.1.4   Data Packages/Submittals Requirements

****

Technical data packages consisting of computer software and technical data
(meaning technical data which relates to computer software) which are
specifically identified in this project and which may be defined/required
in other specifications must be delivered strictly in accordance with the
CONTRACT CLAUSES and in accordance with the Contract Data Requirements
List, DD Form 1423. Data delivered must be identified by reference to the
particular specification paragraph against which it is furnished. All
submittals not specified as technical data packages are considered shop
drawings under the Federal Acquisition Regulation Supplement (FARS) and
must contain no proprietary information and must be delivered with
unrestricted rights.

1.2   RELATED SECTIONS

****
        **NOTE: If Section 25 05 11 has been renumbered and/or
        renamed use the blank brackets to indicate the
        appropriate section, otherwise keep the reference to
        Section 25 05 11.**
****

Cybersecurity requirements related to this Section are specified in a
separate cybersecurity specification derived from UFGS 25 05 11. Section [
25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS][____]
specifies cybersecurity requirements related to this Section.

1.3   REFERENCES

****
        **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 RID (Reference ID) 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.**
****

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI INCITS 154   (1988; R 2004) Office Machines and
                                Supplies - Alphanumeric Machines -

Keyboard Arrangement

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

ASHRAE 135   (2020; Interpretation 1-8 2021; Errata 1-2 2021; Addenda CD 2021; Addenda BV-CE 2022; Interpretation 9-12 2022; Interpretation 13-24 2023; Addenda BV-CF 2023; Errata 3 2023) BACnet—A Data Communication Protocol for Building Automation and Control Networks

ASHRAE FUN IP   (2021) Fundamentals Handbook, I-P Edition

ASHRAE FUN SI   (2021) Fundamentals Handbook, SI Edition

CONSUMER ELECTRONICS ASSOCIATION (CEA)

CEA-709.1-D   (2014) Control Network Protocol Specification

CEA-709.3   (1999; R 2015) Free-Topology Twisted-Pair Channel Specification

CEA-852-C   (2014) Tunneling Device Area Network Protocols Over Internet Protocol Channels

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 754   (2008) Floating-Point Arithmetic - IEEE Computer Society

IEEE 802.11   (2020; BD 2022) Information Technology-Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 3: Wake-Up Radio Operation

IEEE 1815   (2015; CORR 2016) Exchanging Information Between Networks Implementing IEC 61850 and IEEE Std 1815 [Distributed Network Protocol (DNP3)]

IEEE C62.41   (1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

IEEE Stds Dictionary   (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 8601   (2004) Data Elements and Interchange Formats - Information Interchange - Representation of Dates and Times

ISO 8859-1   (1998) Information Technology - 8-Bit
                                    Single-Byte Coded Graphic Character Sets -
                                    Part 1: Latin Alphabet No. 1

          INTERNET ENGINEERING TASK FORCE (IETF)

IETF RFC 4361   (2006) Node-specific Client Identifiers
                                    for Dynamic Host Configuration Protocol
                                    Version Four (DHCPv4)

IETF RFC 7465   (2015) Prohibiting RC4 Cipher Suites

RFC 821   (2001) Simple Mail Transfer Protocol (SMTP)

          LONMARK INTERNATIONAL (LonMark)

LonMark Interoperability Guide   (2005) LonMark Application-Layer
                                    Interoperability Guide and LonMark Layer
                                    1-6 Interoperability Guide; Version 3.4

LonMark SNVT List   (2014) LonMark SNVT Master List; Version 15

LonMark XIF Guide   (2001) LonMark External Interface File
                                    Reference Guide; Revision 4.402

          MODBUS ORGANIZATION, INC (MODBUS)

MODBUS Protocol   (2012) Modbus Application Protocol
                                    Specification; Version 1.1b3

MODBUS TCP/IP   (2006) Modbus Messaging on TCP/IP
                                    Implementation Guide; Version V1.0b

          NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250   (2020) Enclosures for Electrical Equipment
                                    (1000 Volts Maximum)

          NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70   (2023; ERTA 1 2024; TIA 24-1) National
                                    Electrical Code

NFPA 262   (2023) Standard Method of Test for Flame
                                    Travel and Smoke of Wires and Cables for
                                    Use in Air-Handling Spaces

          OPC FOUNDATION (OPC)

OPC DA   (Ver 3.0; Errata) OPC Data Access (DA)

          TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568.1   (2020e) Commercial Building
                                    Telecommunications Infrastructure Standard

TIA-606   (2021d) Administration Standard for
                                    Telecommunications Infrastructure

| TIA-607 | (2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises |

TRIDIUM, INC (TRIDIUM)

| Niagara Framework | (2021) NiagaraAX User's Guide |

| Tridium Open NiCS | (2021) Understanding the NiagaraAX Compatibility Statement (NiCS) |

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

| FCC EMC | (2002) FCC Electromagnetic Compliance Requirements |

| FCC Part 15 | Radio Frequency Devices (47 CFR 15) |

UL SOLUTIONS (UL)

| UL 1778 | (2014; Reprint Apr 2023) UL Standard for Safety Uninterruptible Power Systems |

| UL 60950 | (2000; Reprint Oct 2007) Safety of Information Technology Equipment |

1.4   DEFINITIONS

The following list of definitions may contain terms not found elsewhere in this Section but are included here for completeness. Some terms are followed with a protocol reference in parenthesis indicating to which protocol the term and definition applies. Inclusion of protocol-specific definitions does not create a requirement to support that protocol, nor does it relax any requirements to support specific protocols as indicated elsewhere in this section.

1.4.1   Alarm Generation

The process of comparing a point value (the point being alarmed) with a pre-defined alarm condition (e.g. a High Limit) and performing some action based on the result of the comparison.

1.4.2   Alarm Handling

see Alarm Routing

1.4.3   Alarm Routing

Alarm routing is M&C software functionality that starts with a notification that an alarm exists (typically as the output of an Alarm Generation process) and sends a specific message to a specific alarm recipient or device.

1.4.4   Application Generic Controller (AGC)(LonWorks)

A device that is furnished with a (limited) pre-established application that also has the capability of being programmed. Further, the ProgramID and XIF file of the device are fixed. The programming capability of an AGC

may be less flexible than that of a General Purpose Programmable
Controller (GPPC).

1.4.5   Application Specific Controller (ASC)(LonWorks)

A device that is furnished with a pre-established built in application
that is configurable but not re-programmable. An ASC has a fixed
factory-installed application program (i.e Program ID) with configurable
settings.

1.4.6   BACnet (BACnet)

The term BACnet is used in two ways. First meaning the BACnet Protocol
Standard - the communication requirements as defined by ASHRAE 135
including all annexes and addenda. The second to refer to the overall
technology related to the ASHRAE 135 protocol.

1.4.7   BACnet Advanced Application Controller (B-AAC)(BACnet)

A hardware device BTL Listed as a B-AAC. A control device which contains
BIBBs in support of scheduling and alarming but otherwise has limited
resources relative to a B-BC. It may be intended for specific applications
and supports some degree of programmability.

1.4.8   BACnet Advanced Operator Workstation (B-AWS)(BACnet)

Monitoring and Control (M&C) Software BTL Listed as an Advanced Operator
Workstation and includes the ability to manage scheduling, alarming and
trending in an open manner. The B-AWS is the advanced operator's window
into a BACnet system. It is primarily used to monitor the performance of a
system and to modify parameters that affect the operation of a system.

1.4.9   BACnet Application Specific Controller (B-ASC)(BACnet)

A hardware device BTL Listed as a B-ASC. A controller with limited
resources relative to a B-AAC. It is intended for use in a specific
application and supports limited programmability.

1.4.10   BACnet Building Controller (B-BC)(BACnet)

A hardware device BTL Listed as a B-BC. A general-purpose,
field-programmable device capable of carrying out a variety of building
automation and control tasks including control and monitoring via direct
digital control (DDC) of specific systems and data storage for trend
information, time schedules, and alarm data. Like the other BTL Listed
controller types (B-AAC, B-ASC etc.) a B-BC device is required to support
the server ("B") side of the ReadProperty and WriteProperty services, but
unlike the other controller types it is also required to support the
client ("A") side of these services. Communication between controllers
requires that one of them support the client side and the other support
the server side, so a B-BC is often used when communication between
controllers is needed.

1.4.11   BACnet Internetwork (BACnet)

Two or more BACnet networks connected with BACnet routers. In a BACnet
Internetwork, there exists only one message path between devices.

1.4.12   BACnet Interoperability Building Blocks (BIBBs) (BACnet)

  A BIBB is a collection of one or more BACnet services intended to define a
  higher level of interoperability. BIBBs are combined to build the BACnet
  functional requirements for a device in a specification. Some BIBBs
  define additional requirements (beyond requiring support for specific
  services) in order to achieve a level of interoperability. For example,
  the BIBB DS-V-A (Data Sharing-View-A), which would typically be used by an
  M&C client, not only requires the client to support the ReadProperty
  Service, but also provides a list of data types (Object / Properties)
  which the client must be able to interpret and display for the user.

1.4.13   BACnet Operator Display (B-OD)(BACnet)

  A hardware device BTL Listed as a B-OD. A basic operator interface with
  limited capabilities relative to a B-OWS. It is not intended to perform
  direct digital control. The B-OD profile could be used for wall-mounted
  LCD devices, displays affixed to BACnet devices; hand-held terminals or
  other very simple user interfaces.

1.4.14   BACnet Operator Workstation (B-OWS)(BACnet)

  Monitoring and Control (M&C) Software BTL Listed as a B-OWS. An operator
  interface with limited capabilities relative to a B-AWS. The B-OWS is
  used for monitoring and basic control of a system, but differs from a
  B-AWS in that it does not support configuration activities, nor does it
  provide advanced troubleshooting capabilities.

1.4.15   BACnet Smart Actuator (B-SA)(BACnet)

  A hardware device BTL Listed as a B-SA. A simple control output device
  with limited resources; it is intended for specific applications.

1.4.16   BACnet Smart Sensor (B-SS)(BACnet)

  A hardware device BTL Listed as a B-SS. A simple sensing device with very
  limited resources.

1.4.17   BACnet Testing Laboratories (BTL)(BACnet)

  Established by BACnet International to support compliance testing and
  interoperability testing activities and consists of BTL Manager and the
  BTL Working Group (BTL-WG). BTL also publishes Implementation Guidelines.

1.4.18   BACnet Testing Laboratories (BTL) Listed (BACnet)

  A device that has been certified by BACnet® Testing Laboratory. Devices
  may be certified to a specific device profile, in which case the
  certification indicates that the device supports the required capabilities
  for that profile, or may be certified as "other".

1.4.19   Binary

  A two-state system or signal; for example one where an "ON" condition is
  represented by a high signal level and an "OFF" condition is represented
  by a low signal level. 'Digital' is sometimes used interchangeably with
  'binary'.

1.4.20   Binding (LonWorks)

The act of establishing communications between CEA-709.1-D devices by associating the output of a device to the input of another so that information is automatically (and regularly) sent without being requested by the recipient.

1.4.21   Broadcast

Unlike most messages, which are intended for a specific recipient device, a broadcast message is intended for all devices on the network.

1.4.22   Building Control Network (BCN)

The network used by the Building Control System. Typically the BCN is a BACnet ASHRAE 135 or LonWorks CEA-709.1-D network installed by the building control system contractor.

1.4.23   Building Control System (BCS)

One type of Field Control System. A control system for building electrical and mechanical systems, typically HVAC (including central plants) and lighting. A BCS generally uses Direct Digital Control (DDC) Hardware and generally does NOT include its own local front end.

1.4.24   Building Point of Connection (BPOC)

A FPOC for a Building Control System. (This term is being phased out of use in preference for FPOC but is still used in some specifications and criteria. When it was used, it typically referred to a piece of control hardware. The current FPOC definition typically refers instead to IT hardware)

1.4.25   Channel (LonWorks)

A portion of the control network consisting of one or more segments connected by repeaters. Channels are separated by routers. The device quantity limitation is dependent on the topology/media and device type. For example, a TP/FT-10 network with locally powered devices is limited to 128 devices per channel.

1.4.26   Commandable (BACnet)

A point (Object) is commandable if its Present_Value Property is writable and it supports the optional Priority_Array Property. This functionality is useful for Overrides.

1.4.27   Configuration Property (LonWorks)

Controller parameter used by the application which is usually set during installation/testing and seldom changed. For example, the P and I settings of a P-I control loop. Also see 'Standard Configuration Property Type (SCPT)'

1.4.28   Control Logic Diagram

A graphical representation of control logic for multiple processes that make up a system.

1.4.29   Device Object (BACnet)

  Every BACnet device requires one Device Object, whose properties represent
  the network visible properties of that device. Every Device Object
  requires a unique Object_Identifier number on the BACnet Internetwork.
  This number is often referred to as the device instance or device ID.

1.4.30   Explicit Messaging (LonWorks)

  A non-standard and often vendor (application) specific method of
  communication between devices.

1.4.31   External Interface File (XIF) (LonWorks)

  A file which documents a device's external interface, specifically the
  number and types of LonMark objects, the number, types, directions, and
  connection attributes of network variables, and the number of message tags.

1.4.32   Field Point Of Connection (FPOC)

  The FPOC is part of the UMCS IP network and acts as the point of
  connection between the UMCS IP Network and the field control IP network.
  The FPOC is an IT device such as a switch, IP router, or firewall,
  typically managed by the site IT staff. (Note that the field control IP
  network may consist of a single IP device, or that integration may require
  installation of a field control network IP device.)

1.4.33   Field Control Network

  The network used by a field control system.

1.4.34   Field Control System (FCS)

  A building control system or utility control system.

1.4.35   Fox Protocol (Niagara Framework)

  The protocol used for communication between components in the Niagara
  Framework. By default, Fox uses TCP port 1911

1.4.36   Functional Profile (LonWorks)

  A standard description, defined by LonMark International, of a LonMark
  Object used to classify and certify devices.

1.4.37   Gateway

  A device that translates from one protocol to another. Devices that
  change only the transport mechanism of the protocol - "translating" from
  LonWorks over TP/FT-10 to LonWorks over IP for example - are not gateways
  as the underlying protocol (data format) does not change. Gateways are
  also called Communications Bridges or Protocol Translators.

1.4.38   General Purpose Programmable Controller (GPPC) (LonWorks)

  Unlike an ASC or AGC, a GPPC is not furnished with a fixed application
  program and does not have a fixed ProgramID or XIF file. A GPPC can be
  (re-)programmed, usually using vendor-supplied software. When a change to
  the program affects the external interface (and the XIF file) the

ProgramID will change.

1.4.39   Internetwork (BACnet)

See BACnet Internetwork.

1.4.40   JACE (Niagara Framework)

Java Application Control Engine. See Niagara Framework Supervisory Gateway

1.4.41   LonMark Object (LonWorks)

A collection of network variables, configuration properties, and
associated behavior defined by LonMark International and described by a
Functional Profile. It defines how information is exchanged between
devices on a network (inputs from and outputs to the network).

1.4.42   LNS Plug-in (LonWorks)

Software which runs in an LNS compatible software tool, typically a
network configuration tool. Device configuration plug-ins provide a 'user
friendly' method to edit a device's configuration properties.

1.4.43   LonMark (LonWorks)

See LonMark International. Also, a certification issued by LonMark
International to CEA-709.1-D devices.

1.4.44   LonMark International (LonWorks)

Standards committee consisting of independent product developers, system
integrators and end users dedicated to determining and maintaining the
interoperability guidelines for LonWorks. Maintains guidelines for the
interoperability of CEA-709.1-D devices and issues the LonMark
Certification for CEA-709.1-D devices.

1.4.45   LonWorks (LonWorks)

The term used to refer to the overall technology related to the CEA-709.1-D
 protocol (sometimes called "LonTalk"), including the protocol itself,
network management, interoperability guidelines and products.

1.4.46   LonWorks Network Services (LNS) (LonWorks)

A network management and database standard for CEA-709.1-D devices.

1.4.47   LonWorks Network Services (LNS) Database (LonWorks)

The standard database created and used by LonWorks Network Services (LNS)
compatible tools, such as LNS Network Configuration tools.

1.4.48   Modbus

A basic protocol for control network communications generally used in
utility control systems. The Modbus protocol standard is maintained by
The Modbus Organization.

1.4.49   Master-Slave/Token Passing (MS/TP)(BACnet)

  Data link protocol as defined by the BACnet standard. Multiple speeds
  (data rates) are permitted by the BACnet MS/TP standard.

1.4.50   Monitoring and Control (M&C) Software

  The UMCS 'front end' software which performs supervisory functions such as
  alarm handling, scheduling and data logging and provides a user interface
  for monitoring the system and configuring these functions.

1.4.51   Network (BACnet)

  In BACnet, a portion of the control internetwork consisting of one or more
  segments of the same media connected by repeaters. Networks are separated
  by routers.

1.4.52   Network Variable (LonWorks)

  See 'Standard Network Variable Type (SNVT)'.

1.4.53   Network Configuration Tool (LonWorks)

  The software used to configure the control network and set device
  configuration properties. This software creates and modifies the control
  network database (LNS Database).

1.4.54   Niagara Framework

  A set of hardware and software specifications for building and utility
  control owned by Tridium Inc. and licensed to multiple vendors. The
  Framework consists of front end (M&C) software, web based clients, field
  level control hardware, and engineering tools. While the Niagara
  Framework is not adopted by a recognized standards body and does not use
  an open licensing model, it is sufficiently well-supported by multiple
  HVAC vendors to be considered a de-facto Open Standard.

1.4.55   Niagara Framework Supervisory Gateway (Niagara Framework)

  DDC Hardware component of the Niagara Framework. A typical Niagara
  architecture has Niagara specific supervisory gateways at the IP level and
  other (non-Niagara specific) controllers on field networks (TP/FT-10,
  MS/TP, etc.) beneath the Niagara supervisory gateways. The Niagara
  specific controllers function as a gateway between the Niagara framework
  protocol (Fox) and the field network beneath. These supervisory gateways
  may also be used as general purpose controllers and also have the
  capability to provide a web-browser based user interface.

  Note that different vendors refer to this component by different names.
  The most common name is "JACE"; other names include "EC-BOS", "FX-40", and
  "UNC".

1.4.56   Node (LonWorks)

  A device that communicates using the CEA-709.1-D protocol and is connected
  to a CEA-709.1-D network.

1.4.57   Node Address (LonWorks)

  The logical address of a node on the network, consisting of a Domain
  number, Subnet number and Node number. Note that the "Node number"
  portion of the address is the number assigned to the device during
  installation and is unique within a subnet. This is not the factory-set
  unique Node ID (see Node ID).

1.4.58   Node ID (LonWorks)

  A unique 48-bit identifier assigned (at the factory) to each CEA-709.1-D
  device. Sometimes called the Neuron ID.

1.4.59   Object (BACnet)

  A BACnet Object. The concept of organizing BACnet information into
  standard components with various associated Properties. Examples include
  Analog Input objects and Binary Output objects.

1.4.60   Override

  To change the value of a point outside of the normal sequence of operation
  where this change has priority over the sequence. An override can be
  accomplished in one of two ways: the point itself may be Commandable and
  written to with a priority or there may be a separate point on the
  controller for the express purpose of implementing the override.

  Typically this override is from the Utility Monitoring and Control System
  (UMCS) Monitoring and Control (M&C) Software. Note that this definition
  is not standard throughout industry.

1.4.61   Point, Calculated

  A value within the M&C Software that is not a network point but has been
  calculated by logic within the software based on the value of network
  points or other calculated points. Calculated points are sometimes called
  virtual points or internal points.

1.4.62   Point, Network

  A value that the M&C Software reads from or writes to a field control
  network.

1.4.63   Polling

  A requested transmission of data between devices, rather than an
  unrequested transmission such as Change-Of-Value (COV) or Binding where
  data is automatically transmitted under certain conditions.

1.4.64   Program ID (LonWorks)

  An identifier (number) stored in the device (usually EEPROM) that
  identifies the node manufacturer, functionality of device (application &
  sequence), transceiver used, and intended device usage.

1.4.65   Property (BACnet)

  A BACnet Property - a data element associated with an Object. Different
  Objects have different Properties, for example an Analog Input Object has

a Present_Value Property (which provides the value of the underlying
hardware analog input), a High_Limit Property (which contains a high limit
for alarming), as well as other properties.

1.4.66   Protocol Implementation Conformance Statement (PICS)(BACnet)

A document, created by the manufacturer of a device, which describes which
potions of the BACnet standard are implemented by a given device.

1.4.67   Repeater

A device that connects two control network segments and retransmits all
information received on one side onto the other.

1.4.68   Router (LonWorks)

A device that connects two channels and controls traffic between the
channels by retransmitting signals received from one subnet onto the other
based on the signal destination. Routers are used to subdivide a control
network and to control bandwidth usage.

1.4.69   Router (BACnet)

A device that connects two or more BACnet networks and controls traffic
between the networks by retransmitting signals received from one network
onto another based on the signal destination. Routers are used to
subdivide an internetwork and to control bandwidth usage.

1.4.70   Segment

A 'single' section of a control network that contains no repeaters or
routers. There is generally a limit on the number of devices on a
segment, and this limit is dependent on the topology/media and device
type. For example, a TP/FT-10 segment with locally powered devices is
limited to 64 devices, and a BACnet MS/TP segment is limited to 32 devices.

1.4.71   Service (BACnet)

A BACnet Service. A defined method for sending a specific type of data
between devices. Services are always defined in a Client-Server manner,
with a Client initiating a Service request and a Server Executing the
Service. Some examples are ReadProperty (a client requests a data value
from a server), WriteProperty (a client writes a data value to a server),
and CreateObject (a client requests that a server create a new object
within the server device).

1.4.72   Service Pin (LonWorks)

A hardware push-button on a device which causes the device to broadcast a
message containing its Node ID and Program ID. This broadcast can also be
initiated via software.

1.4.73   Standard BACnet Object/Property/Service (BACnet)

BACnet Objects, Properties, or Services that are standard Objects,
Properties, or Services enumerated and defined in ASHRAE 135. Clause 23
of ASHRAE 135 defines methods to extend ASHRAE 135 to non-standard or
proprietary information. Standard BACnet Objects/Properties/Services
specifically exclude any vendor specific extensions.

1.4.74   Standard Configuration Property Type (SCPT) (LonWorks)

  Pronounced 'skip-it'. A standard format type (maintained by LonMark
  International) for Configuration Properties.

1.4.75   Standard Network Variable Type (SNVT) (LonWorks)

  Pronounced 'snivet'. A standard format type (maintained by LonMark
  International) used to define data information transmitted and received by
  the individual nodes. The term SNVT is used in two ways. Technically it
  is the acronym for Standard Network Variable Type, and is sometimes used
  in this manner. However, it is often used to indicate the network
  variable itself (i.e. it can mean "a network variable of a standard
  network variable type"). In general, the intended meaning should be clear
  from the context.

1.4.76   Subnet (LonWorks)

  Consists of a logical grouping of up to 127 nodes, where the logical
  grouping is defined by node addressing. Each subnet is assigned a number
  which is unique within the Domain. See also Node Address.

1.4.77   Supervisory Controller

  A controller implementing a combination of supervisory logic (global
  control strategies or optimization strategies), scheduling, alarming,
  event management, trending, web services or network management. Note this
  is defined by use; many supervisory controllers have the capability to
  also directly control equipment.

1.4.78   Supervisory Gateway

  ****
          NOTE: This subpart uses tailoring options: The
          phrase ", such as a Niagara Framework Supervisory
          Gateway" is only included when the NIAGARA FRAMEWORK
          tailoring option is selectedT
  ****

  A device that is both a supervisory controller and a gateway, such as a
  Niagara Framework Supervisory Gateway.

1.4.79   TP/FT-10 (LonWorks)

  A Free Topology Twisted Pair network (at 78 kbps) defined by CEA-709.3.
  This is the most common media type for a CEA-709.1-D control network.

1.4.80   TP/XF-1250 (LonWorks)

  A high speed (1.25 Mbps) twisted pair, doubly-terminated bus network
  defined by the LonMark Interoperability Guidelines. This media is
  typically used only as a backbone media to connect multiple TP/FT-10
  networks.

1.4.81   UMCS Network

  An IP network connecting multiple field control systems to the Monitoring
  and Control Software using one or more of: LonWorks (CEA-709.1-D and

CEA-852-C), BACnet (ASHRAE 135 Annex J), MODBUS Protocol, MODBUS TCP/IP or OPC DA.

1.4.82   User-defined Configuration Property Type (UCPT) (LonWorks)

Pronounced 'u-keep-it'. A Configuration Property format type that is defined by the device manufacturer.

1.4.83   User-defined Network Variable Type (UNVT) (LonWorks)

A network variable format defined by the device manufacturer. Note that UNVTs create non-standard communications (other vendor's devices may not correctly interpret it) and may close the system and therefore are not permitted by this specification.

1.4.84   Utility Control System (UCS)

One type of field control system. Used for control of utility systems such as an electrical substation, sanitary sewer lift station, water pump station, etc. Building controls are excluded from a UCS, however it is possible to have a Utility Control System and a Building Control System in the same facility, and for those systems to share components such as the FPOC. A UCS may include its own local front-end.

1.5   SUBMITTALS

****
        NOTE: Review submittal description (SD) definitions
        in Section 01 33 00 SUBMITTAL PROCEDURES and edit
        the following list, and corresponding submittal
        items in the text, to reflect only the submittals
        required for the project. The Guide Specification
        technical editors have classified those items that
        require Government approval, due to their complexity
        or criticality, with a "G." Generally, other
        submittal items can be reviewed by the Contractor's
        Quality Control System. Only add a "G" to an item,
        if the submittal is sufficiently important or
        complex in context of the project.

        For Army projects, fill in the empty brackets
        following the "G" classification, with a code of up
        to three characters to indicate the approving
        authority. Codes for Army projects using the
        Resident Management System (RMS) are: "AE" for
        Architect-Engineer; "DO" for District Office
        (Engineering Division or other organization in the
        District Office); "AO" for Area Office; "RO" for
        Resident Office; and "PO" for Project Office. Codes
        following the "G" typically are not used for Navy
        and Air Force projects.

        The "S" classification indicates submittals required
        as proof of compliance for sustainability Guiding
        Principles Validation or Third Party Certification
        and as described in Section 01 33 00 SUBMITTAL
        PROCEDURES.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and TABLE 1: PROJECT SEQUENCING:

    SD-02 Shop Drawings

        UMCS Contractor Design Drawings; G, [_____]

    UMCS Contractor Design Drawings as a single complete package: [_____] hard copies and [_____] copies on CDROM. Submit hardcopy drawings on [ISO A1 841 by 594 mm 34 by 22 inches][or][A3 420 by 297 mm 17 by 11 inches] sheets, and electronic drawings in both PDF and [AutoCAD][Microstation][Bentley BIM V8][Autodesk Revit 2013] format.

        Draft As-Built Drawings; G, [_____]

    Draft As-Built Drawings as a single complete package: [_____] hard copies and [_____] copies on CDROM. Submit hardcopy drawings must on [ISO A1 841 by 594 mm 34 by 22 inches][or][A3 420 by 297 mm 17 by 11 inches] sheets, and electronic drawings in both PDF and [AutoCAD][Microstation][Bentley BIM V8][Autodesk Revit 2013] format.

        Final As-Built Drawings; G, [_____]

Final As-Built Drawings as a single complete package: [_____] hard copies and [_____] copies on CDROM. Submit hardcopy drawings on [ISO A1 841 by 594 mm 34 by 22 inches][or][A3 420 by 297 mm 17 by 11 inches] sheets, and electronic drawings in both PDF and [AutoCAD][Microstation][Bentley BIM V8][Autodesk Revit 2013] format.

SD-03 Product Data

Product Data Sheets; G, [_____]

Computer Software; G, [_____]

The most recent versions of all computer software provided under this specification delivered as a Technical Data Package. Submit the user manuals for all software delivered for this project with the software.

Enclosure Keys; G, [_____]

SD-05 Design Data

UMCS IP Network Bandwidth Usage Estimate; G, [_____]

[Four][_____] copies of the UMCS IP Network Bandwidth Usage Estimate.

SD-06 Test Reports

Pre-Construction QC Checklist; G, [_____]

[Four] [_____] copies of the Pre-Construction QC Checklist.

Post-Construction QC Checklist; G, [_____]

[Four] [_____] copies of the Post-Construction QC Checklist.

[
****
NOTE: If not requiring a Factory Test in PART 3
EXECUTION, remove the submittal requirements for
Factory Test Procedures and Factory Test Report
****

Factory Test Procedures; G, [_____]

[Four] [_____] copies of the Factory Test Procedures. The Factory Test Procedures may be submitted as a Technical Data Package.

Factory Test Report; G, [_____]

[Four] [_____] copies of the Factory Test Report. The Factory Test Report may be submitted as a Technical Data Package.

]   Existing Conditions Report; G, [_____]

[Four] [_____] copies of the Existing Conditions Report.

Start-Up and Start-Up Testing Report; G, [_____]

[Four] [_____] copies of the Start-Up and Start-Up Testing Report. The Start-Up and Testing report may be submitted as a Technical Data Package.

PVT Phase I Procedures; G, [_____]

[Four] [_____] copies of the PVT Phase I Procedures. The PVT Procedures may be submitted as a Technical Data Package.

PVT Phase I Report; G, [_____]

[Four] [_____] copies of the PVT Phase I Report. The PVT Phase I Report may be submitted as a Technical Data Package.

PVT Phase II Report; G, [_____]

[Four] [_____] copies of the PVT Phase II Report. The PVT Phase II Report may be submitted as a Technical Data Package.

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G, [_____]

[Four] [_____] bound O&M Instructions[and [_____] copies of the Instructions in PDF format on optical disc]. Index and tab bound instructions.[Submit instructions in PDF form as a single PDF file, or as multiple PDF files with a PDF file table of contents containing links to the other files.] O&M Instructions may be submitted as a Technical Data Package.

Preventive Maintenance Work Plan; G, [_____]

[Four] [_____] copies of the Preventive Maintenance Work Plan. The Preventive Maintenance Work Plan may be submitted as a Technical Data Package.

Basic Training Documentation; G, [_____]

Training manuals for Basic Training delivered for each trainee on the Course Attendance List with [two] [_____] additional copies delivered for archival at the project site. Submit [two] [_____] copies of the Course Attendance List with the archival copies. The Basic Training Documentation may be submitted as a Technical Data Package.

Advanced Training Documentation; G, [_____]

One set of training manuals delivered for each trainee on the Course Attendance List with [two] [_____] additional copies delivered for archival at the project site. Submit [two] [_____] copies of the Course Attendance List with the archival copies. The Advanced Training Documentation may be submitted as a Technical Data Package.

Refresher Training Documentation; G, [_____]

One set of training manuals delivered for each trainee on the Course Attendance List with [two] [_____] additional copies

delivered for archival at the project site. Submit [two] [_____]
copies of the Course Attendance List with the archival copies.
The Refresher Training Documentation may be submitted as a
Technical Data Package.

SD-11 Closeout Submittals

Closeout QC Checklist; G, [_____]

[Four] [_____] copies of the Closeout QC Checklist.

1.6   PROJECT SEQUENCING

****
          NOTE: Table I provides bracketed text in which the
          number of days between items may be specified. In
          many cases this information will be specified
          elsewhere. When project schedule is specified
          elsewhere remove bracketed text and Table I will
          provide sequencing but not specific intervals. If
          time intervals are to be specified here keep the
          bracketed text and enter the number of days in the
          space provided.
****

TABLE I: PROJECT SEQUENCING specifies the sequencing of submittals as
specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column)
and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the
'TYPE' column).

1.6.1   Sequencing for Submittals

The sequencing specified for submittals is the deadline by which the
submittal must be initially submitted to the Government. Following
submission there will be a Government review period as specified in
Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted
by the Government, revise the submittal and resubmit it to the Government
within [14] [_____] days of notification that the submittal has been
rejected. Upon re-submittal there will be an additional Government review
period. If the submittal is not accepted the process repeats until the
submittal is accepted by the Government.

1.6.2   Sequencing for Activities

The sequencing specified for activities indicates the earliest the
activity may begin.

1.6.3   Abbreviations

In TABLE I the abbreviation AAO is used for 'after approval of' and 'ACO'
is used for 'after completion of'.

****
          NOTE:
          If requiring a Factory Test in PART 3 EXECUTION,
          keep "Acceptance of Factory Test Report" in the
          DESCRIPTION column for item 1. If NOT requiring a
          factory test keep "Notice to proceed" or edit to
          indicate other starting condition.

TABLE I. PROJECT SEQUENCING

ITEM	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL)
1		[Acceptance of Factory Test Report][Notice to proceed][_____]	
2	S	Existing Conditions Report	[_____] days after #1
3	S	Design Drawings	[_____] days after #1
4	S	Product Data Sheets and Certificate of Networthiness Documentation	[_____] days after #1
5	S	UMCS IP Network Bandwidth Usage Estimate	[_____] days after #1
6	S	Pre-construction QC Checklist	[_____] days after #1
7	E	Install UMCS	AAO #2 thru #6
8	E	Start-Up and Start-Up Testing	ACO #7

TABLE I. PROJECT SEQUENCING

ITEM	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL)
9	S	Post-Construction QC Checklist	[_____] days ACO #8
10	S	Computer Software	[_____] days ACO #8
11	S	Start-Up and Start-Up Testing Report	[_____] days ACO #8
12	S	Draft As-Built Drawings	[_____] days ACO #8
13	S	PVT Phase I Procedures	[_____] days before scheduled start of #14 and AAO #11
14	E	PVT Phase I	AAO #13 and #12
15	S	PVT Phase I Report	[_____] days ACO #14
16	S	Preventive Maintenance Work Plan	AAO #11
17	S	O&M Instructions	AAO #11
18	S	Basic Training Documentation	AAO #11 and [_____] days before scheduled start of #19
19	E	Basic Training (PVT Phase II)	AAO #16, #17 and #18
20	S	PVT Phase II Report	[_____] days ACO #19
21	S	Final As-Built Drawings	[_____] days AAO #20
22	S	Advanced Training Documentation	[_____] days before schedule start of #23 and AAO #18
23	E	Advanced Training	ACO #19, [_____] days AAO #22, and no later than [60] days ACO #19
24	S	Refresher Training Documentation	[_____] days before #25 and AAO #18 and #22
25	E	Refresher Training	between [_____] and [_____] days ACO #19 and AAO #24
26	S	Closeout QC Checklist	ACO #23

1.7   QUALITY CONTROL (QC) CHECKLISTS

The Contractor's Chief Quality Control (QC) Representative must complete the QC Checklist in APPENDIX A, and must submit the Pre-Construction QC Checklist, Post-Construction QC Checklist and Closeout QC Checklist as specified. The QC Representative must verify each item in the Checklist and initial in the provided area to indicate that the requirement has been met. The QC Representative must sign and date the Checklist prior to submission to the Government.[

The APPENDIX A QC Checklist is available as an editable file at http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-10-10
]

1.8   OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide UMCS Operation and Maintenance Instructions which include:

a.   Procedures for the UMCS system start-up, operation and shut-down.

b.   Final As-Built drawings.

c.   Routine maintenance checklist, arranged in a columnar format: The first column listing all installed devices, the second column stating the maintenance activity or stating that no maintenance required, the third column stating the frequency of the maintenance activity, and the fourth column providing any additional comments or reference.

d.   Qualified service organization list including points of contact with phone numbers.

e.   Start-Up and Start-Up Testing Report.

f.   Performance Verification Test (PVT) Procedures and Reports.

PART 2   PRODUCTS

2.1   EQUIPMENT REQUIREMENTS

2.1.1   Product Certifications

For computing devices, as defined in FCC Part 15, supplied as part of the UMCS provide devices which are certified to comply with the requirements of Class B computing devices.

2.1.2   Product Sourcing

For units of the same type of equipment, provide products of a single manufacturer. For each major component of equipment provide equipment with the manufacturer's name and the model and serial number in a conspicuous place. For materials and equipment, provide new standard unmodified products of a manufacturer regularly engaged in the manufacturing of such products.

2.1.3   General Requirements

Provide components that meet the following requirements:

****

a. Portions of the data communications equipment system installed in
unconditioned spaces must operate properly in an environment with
ambient temperatures between [0 and 49] [_____] degrees C [32 and 120]
[_____] degrees F and ambient relative humidity between 10 percent and
90 percent noncondensing.

b. Components must accept 100 to 125 volts AC (Vac), 60 Hz, single phase,
three wire with a three-pronged, dedicated circuit outlet or be
provided with a transformer to meet the component's power requirements.

c. The equipment must meet the requirements of NFPA 70, UL 60950, NFPA 262,
FCC EMC, and FCC Part 15.

2.1.4   Nameplates

Provide nameplates of laminated plastic identifying the function, network
address, if applicable, and identifier of the device. Laminated plastic
must be at least 3 mm 0.125 inch thick, white with black center core.
Nameplates must be a minimum of 25 by 75 mm 1 by 3 inch with minimum 6 mm
0.25 inch high engraved block lettering.

2.1.5   Product Data Sheets

For all products (equipment) specified in PART 2 and supplied under this
contract, submit copies of all manufacturer catalog cuts and specification
sheets to indicate conformance to product requirements. For Monitoring
and Control (M&C) Software also include the PICS verifying BTL Listing as
a B-AWS.

2.2   CONTROL HARDWARE

2.2.1   Control Protocol Routers

2.2.1.1   LonWorks/IP Router

Provide LonWorks/IP Routers which perform layer 3 routing of CEA-709.1-D
packets over an IP network in accordance with CEA-852-C. The router must
provide the appropriate connection to the IP network and connections to
the CEA-709.3 TP/FT-10 or TP/XF-1250 network. LonWorks/IP Routers must
support the Dynamic Host Configuration Protocol (DHCP; IETF RFC 4361) for
IP configuration and the use of an CEA-852-C Configuration Server (for
CEA-852-C configuration), but must not rely on these services for
configuration. LonWorks/IP Routers must be capable of manual
configuration via a console RS-232 port.

2.2.1.2   BACnet/IP Router

Provide BACnet/IP Routers which 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 a ASHRAE 135 MS/TP[, or other ASHRAE 135]
network.   Devices used as BACnet/IP Routers must be BTL Listed and must
support the Network Management-Router Configuration-B (NM-RC-B) BIBB.

2.2.1.3   Modbus/IP Router

Provide Modbus/IP Routers which perform layer 3 routing of MODBUS Protocol/
MODBUS TCP/IP packets over an IP network in accordance with MODBUS Protocol
/MODBUS TCP/IP. The router must provide the appropriate connection to the
IP network and connections to a non-IP MODBUS Protocol/MODBUS TCP/IP
network. Modbus/IP Routers must support the Dynamic Host Configuration
Protocol (DHCP; IETF RFC 4361) for IP configuration but must not rely on
this service for configuration. Modbus/IP Routers must be capable of
disabling the capability for remote configuration of Modbus routing
information from the IP network.

2.2.2   Monitoring and Control (M&C) Controller Hardware

Provide Monitoring and Control (M&C) Controller Hardware which is a
Niagara Framework Supervisory Gateway or a microprocessor-based direct
digital control hardware and which communicates over the UMCS IP network
using one of:

a.   CEA-709.1-D in accordance with CEA-852-C and using only Standard
     Network Variable Types (SNVTs) as defined by the LonMark SNVT List.

b.   ASHRAE 135 in accordance with ASHRAE 135 Annex J and using only
     Standard ASHRAE 135 services.

Monitoring and Control (M&C) Controller Hardware must either meet the
requirements of the LonMark Interoperability Guide or be BTL Listed.

2.2.3   BACnet Supervisory Controller Hardware

Provide BACnet Supervisory Controller Hardware which is direct digital control hardware and which:

a. is BTL Listed

b. communicates using ASHRAE 135 over an IP network in accordance with ASHRAE 135 Annex J

c. has a configurable Object_Name Property

d. supports the following BIBBS

    (1) DS-RP-B (Data Sharing-Read Property-B) BIBB for Objects requiring read access from the M&C Software

    (2) DS-WP-B (Data Sharing-Write Property-B) BIBB for Objects requiring write access from the M&C Software.

    (3) SCHED-E-B (Scheduling-External-B)

    (4) AE-N-I-B (Alarm and Event-Notification Internal-B)

    (5) AE-ACK-B (Alarm and Event-ACK-B)

    (6) T-VMT-I-B (Trending-Viewing and Modifying Trends-Internal-B)

    (7) T-ATR-B (Trending-Automated Trend Retrieval-B)

e. has a Writable Recipient_List Property of the Notification Class Object

2.2.4   Control Protocol Gateways

****
          NOTE: FYI: Except for the use of Niagara Framework
          Supervisory Gateways with Niagara Framework M&C
          Software, Gateways should be used only for the
          integration of legacy building control systems
          (HVAC, lighting etc) or for the integration of new
          or legacy utility control systems. Gateways should
          not be used to permit the installation of new
          building control systems which do not use, CEA-709.1-D
           or ASHRAE 135.

          Indicate if additional capability may be required.
          Note that since the Legacy system should not change
          this requirement shouldn't be needed, and when used
          will normally be intended to cover the case of
          'forgotten' points (when the mapping requirements
          from the legacy system have not been fully/properly
          identified). Requiring excess capacity may add cost.
****

****
          NOTE: This subpart uses tailoring options. Fox
          Protocol is included in the protocol list only when
          the NIAGARA FRAMEWORK tailoring option is selected.
****

Provide Control Protocol Gateways which perform bi-directional protocol

translation between two of the following protocols, or between one of the following protocols and another protocol: CEA-709.1-D, ASHRAE 135, MODBUS Protocol, MODBUS TCP/IP, Fox protocol, and OPC DA. Provide Control Protocol Gateways which also meet the following requirements.

a. Gateways must have two or more separate network connections, each appropriate for the protocol and media used. A single network connection must not be used for both protocols.

b. Gateways must be capable of being installed, configured and programmed through the use of instructions in the manual supplied by the Contractor.

c. Provide and license to the Government all software required for gateway configuration.

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

e. Gateways must provide capacity for mapping all required points as indicated[plus an additional [10 percent][_____]] between the two protocols it uses.

f. Gateways must, in addition, meet all requirements specified (in the following subparagraphs) for each of the two protocols it translates.

2.2.4.1   Gateway for CEA-709.1

For a gateways using CEA-709.1-D provide gateways which meet the following requirements in addition to the requirements for all gateways:

a. It must allow bi-directional mapping of data in the Gateway to Standard Network Variable Types (SNVTs) according to the LonMark SNVT List.

b. Gateways communicating CEA-709.1-D over an IP network must communicate in accordance with CEA-852-C.

c. It must allow of its standard network variables (SNVTs) and support transmitting data using the "min, max, and delta" (throttling and heartbeat) methodology.

d. It must provide the ability to label SNVTs.

e. It must supply a LonMark external interface file (XIF) as defined in the LonMark XIF Guide for use with LNS tools and utilities.

f. It must have a "service pin" which, when pressed, will cause the Gateway to broadcast its 48-bit NodeID and ProgramID over the network.

g. It must provide a configurable self-documenting string.

2.2.4.2   Gateway for ASHRAE 135

For gateways using ASHRAE 135 provide gateways which meets the following requirements in addition to the requirements for all gateways:

a. It must allow bi-directional mapping of data in the Gateway to

Standard Objects as defined in ASHRAE 135.

b. All ASHRAE 135 Objects must have a configurable Object_Name Property.

c. It must be BTL Listed.

d. Gateways communicating ASHRAE 135 over an IP network must communicate in accordance with ASHRAE 135 Annex J.

****
          NOTE: The following 2 requirements cover 2 ways in which the gateway can be used:

          1) The gateway communicates with a BACnet building control system. In this case the gateway has to be able to read from and write to devices in the BACnet building control system.

          2) The gateway communicates with a BACnet front-end (M&C Software). In this case the gateway must be able to be read from and be written to by the M&C Software. In addition, the gateway must provide scheduling, alarming and trending for the building system.

          Note that it would be possible to have a BACnet-BACnet gateway that is used in both of these ways at the same time.
****

e. Gateways communicating ASHRAE 135 to a field control systems must support the DS-RP-A (Data Sharing–Read Property–A) BIBB and the DS-WP-A (Data Sharing–Write Property–A) BIBB.

f. Gateways communicating ASHRAE 135 to the M&C Software or to a BACnet Supervisory Controller must support the DS-RP-B (Data Sharing–Read Property–B) BIBB for Objects requiring read access from the M&C Software and the DS-WP-B (Data Sharing–Write Property–B) BIBB for Objects requiring write access from the M&C Software

2.2.4.3   Gateway for Modbus

****
          NOTE: This subpart uses tailoring options. Requirements for the presentation of data in accordance with the MODBUS REQUIREMENTS paragraph is only included when the MODBUS tailoring option is selected.
****

For gateways that use MODBUS Protocol/MODBUS TCP/IP provide gateways that meet the requirements specified for all gateways and which allow bi-directional mapping of data in the Gateway to MODBUS Protocol/ MODBUS TCP/IP registers using the four standard Modbus register types (Discrete Input, Coil, Input Register, and Holding Register). Gateways communicating MODBUS Protocol/MODBUS TCP/IP to the M&C Software must communicate via MODBUS Protocol/MODBUS TCP/IP over TCP/IP and must present floating point values, character values, and date values using the appropriate data type as specified in paragraph MODBUS REQUIREMENTS.

2.2.4.4   Gateway for OPC

  For gateways that use OPC DA, provide gateways that meet the requirements
  specified for all gateways and which allow bi-directional mapping of data
  in the Gateway using OPC DA tags and which communicate over an IP network
  in accordance with OPC DA.

2.2.4.5   Gateway for DNP3

  For gateways that use DNP3, provide gateways that meet the requirements
  specified for all gateways and which allow bi-directional mapping of data
  in the Gateway to DNP3 object groups and variations as defined by IEEE 1815.
  Gateways communicating DNP3 over an IP network must communicate in
  accordance with the LAN/WAN Networking volume of IEEE 1815.

2.2.4.6   Niagara Framework Supervisory Gateway

  ****
          NOTE: This subpart is only required for Niagara
          Framework systems, or for Navy Projects and is only
          included when the NIAGARA FRAMEWORK or NAVY
          tailoring option is selected.
  ****

  ****
          NOTE: FYI - The Niagara Framework Supervisory
          Gateway is known by many names within industry, and
          this specification uses the name "Niagara Framework
          Supervisory Gateway" in order to remain vendor
          neutral.   Probably the most common term used for
          this device in industry is a "Java Application
          Control Engine", or JACE.
  ****

  Niagara Framework Supervisory Gateway Hardware must:

  a. be direct digital control hardware.

  b. have an unrestricted interoperability license and a Niagara
      Compatibility Statement (NiCS) that follows the Tridium Open NiCS
      Specification.

  c. manage communications between a field control network and the Niagara
      Framework Monitoring and Control Software and between itself and other
      Niagara Framework Supervisory Gateways. Niagara Framework Supervisory
      Gateway Hardware must use Fox protocol for communication with other
      Niagara Framework Components.

  d. be fully programmable using the Niagara Framework Engineering Tool and
      support the following:

      (1) Time synchronization, Calendar, and Scheduling using Niagara
           Scheduling Objects

      (2) Alarm generation and routing using the Niagara Alarm Service

      (3) Trending using the Niagara History Service and Niagara Trend Log
           Objects

(4)   Integration of field control networks using the Niagara Framework
                  Engineering Tool

            (5)   Configuration of integrated field control system using the
                  Niagara Framework Engineering Tool when supported by the field
                  control system

      e. meet the following minimum hardware requirements:

            (1)   [One][Two] 10/100/1000 Mbps Ethernet Ports

            (2)   One port compatible with the field control system to be
                  integrated using this product.[

            (3)   Central Processing Unit of 600 Mhz or higher.][

            (4)   Embedded operating system.]

      f. provide access to field control network data and supervisory functions
          via web interface and support a minimum of 16 simultaneous users

2.3   COMPUTER HARDWARE

****
            **NOTE: Coordinate with the project site to determine
            if the server(s) will be contractor supplied or
            Government Furnished. If Government Furnished
            remove the following bracketed text.**
****
For computer hardware furnished under this specification provide standard
products of a single manufacturer which advertises service in all 48
contiguous states, and provide only model currently in production. Except
for PCI-E cards installed into expansion slots provided in a desktop or
server computer in order to meet the requirements of this specification,
do not modify computer hardware from the manufacturer configuration.

2.3.1   Server Hardware

****
            **NOTE: Coordinate with the project site to determine
            if the server(s) will be contractor supplied or
            Government Furnished.**

            **If contractor supplied, coordinate with the Project
            Site's NEC (IT group) and include the sites
            'standard' server redundancy requirements.**

            **Note that computer technology changes quickly and
            these requirements should be edited to reflect
            current products.   Default requirements (current as
            of 2012) have been provided in brackets.**
****

Computer Server Hardware (server) [will be furnished by the Government]
[must be a desktop or server computer meeting the following minimum
requirements:]

[2.3.1.1   Processor

   [_____][Quad-core processor designed for server applications. Processor
   speed must be at least 50 percent of the speed of the fastest Intel server
   processor commercially available].

2.3.1.2   Random Access Memory (RAM)

   [_____][300 percent of the recommended requirements of the software to be
   installed on the server[and no less than 24GB].]

2.3.1.3   Communications Ports

   [_____][Four USB ports.]

2.3.1.4   Hard Drives

2.3.1.4.1   Internal Hard Drives

   [____][Hard drives with SATA-3 Controller providing at least [2TB][____]
   usable disk space. Hard drives must use RAID (Redundant Array of
   Inexpensive Disks) at levels 1 or 5 (RAID-1 or RAID-5).]

2.3.1.4.2   External Hard Drive

   [____][[4TB][____] disk space with a USB 3.0 interface.]

2.3.1.5   Optical Drive

   [____][Blueray burner drive.]

2.3.1.6   Video Output

   [____][32-bit color at a minimum resolution of 1920 by 1080 at a minimum
   refresh rate of 70 Hz and a DVI or display port output.]

2.3.1.7   Network Interface

   [____][[Two] integrated 1000Base-T Ethernet with RJ45 connector.]

2.3.1.8   Monitor

   [____][Widescreen flat panel LCD monitor sized as indicated but no less
   than 24 inch nominal with a minimum resolution of 1600 by 1050 pixels and
   a minimum refresh rate of 70Hz.]

2.3.1.9   Keyboard

   [____][101 key wired USB keyboard having a minimum 64 character standard
   ASCII character set based on ANSI INCITS 154 and an integral smart card
   reader compatible with a Department of Defense Common Access Card (CAC).]

2.3.1.10   Mouse

   [____][2-button wired USB optical scroll mouse with a minimum resolution
   of 400 dots per inch.]

2.3.1.11   Power Supplies

[_____][Hot-swappable redundant power supplies.]

]2.3.2   Workstation Hardware (Desktop and Laptop)

[The Government will provide the] [Provide a standard desktop computer or
a laptop meeting the following minimum requirements for the] Computer
Workstation Hardware (workstation) [as indicated].

[2.3.2.1   Processor

2.3.2.1.1   Desktop

Quad-core processor designed for desktop applications. Processor speed
must be at least 75 percent of the speed of the fastest Intel desktop
processor commercially available.

2.3.2.1.2   Laptop

Quad-core processor designed for laptop applications. Processor speed
must be at least 50 percent of the speed of the fastest Intel laptop
processor commercially available.

2.3.2.2   Random Access Memory (RAM)

[_____][300 percent of the recommended requirements of the software to be
installed on the server[and no less than 8GB].]

2.3.2.3   Communications Ports

2.3.2.3.1   Desktop

[_____][Six USB ports.]

2.3.2.3.2   Laptop

  [____][Two USB ports, plus a PCMCIA card slot or an additional USB port,
  plus an integral RS-232 serial port or an additional USB port and a USB to
  RS-232 serial adapter.]

2.3.2.4   Hard Drive and Controller

2.3.2.4.1   Desktop

  [____][[1.5TB][____] or larger with a SATA-3 controller.]

2.3.2.4.2   Laptop

  [____][[250GB][____] or larger solid state drive.]

2.3.2.5   Optical Drive

  [____][DVD-RW drive]

2.3.2.6   Video Output

2.3.2.6.1   Desktop

  [____][32-bit color with dual monitor support minimum resolutions of 1920
  by 1080 at minimum refresh rates of 70 Hz and dual DVI or display port
  outputs.]

2.3.2.6.2   Laptop

  [____][32-bit color with a minimum resolution of 1920 by 1080 at minimum
  refresh rates of 70 Hz and VGA or HDMI output.]

2.3.2.7   Network Interface

2.3.2.7.1   Desktop

  [____][Integrated 1000Base-T Ethernet with RJ45 connector.]

2.3.2.7.2   Laptop

  [____][Integrated 1000Base-T Ethernet with RJ45 connector and an
  integrated IEEE 802.11b/g/n wireless interface. The Laptop must have a
  physical switch for activation and deactivation of the wireless interface.]

2.3.2.8   Monitor

2.3.2.8.1   Desktop

  [____][Dual widescreen flat panel LCD monitors sized as indicated but no
  less than600 mm 24 inch nominal with minimum resolutions of 1920 by 1080
  pixels and a minimum refresh rate of 70Hz.]

2.3.2.8.2   Laptop

  [____][LCD Screen sized as indicated but no less than 325 mm 13 inch
  nominal with a maximum supported resolution of no less than 1600 by 900
  pixels.]

2.3.2.9   Keyboard and Smart Card Reader

2.3.2.9.1   Desktop

  [____][101 key wired USB keyboard having a minimum 64 character standard
  ASCII character set based on ANSI INCITS 154 and an integral smart card
  reader compatible with a Department of Defense Common Access Card (CAC).]

2.3.2.9.2   Laptop

  [____][Standard laptop keyboard. Internal smart card reader compatible
  with a Department of Defense Common Access Card (CAC).]

2.3.2.10   Mouse

2.3.2.10.1   Desktop

  [____][2-button wired USB optical scroll mouse with a minimum resolution
  of 400 dots per inch.]

2.3.2.10.2   Laptop

  [____][Integrated touch-pad plus a 2-button wired USB optical scroll mouse
  with a minimum resolution of 400 dots per inch.]

]2.3.3   Printers

  Provide local or network printers as indicated. Provide local printers
  which have a USB interface. Provide network printers which have a
  100Base-T or faster interface with an RJ45 connection and a firmware print
  spooler compatible with the Operating System print spooler.

2.3.3.1   Alarm Printer

  Provide alarm printers which use sprocket-fed fanfold paper with
  adjustable sprockets for paper width up to 280 mm 11 inches. Alarm
  printers must have programmable control of top-of-form. [Provide floor
  stands with paper racks for alarm printers.]

2.3.3.2   Laser Printer

  Provide laser printers as indicated meeting the following minimum
  requirements:

Resolution	600 by 600 dots per inch
Printing Time	10 pages per minute
Data Buffer Size	16 Megabytes
Media Type	Paper and transparency film
Media Size	ANSI A(216 by 279 mm 8.5 by 11 inches) and other sizes as indicated

Paper Cassette	250 sheet capacity

2.4   COMPUTER SOFTWARE

2.4.1   Operating System (OS)

****
         **NOTE: Coordinate with the project site to determine
         if the OS license will be contractor supplied or
         Government Furnished.**
****

****
         **NOTE: This subpart uses tailoring options to
         indicate the Gold Master version to use.**
****

Provide the latest version of the Army [DISA][_____] Gold Master Windows
Operating System. The Operating System media will be furnished by the
Government. [Provide][The Government will provide] the Operating System
license.

2.4.2   Office Automation Software

****
         **NOTE: Coordinate with the project site to determine
         if the Office Automation Software will be contractor
         supplied or Government Furnished.**
****

[Provide Office Automation Software consisting of the [e-mail,]
spreadsheet and word processing portions of the project site's standard
office automation software.] [Office Automation Software will be furnished
by the Government.]

2.4.3   Virus Protection Software

****
         **NOTE: Coordinate with the project site to determine
         if the Virus Protection Software will be contractor
         supplied or Government Furnished.**
****

[Provide Virus Protection Software consisting of the project site's
standard virus protection software complete with a virus definition update
subscription] [Virus Protection Software will be furnished by the
Government].

2.4.4   Disk Imaging (Backup) Software

****
         **NOTE: Coordinate with the project site to determine
         if the Disk Imaging (Backup) Software will be
         contractor supplied or Government Furnished.**
****

[Provide Disk imaging (backup) software capable of performing a bare-metal

restore (imaging and restoring to a new blank hard drive such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software).] [Provide Disk imaging (backup) software consisting of the project site's standard disk imaging software.] [Disk imaging (backup) software will be furnished by the Government.]

2.4.5   M&C Controller Hardware Configuration Software

Provide M&C Controller Hardware Configuration Software consisting of the software required to configure, program, or configure and program each Monitoring and Control (M&C) Controller Hardware provided for the functions it performs.

2.4.6   CEA-852-C Configuration Server

****
        NOTE: This subpart only applies to LonWorks systems
        and is only included when the LONWORKS tailoring
        option is selected.
****

Provide CEA-852-C configuration server software meeting the requirements of CEA-852-C.

2.4.7   CEA-709.1-D Network Configuration Tool

****
        NOTE: This subpart only applies to LonWorks systems
        and is only included when the LONWORKS tailoring
        option is selected..
****

Provide a network configuration tool software which:

a. Solely uses LonWorks Network Services (LNS) for all network
    configuration and management of CEA-709.1-D devices.

b. Is capable of executing LNS plug-ins.

c. Is capable of performing network database reconstruction of an
    CEA-709.1-D control network, such that if connected to an existing
    CEA-709.1-D network it has the ability to query the network and create
    an LNS database for that network.

d. Allows configuration of the network while off-line such that an
    operator may set up changes to the network while disconnected from the
    network, and then execute all of them once connected.

e. Includes the standard LNS Report Generator and is capable of
    generating and printing the following reports:

    (1) A table containing domain/subnet/node address and node identifier
         for the entire network or any subset thereof, selected by the
         user.

    (2) A table containing Standard Network Variable (SNVT) input and
         output details for any CEA-709.1-D device on the network.

(3) A table containing Standard and User-Defined Configuration
                 Properties (SCPTs and UCPTs) for any CEA-709.1-D device on the
                 network.

      f.   Is capable of merging two existing standard LNS databases into a
           single standard LNS database.

2.4.8   BACnet Network Browser

   ****
            NOTE: This subpart only applies to BACnet systems
            and is only included when the BACNET tailoring
            option is selected.
   ****

   Provide a BACnet Network Browser software that:

   a.   Can perform full discovery of a ASHRAE 135 system including but not
        limited to discovery of all ASHRAE 135 devices, the ASHRAE 135 Objects
        and Properties of each device, and the standard ASHRAE 135 services
        supported by each device.

   b.   Can read any ASHRAE 135 Property of any Object in any device.
        Proprietary Properties may be presented as read without further
        interpretation.

   c.   Can write any Standard ASHRAE 135 Property of any Object in any device.

   d.   Supports segmentation.

   e.   Supports all of the following BIBBs:

        (1) DM-ANM-A (Device Management-Automatic Network Management-A)

        (2) DM-ADM-A (Device Management-Automatic Device Management-A)

        (3) DM-DDB-A (Device Management-Dynamic Device Binding-A)

        (4) DM-DOB-A (Device Management-Dynamic Object Binding-A)

        (5) DS-RP-A (Data Sharing-Read Property-A)

        (6) DS-RPM-A (Data Sharing-Read Property Multiple-A)

        (7) DS-WP-A (Data Sharing-Write Property-A)

2.4.9   Niagara Framework Engineering Tool

   ****
            NOTE: This subpart only applies to Niagara
            Framework systems and is only included when the
            NIAGARA FRAMEWORK tailoring option is selected.
   ****

   Provide Niagara Framework engineering tool software which:

   a.   has unrestricted interoperability license and a Niagara Compatibility
        Statement (NiCS) which follows the Tridium Open NiCS Specification.

b. is capable of performing network configuration for Niagara Framework
    Supervisory Gateways and Niagara Framework Monitoring and Control
    Software.

c. is capable of programming and configuring Niagara Framework
    Supervisory Gateways and Niagara Framework Monitoring and Control
    Software.

d. is capable of discovery of Niagara Framework Supervisory Gateways and
    all points mapped into each Niagara Framework Supervisory Gateway and
    making these points accessible to Niagara Framework Monitoring and
    Control Software.

2.4.10   Monitoring and Control (M&C) Software

****
          NOTE: Designer should choose the minimum number of
          points and clients the M&C software is required to
          accommodate based on the project site's master
          plan. The initial number of points to be
          accommodated should be chosen such that it is
          sufficient to cover all current and known future
          projects. The total system expansion requirement
          should be based on potential/anticipated future
          projects.

          It's a good idea to obtain pricing for several
          price-points between the current specified
          points/clients and the future number of
          points/clients. Depending on the vendor the cost
          increase for system expansion may be drastically
          different.

          For non-Niagara Framework systems, points means
          "points that the M&C software can read/write on the
          network". In general, points will be SNVTs for
          LonWorks and the Present Value Property of Objects
          for BACnet. Other examples of Points are other
          BACnet Properties or LonWorks configuration
          properties/configuration network variables. For
          Modbus, a point will generally be a Modbus register.
          For OPC, a point will be an OPC "tag".

          For the Niagara Framework, point licensing only
          applies to points directly integrated to the M&C
          Software without first being brought into a Niagara
          Framework Supervisory Gateway. Discuss with the
          installation whether integration will generally be
          accomplished via Niagara Framework Supervisory
          Gateways (this is the normal method) or not before
          determining a point licensing requirement When
          integration will "always" be through a Niagara
          Framework Supervisory Gateway change the number of
          network points required below to zero or a very
          small number. When requiring network points
          indicate in the space provided the protocol drivers
          required and network points required to be licensed
          by each.

Provide monitoring and control (M&C) software which is a client-server
software package with a graphical user interface (GUI) using web-browser
based clients. Provide Niagara Framework monitoring and control software
which communicates with Niagara Framework field control systems using the
Fox protocol. Provide M&C Software which communicates via CEA-709.1-D, and
ASHRAE 135, and MODBUS Protocol/MODBUS TCP/IP, and OPC DA. The M&C
Software may support other field control protocols. Provide M&C Software
which is BACnet Testing Laboratories Certified ("Listed") as a B-AWS.

Provide a single software package which implements the Scheduling,
Alarming, Trending, Graphical System Display, and System Display Editor
functionality. Other specified M&C functionality may be implemented in
the same software package or in additional software packages. As
specified in PART 3 EXECUTION, the M&C Software must operate on Server
hardware, except that software for Point Calculations and Demand Limiting
may operate on M&C Controller Hardware.

2.4.10.1   M&C Software License

License the M&C Software as specified. Use of multiple copies of M&C
Server software working in coordination and sharing data between them such
that they function as, and appear to an operator as, a single M&C Server
is permitted to meet these requirements.

2.4.10.1.1   Network Points

For Niagara Framework systems, a network point is a point brought directly into the Web Supervisor M&C Software through a protocol other than the Fox Protocol and via a Niagara Framework Supervisory Gateway. Provide M&C Software and licensing to support no less than [_____] network points, and to be capable of expansion to support no less than [50,000] [_____] network points. [Provide Niagara Framework M&C Software which includes the following drivers, each of which is licensed for a number of network points as follows: [_____].]

2.4.10.1.2   Web Clients

Provide M&C Software and licensing to support no less than [10] [_____] simultaneous web clients with no limit on the total number of web clients. M&C Software must be capable of expansion to support no less than [30] [_____] simultaneous web clients.

2.4.10.1.3   Calculations

Provide M&C Software and licensing to support no less than one calculated point for every ten network points (see "Network Points" above).

2.4.10.1.4   Other Points

For installations using M&C Software installed on M&C Controller Hardware (as opposed to Server hardware), provide additional licensing to support additional network points for the communications between portions of the M&C Software installed on different hardware. For example, if the Calculations requirement is performed by M&C Software installed on Controller hardware, the M&C Software must be licensed for additional network points to cover the network points required for communication between the Controller hardware and the Server hardware.

2.4.10.1.5   Alarming

****
        NOTE: This subpart uses tailoring options:
        1) the phrase "alarm generation and" and the work
        "points" is included if the LONWORKS, MODBUS or OPC
        tailoring option is selected.

        2) the phrase "ASHRAE 135 Alarm Event Notifications"
        is included if the BACNET tailoring option is
        selected.
****

Provide M&C Software and licensing to support alarm generation and the handling (routing) of alarms for no less than [10,000] [_____] points and ASHRAE 135 Alarm Event Notifications.

2.4.10.1.6   Trending

Provide M&C Software and licensing to support a minimum of [8,000] [_____] simultaneous trends.

[2.4.10.1.7   Scheduling

****
        NOTE: This subpart only applies to LonWorks,
        Modbus, or OPC systems and is only included when the

Provide M&C Software and licensing to support a minimum of [200] [_____]
user-definable schedules.

]2.4.10.1.8   Niagara Framework Open License

Provide M&C Software with an unrestricted interoperability license and a
Niagara Compatibility Statement (NiCS) which follows the Tridium Open NiCS
Specification.

2.4.10.2   M&C Software Update Licensing

In addition to all other licensing requirements, provide M&C Software licensing which includes licensing of the following software updates for a period [of no less than 5 years][_____]:

a. Security and bug-fix patches issued by the M&C Software manufacturer.

b. Security patches to address any vulnerability identified in the National Vulnerability Database at http://nvd.nist.gov with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

2.4.10.3   Supported Field Control Protocols

****
          NOTE: FYI: one of the integration methods for
          legacy systems is to use a protocol driver (a
          'software gateway') in the M&C software to integrate
          the legacy system, and these requirements permit the
          M&C Software to support protocols other than those
          specifically required in this specification.
****

****
          NOTE: WARNING - The BACnet tailoring option has
          been selected with another protocol tailoring option
          (LonWorks, Modbus, OPC). As described in UFC
          3-470-01, many of the Monitoring and Control
          Software packages which support BACnet support ONLY
          BACnet, so the inclusion of other protocol tailoring
          options may unnecessarily limit the number of
          vendors able to provide the UMCS. The need for
          supporting multiple protocols at the Monitoring and
          Control Software should be verified/checked with the
          project site. Note that any protocol can be
          integrated to the UMCS with the use of a gateway, so
          omitting a tailoring option does not prohibit the
          integration of systems using that protocol.

          See UFC 3-470-01 for more information.
****

****
          NOTE: WARNING - The Niagara Framework tailoring
          option has been selected with the LonWorks tailoring
          option. As described in UFC 3-470-01, LNS-based
          LonWorks (required by the LonWorks tailoring option)
          is generally not compatible with the Niagara
          Framework.

          See UFC 3-470-01 for more information.
****

Provide M&C Software which supports field control protocols as follows:

****
          NOTE: Due to the use of tailoring options in the
          following list of requirements not all requirements
          will be included in all projects and items may

```
              require renumbering.
     ************************************************************************
```

a. The M&C Software must include a driver to LNS, or a driver to an OPC
    interface to LNS, or a driver to CEA-852-C, and must be capable of
    reading and writing any SNVT on the CEA-852-C network. Software with
    a driver to LNS or a driver to an OPC interface to LNS must
    communicate with field control systems via LNS using this driver.
    Software with a driver to CEA-852-C must obtain all communication
    information (such as device addresses and network variable indices)
    from LNS and must automatically update this information whenever the
    LNS Database changes.

b. The M&C Software must include a driver to ASHRAE 135 over IP in
    accordance with ASHRAE 135 Annex J.

c. The M&C Software must include a driver to MODBUS Protocol/MODBUS TCP/IP
     over TCP/IP. The M&C Software must be capable of reading and writing
    the Modbus data types as defined in paragraph MODBUS REQUIREMENTS and
    must, in addition, be capable of manipulating and presenting arbitrary
    data formats derived from the four standard Modbus data types.

d. The M&C Software must be an OPC DA client.

e. The Software must use the Niagara Framework and must communicate with
    Niagara Framework Supervisory Gateways using the Fox protocol.

f. The M&C Software may, in addition, include drivers to other protocols.

Provide M&C Software capable of reading values from and writing values to
points via any supported field protocol, and capable of reading values
from one field protocol and writing them to another. All points obtained
from any field protocol must be available to all M&C Software

functionality.

2.4.10.4   Supported Enterprise Protocols

Provide M&C Software which supports oBIX, BACnet Web Services or OPC as an enterprise protocol and which meets the following requirements:

a. It is able to read values from any point or collection of points (network point, internal point, trend log or schedule) and transmit these values via the enterprise protocol.

b. It is able to receive data via the enterprise protocol and use this data to change the value of any point.

c. License the enterprise protocol interface to the project site and document the interface such that any system capable of communicating with that protocol can be used to read and write data from the M&C Software.

2.4.10.5   Point Information

Every point, both network and internal, in the M&C Software must contain the following fields:

2.4.10.5.1   Name

A configurable name used for identification of the point within the M&C Software.

2.4.10.5.2   Description

A configurable description of no less than 80 alpha-numeric characters.

2.4.10.5.3   Value

A field containing the current point value.

2.4.10.5.4   Units

A field containing the engineering units.

2.4.10.5.5   Source

A field identifying the source of the point. For network points, this is generally the address or identification of the field device (for example, the Domain-Subnet-Node address for LonWorks field control devices or the DeviceID for BACnet devices).

2.4.10.6   Point Calculations

Provide M&C software capable of performing calculations and computing the value of a calculated point based on the values of two or more network points and calculated points. Mathematical operators must include: addition, subtraction, multiplication, division, exponentiation (y^x, power), square root, reciprocal, natural logarithm, sin, cos, tan, arcsin, arccos, arctan, and parenthesis. Pi and e must be available as constants for use in calculations.

2.4.10.7   Browser-Based Graphical User Interface (GUI)

Provide M&C Software which includes a web-browser based (client-server)
graphical user interface through which all M&C Software functionality,
except for the Graphics Editor, System Display Editor, report
configuration, point calculation configuration, and enterprise protocol
configuration, is accessible.

Provide graphical user interface web server and web clients meeting the
following requirements:

a.   The web server must use HTTPS based on the Transport Layer Security
     (TLS) Protocol in accordance with IETF RFC 7465 using a
     Government-furnished certificate.

b.   The graphical user interface must be Common Access Card (CAC) enabled:
     It must support web client authentication using certificates obtained
     from a Department of Defense Common Access Card (CAC) Smart Card.

c.   The web client must operate on any version of Windows currently
     supported by Microsoft.

d.   The web client must function in the most recent three version of
     Internet Explorer [and [the most recent three versions of
     Firefox][____]].

e.   The web client must not require a connection to any server other than
     the M&C Server.

f.   The web client must function in a browser with Java, Shockwave,
     Silverlight, and Flash installed. The client may require a download
     of mobile code from the M&C Server, but must not require the download
     of additional browser plug-ins or add-ins and there must be no limit
     on the number of downloads. The client must not require ActiveX.

2.4.10.8   Passwords

Provide M&C software with user-based access control to M&C functionality.
The M&C Software must recognize at least [100] [_____] separate users and
have [at least 4] [_____] levels of user permissions. User permission
levels (from most restrictive to most permissive) must include:[

a. Permission Level 1: View-only access to the graphical user interface.

b. Permission Level 2: Permission Level 1 plus acknowledge alarms and set
    up (configure) trends and reports.

c. Permission Level 3: Permission Level 2 plus override points and set up
    (configure) alarms, schedules and demand limiting.

d. Permission Level 4: Permission Level 3 plus create and modify
    Graphical System Displays using the System Display Editor.][_____]

Passwords must not be displayed and must not be logged. The system must
maintain a disk file on the server hardware logging all activity of the
system.   This file must maintain, as a minimum, a record of all
operators logged onto the system, alarm acknowledgments, commands issued
and all database modifications. If the file format is not plain ASCII
text, provide a means to export or convert the file to plain ASCII text.
Provide a mechanism for archiving the log files for long term record
storage.

2.4.10.9   Graphical System Displays

Provide graphical displays consisting of building system (air handler
units, VAV boxes, chillers, cooling towers, boilers, etc.) graphic
displays. Data associated with an active display must be updated at least
once every 5 seconds.

2.4.10.9.1   Navigation Scheme

System graphic displays of building systems and points must be
hierarchical displays using a building-to-equipment point-and-click
navigation scheme which allows navigation from a garrison-wide display,
through a building-wide display to the individual units. Each display must
show the building name and number. Each display must show system wide
data such as outside air temperature and humidity in the case of an HVAC
system application.

a. For each Building or Building Sub-Area display, show the building foot
    print and basic floor plan, and clearly show and distinguish between
    the individual zones and the equipment serving each zone and space.
    Show all space sensor and status readings, as applicable, for the
    individual zones such as space temperature, humidity, occupancy
    status, etc. Show the locations of individual pieces of monitored and
    controlled equipment.

**detailed graphics have on the performance of the
user interface; the more complex the graphic, the
longer it will take for the page to load.**
****

b. For each equipment display show a [one-line diagram control
    schematic][3-dimensional] representation of the individual pieces of
    equipment using the symbols and M&C point data types as specified.
    Use different colors and textures to indicate various components and
    real time data. Use consistent color and texture meanings across all
    displays.

c. Provide displays which clearly distinguish between the following point
    data types and information:

    (1) Real-time data.

    (2) Other user-entered data.

    (3) Devices in alarm (unacknowledged).

    (4) Out-of-range, bad, or missing data.

    (5) Points which are overridden.

2.4.10.9.2   Navigation Commands

Provide system displays which support English language operator commands
via point-and-click mouse or keyboard entry for defining and selecting
points, parameters, graphics, report generation, and all other functions
associated with operation. The operator commands must be usable from any
operator workstation with individual operator passwords as specified.

2.4.10.10   Graphic Editor

Provide a fully featured graphics editor and capable of creating custom
graphics and graphic symbols for use by the System Display Editor.

2.4.10.11   System Display Editor

Provide a system display editor which allows the user to create, modify,
and delete graphic displays. The display editor may have a separate user
interface and is not required to be accessible via the web browser
interface. Provide a display editor which includes the following
functions:

a. Create and save displays. Save an existing or modified display as a
    new display (i.e. "save as")

b. Group and ungroup graphics, where graphics include both alphanumeric
    and graphic symbols, and where a grouped graphic is manipulated as a
    single graphic.

c. Place, locate, resize, move, remove, reposition, rotate and mirror a
    graphic on a display.

d. Overlay graphics over other graphics and assign depths such that when
    there are coincident graphics the one on top is visible.

e. Modify graphic properties based on the value of network points and
    create conditions governing the display of a graphics such that
    different graphics are visible based on the value of network points or
    calculated points

f. Integrate real-time data with the display.

g. Establish connecting lines.

h. Establish sources of latest data and location of readouts.

i. Display analog values as specified.

j. Assign conditions which automatically initiate a system display.

k. Include library of display symbols which include: Pump, Motor, Two-
    and Three-way Valves, Flow Sensing Element, Point and Averaging
    Temperature Sensors, Pressure Sensor, Humidity Sensor, Single and
    Double Deck Air Handling Unit, Fan, Chiller, Boiler, Air Compressor,
    Chilled Water Piping, Steam Piping, Hot Water Piping, Ductwork, Unit
    Heater, Pressure Reducing Valve, Damper, Electric Meter, Limit Switch,
    Flow Switch, High- and Low- Point and Averaging Temperature Switches,
    High- and Low- Pressure Switches, Coil, Solenoid Valve, Filter,
    Condensing Unit, Cooling Tower, Variable Frequency Drive (VFD), Heat
    Exchanger, Current Sensing Relays, Generator, Circuit Breaker,
    Transformer, Tank. Symbols must at a minimum conform to ASHRAE FUN SI
    ASHRAE FUN IP where applicable.

2.4.10.12   Scheduling

****
            NOTE: FYI: For BACnet systems it is expected that
            there will be Scheduling Objects in the field
            control system and the M&C Software will edit
            (configure) these schedules.

            For LonWorks the M&C software will be the primary
            method of scheduling; building systems have 'backup'
            scheduling capability in the event of a loss of
            communication with the M&C Software Server.

            For Niagara Framework systems it is expected that
            there will be Niagara Framework Scheduling Objects
            in the Niagara Framework Supervisory Gateway(s) and
            the M&C Software will edit (configure) these
            schedules.

            In general it is expected that Modbus and OPC will
            be used for the integration of utility control
            systems which will likely have their own scheduling
            capability. In this case scheduling from the M&C
            Software will be for secondary/supervisory functions.

            Due to the use of tailoring options in the following
            list of requirements not all requirements will be
            included in all projects and items may require
            renumbering.

a. Provide M&C software capable of changing the value of any network
    point according to a schedule. The M&C Software must be capable of
    scheduling points to any value, including a "null" or invalid value if
    one is defined for the data type of the point.

b. The specified scheduling functions must be operator accessible and
    adjustable via the graphical user interface. Each schedule must be
    able to change the value of multiple points. The M&C software must
    reinforce all schedules by transmitting the scheduled value no less
    than once every 30 minutes.

c. The M&C software must be capable of performing time synchronization
    and configuring Schedule Objects in ASHRAE 135 field devices in
    accordance with the DM-MTS-A (Device Management-Manual Time
    Synchronization-A).

d. The M&C software must be capable of performing time synchronization
    and configuring Niagara Framework Schedule Objects in Niagara
    Framework Supervisory Gateways.

e. The M&C Software must include a scheduling graphic display, accessible
    via the graphical user interface, with the following fields and
    functions:

    (1) Current date and time.

    (2) System identifier(s) and name(s), including location information
        such as Building name(s) and number(s).

    (3) System group. Systems grouped by the user to perform according to
        a common schedule.

    (4) Weekly schedules. For each system, a weekly schedule based on a
        seven day per week schedule with independent schedules for each
        day of the week including no less than 6 value changes per day.

    (5) Holiday and special event schedules. Support for holiday and
        special event calendar schedules independent of the daily
        schedule. Special event schedules include one-time events and

recurring events. Scheduling of one-time events include the
beginning and ending dates and times of the event. Holiday and
special event schedules must have precedence over device weekly
schedules.

2.4.10.13   Alarms

Provide M&C Software meeting the following minimum requirements for alarms:

****
NOTE: The following list paragraph uses tailoring
options:
1) "generating alarms by comparing the value of any
point from any connected system to user-configurable
limits" is included when the LONWORKS, MODBUS or OPC
tailoring option is selected

2) "configuring alarms in ASHRAE 135 field devices
in accordance with the B-AWS BIBBs" is included when
the BACNET tailoring option is selected.

3) "configuring alarms in Niagara Framework
Supervisory Gateways using the Niagara Alarm
Service" is included when the NIAGARA FRAMEWORK
tailoring option is selected.

****

a.   The M&C software must be capable of generating alarms by comparing the
     value of any point from any connected system to user-configurable
     limits, and configuring alarms in ASHRAE 135 field devices in
     accordance with the B-AWS BIBBs, and configuring alarms in Niagara
     Framework Supervisory Gateways using the Niagara Alarm Service.

****
NOTE: The following list paragraph uses tailoring
options:
1) "alarms generated by the M&C Software" is
included when the LONWORKS, MODBUS or OPC tailoring
option is selected

2) "alarms received as an ASHRAE 135 Alarm Event
Notifications" is included when the BACNET tailoring
option is selected.

3) "alarms received from a Niagara Framework
Supervisory Gateway" is included when the NIAGARA
FRAMEWORK tailoring option is selected.

****

b.   The M&C software must be capable of handling (routing) alarms
     generated by the M&C Software, and alarms received as an ASHRAE 135
     Alarm Event Notifications, and alarms received from a Niagara
     Framework Supervisory Gateway.

****
NOTE: The following list paragraph is included only
when the NIAGARA FRAMEWORK tailoring option is

```
        selected.
**************************************************************************
```
c. The M&C software must support Niagara Framework Alarm Classes.

d. The M&C software must support at least two alarm priority levels:
    critical and informational. Critical alarms must remain in alarm
    until acknowledged by an operator and the alarm condition no longer
    exists; informational alarms must remain in alarm until the alarm
    condition no longer exists or until the alarm is acknowledged.

e. The creation, modification, and handling (routing) of alarms must be
    fully accessible and fully adjustable from the graphical user
    interface.

f. Alarm Data. Alarm data to be displayed and stored must include:

    (1) Identification of alarm including building, system (or
         sub-system), and device name.

    (2) Date and time to the nearest second of occurrence.

    (3) Alarm type:

         (a) Unreliable: Indicates that the source device has failed due
              to the sensing device or alarm parameter being out-of-range
              or bad data.

         (b) High Alarm.

         (c) Low Alarm.

    (4) Current value or status of the alarm point, including engineering
         units

    (5) Alarm limits, including engineering units.

    (6) Alarm priority.

    (7) Alarm Message: A unique message with a field of at least 60
         characters. Assignment of messages to an alarm must be an
         operator editable function.

    (8) Acknowledgement status of the alarm including the time, date and
         user of acknowledgement.

```
**************************************************************************
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   ****

   g. Alarm Notification and Routing: The M&C software must be capable of
       performing alarm notification and routing functions. Upon receipt of
       ASHRAE 135 event notification, network variable of type SNVT_alarm or
       SNVT_alarm_2, OPC alarm, or upon generation of an alarm the M&C
       software must immediately perform alarm notification and routing
       according to an assigned routing for that alarm. The M&C software
       must support at least 100 alarm routes, where an alarm route is a
       unique combination of any of the following activities:

       (1) Generate a pop-up active clients.   The pop-up display must
            include the Alarm Data. Alarms must be capable of being
            acknowledged from the pop-up display by operators with sufficient
            permissions. Pop-up must be displayed until acknowledged.

       (2) Send an e-mail message via simple mail transfer protocol (SMTP;
            RFC 821). The e-mail must contain a configurable message and all
            alarm data. The e-mail recipient and scripted message must be
            user configurable for each alarm route.

       (3) Print alarms to designated alarm printers. The printed message
            must be the same as the pop-up message.

   h. Alarm Display and Acknowledgement. The M&C software must include an
       alarm display. Alarms must be available for display at each
       workstation as shown, along with all associated alarm data. Alarms
       must be capable of being acknowledged from this display. Multiple
       alarms must be capable of being acknowledged using a single command.
       Operator acknowledgment of one alarm must not automatically be
       considered as acknowledgment of any other alarm nor may it inhibit
       reporting of subsequent alarms.

   i. Alarm Storage and Reports: The M&C software must store each alarm and
       its associated alarm data to hard disk and retain this information
       after the alarm no longer exists. The stored data must be sortable,
       searchable, and printable.

2.4.10.14   Trending

   ****
   ****

   ****

Provide M&C software capable of creating, modifying, uploading and
archiving ASHRAE 135 Trend Objects in field devices in accordance with the
B-AWS BIBBs and of performing real-time trending with a minimum trending
rate of 100 points per second and of using the Niagara history service to
create, modify, upload and archive trend log objects in Niagara Framework
Supervisory Gateways.

a. The M&C Software must include a graphical display for trend
    configuration, creation and deletion accessible through the graphical
    user interface. Each trend must be user-configurable for:

    (1) Point to trend.

    (2) Sampling interval: adjustable between 1 second and 1 hour.

    (3) Start and Stop Time of Trend: Start and stop times determined by
         one or more of the following methods:

         (a) Start time and stop time

         (b) Start time and duration

         (c) Start time and number of samples

b. The M&C software must be capable of displaying and printing a
    graphical representation of each trend, and of multiple trended points
    on the same graph. The software must be capable of saving trend logs
    to a file. If the file format is not plain ASCII text in a
    Comma-Separated-Value (CSV) format, provide a means to export or
    convert the file to plain ASCII text in a CSV format.

2.4.10.15   Electrical Power Demand Limiting

Provide M&C software which includes demand limiting functionality capable
of performing electrical demand limiting such that it can change the
occupancy mode or setpoint of field control system hardware via a network
point based on a projected demand in order to maintain demand below a
configured target.[The demand target must incorporate real-time pricing
data.] The demand limiting algorithm must incorporate priority levels
such that low priority equipment is adjusted before high-priority
equipment. The demand limiting algorithm must generate a critical alarm
when it begins to impact the system and a critical alarm if the demand
target is exceeded.

2.4.10.16   Report Generation

Provide M&C Software capable of generating, saving and printing reports.
Dynamic operation of the system must not be interrupted to generate a
report.   The report must contain the time and date when the samples were
taken, and the time and date when the report was generated. The software
must be capable of saving reports to a PDF file and to a file compatible
with the provided Office Automation Software.

The software must allow for automatic and manual generation of reports.
For automatic reports an operator must be able to specify the time the
initial report is to be generated, the time interval between reports, end
of period, and the output format for the report. Manual report generation
must allow for the operator to request at any time the output of any
report.

2.4.10.17   Custom Report Generation

Provide M&C software capable of generating custom reports, including but
not limited to the following standard reports:

2.4.10.17.1   Electrical Power Usage Report

An electrical power Usage summary, operator selectable for substations,
meters, or transducers, individual meters and transducers, any group of
meters and transducers, and all meters for an operator selected time
period. The report must include the voltage, current, power factor,
electrical demand, electrical power consumption, reactive power (Kvar) for
each substation, facility, system or equipment as selected by the
operator. The report must be automatically printed at the end of each
summary period and include:

a.   Total period consumption.

b.   Demand interval peak for the period, with time of occurrence.

c. Energy consumption (kWh) over each demand interval.

d. Time-of-use peak, semi-peak, off-peak, or baseline total kWh
    consumption.

e. Reactive power during each demand interval.

f. Power factor during each demand interval.

g. Outside air (OA) temperature and relative humidity (RH) taken at the
    maximum and minimum of OA temperature of the report period with the
    time and dates of occurrence. At the installation's peak demand
    interval, the OA temperature and RH must also be recorded.

h. Calculated heating and cooling degree days based on a 18.3 degrees C
    65 degrees F balance point.

2.4.10.17.2   Electrical Peak Demand Prediction Report

 A report based on the demand limiting program, which includes:

a. Electrical Demand Target (EDT).

b. Actual peak and predicted peak for each demand interval for that day.

c. Predicted demand for the next demand interval.

2.4.10.17.3   Energy usage Report

An energy usage summary, operator selectable, for a unit, building, area,
installation, and the entire UMCS. The report must be divided by utility,
and must be capable of reporting on at least four separate utilities. The
report must include the following information:

a. Beginning and ending dates and times.

b. Total energy usage for each utility for the current and previous day.

c. Total energy usage for each utility for the current and previous month.

d. Maximum 15-minute interval average rate of consumption for each
    utility for the current and previous day and current and previous
    month.

e. Outside air (OA) temperature and OA humidity for current and previous
    month and current and previous day:

    (1) Average temperature and humidity.

    (2) Temperature and humidity at maximum and minimum OA temperature
         with time and date of occurrence.

    (3) Temperature and humidity at maximum and minimum humidity with
         time and date of occurrence.

    (4) Temperature and humidity at the installation's peak demand
         interval with the time and date of occurrence

f. Calculated degree days. Reports which include humidity must be
    configurable to report either dewpoint or relative humidity.

2.4.10.17.4   Water Usage Report

A water usage summary, operator selectable, for a unit, building, area,
installation, and the entire UMCS. The report must include the following
information:

a. Beginning and ending dates and times.

b. Total energy water usage for the current and previous day.

c. Total water usage for the current and previous month.

2.4.10.17.5   Alarm Report

Outstanding alarms by building or unit, including time of occurrence.

2.4.10.17.6   M&C Software Override Report

Points overridden by the M&C Software, including time overridden, and
identification of operator overriding the point.

2.4.10.17.7   Run Time Reports

A report totalizing the accumulated run time of individual pieces of
equipment. The operator must be able to define equipment groupings and to
generate reports based on these groupings.

2.4.10.17.8   Cooling Tower Profiles

 A cooling tower profile for each cooling tower as indicated, including:

a. Total daily and monthly on-time (each fan).

b. Number of on and off transitions (each fan).

c. Maximum and minimum daily condenser water temperature and the time of
    occurrence for the current and previous months.

d. Total daily and monthly makeup water consumption.

2.4.10.17.9   Chiller usage Report

A report of the operation of each chiller as shown on a daily and monthly
basis, for each of at least 10 discrete loading levels. The report must
include:

a. Average power for the month at each level in kW

b. Total monthly energy use in kWh at each level

c. Total monthly energy use in kWh for the chiller (all levels)

d. Total daily run hours at each level

e. Total Monthly run hours at each level

2.4.10.17.10   Device Offline Report

A report listing all offline devices in all CEA-709.1-D or ASHRAE 135
building control systems integrated to the M&C Software and all offline
Niagara Framework Supervisory Gateways.

2.5   UNINTERRUPTIBLE POWER SUPPLY (UPS)

Provide uninterruptible power supplies (UPS) as self contained devices
suitable for installation and operation at the location of Server and
Workstation hardware and sized to provide a minimum of 20 minutes of
operation of the connected hardware. Equipment connected to the UPS must
not be affected in any manner by a power outage of a duration less than
the rated capacity of the UPS. Provide the UPS complete with all
necessary power supplies, transformers, batteries, and accessories.
Provide UPS which include visual indication of normal power operation,
UPS operation, abnormal operation and visual and audible indication of AC
input loss and low battery power. Provide UL 1778 approved UPS. UPS
powering Server Hardware must notify the server via USB interface of
impending battery failure.

2.6   RACKS AND ENCLOSURES

2.6.1   Enclosures

Enclosures supplied as an integral (pre-packaged) part of another product
are acceptable. Provide two Enclosure Keys for each lockable enclosure on
a single ring per enclosure with a tag identifying the enclosure the keys
operate. Provide enclosures meeting the following minimum requirements:

2.6.1.1   Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 [Type 3][Type 4] requirements.

2.6.1.2   Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 [Type 2][Type 4] requirements.

2.6.1.3   Other Locations

For enclosures in other locations including but not limited to occupied spaces, above ceilings, and in plenum returns, provide enclosures meeting NEMA 250 Type 1 requirements.

2.6.2   Equipment Racks

Provide standard 482 mm 19 inch equipment racks compatible with the electronic equipment provided. Racks must be either aluminum or steel with bolted or welded construction. Steel equipment racks must be painted with a flame-retardant paint. Guard rails must be included with each equipment rack and have a copper grounding bar installed and grounded to the earth.

PART 3   EXECUTION

****
          **NOTE: Determine the applicability and need for a
          Factory Test and remove the Factory Test
          requirements if a Factory Test is not needed.**

          **For Army projects, contact the UMCS MCX (Huntsville
          Center) for a list of systems which have already
          been through a Factory Test.**
****

[3.1   FACTORY TEST

****
          **NOTE: Include the reference to section 25 08 10
          UTILITY MONITORING AND CONTROL SYSTEM TESTING if
          appropriate. Otherwise indicate another basis for
          the Factory Test Procedures.**
****

Perform factory testing of the UMCS as specified. The Contractor is responsible for providing personnel, equipment, instrumentation, and supplies necessary to perform required testing. Provide written notification of planned testing to the Government at least 21 days prior to testing, and do not give this notice until after receiving written Government approval of the specific Factory Test Procedures. Provide Factory Test Procedures which define the tests required to ensure that the system meets technical, operational, and performance specifications. Within the Procedures define location of tests, milestones for the tests, and identify simulation programs, equipment, personnel, facilities, and supplies required. Provide procedures which test all capabilities and functions specified and indicated. Develop Procedures from the design documentation and in accordance with [Section 25 08 10 UTILITY MONITORING

AND CONTROL SYSTEM TESTING][_____]. Perform the Factory Test using
equipment and software of the same manufacturer, model and revision as
will be used for the specified project. Include detailed instructions for
test setup, execution, and evaluation of test results in the Procedures.
Upon completion of the test, prepare a Factory Test Report, documenting
the results of the Test, and submit it as specified.

Perform the Factory Test and provide Factory Test Submittals as shown in
TABLE II. FACTORY TEST SEQUENCING.

TABLE II. FACTORY TEST SEQUENCING

ITEM #	DESCRIPTION	SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL)
1	Submit Factory Test Procedures	[[_____] days after notice to proceed][_____]
2	Perform Factory Test	After Approval Of #1
3	Submit Factory Test Report	[_____] days After Completion Of #2

]3.2   EXISTING CONDITIONS SURVEY

Perform a field survey, including but not limited to testing and
inspection of equipment to be part of the UMCS, and submit an Existing
Conditions Report documenting the current status and its impact on the
Contractor's ability to meet this specification. For field control
systems to be integrated to the UMCS which are not already connected to
the UMCS IP network, verify the availability of the building network
backbone at the FPOC location, and verify that FPOCs shown as existing are
installed at the FPOC location.

3.3   DRAWINGS AND CALCULATIONS

3.3.1   UMCS IP Network Bandwidth Usage Estimate

Provide a UMCS IP Network Bandwidth Usage Estimate for a small, medium or
large systems. In this estimate account for field control systems using
all M&C required protocols and the integration of field control system via
gateways. Define all assumptions used to create the estimate, including
but not limited to: trending, fast trends for commissioning, schedules,
alarms, display of system graphics and load shedding.

3.3.2   UMCS Contractor Design Drawings

Revise and update the Contract Drawings to include details of the system
design and all hardware components, including contractor provided and
Government furnished components. Details to be shown on the Design
Drawing include:

****
          NOTE: The following list paragraph uses tailoring
          options:
          1) "BACnet Supervisory Controller" is included only

a. The logical structure of the network, including but not limited to the
    location of all Control Hardware (including but not limited to each
    BACnet Supervisory Controller, Control Protocol Gateway, Control
    Protocol Router, Niagara Framework Supervisory Gateway and Monitoring
    and Control (M&C) Controller).

b. Manufacturer and model number for each piece of Computer Hardware and
    Control Hardware.

c. Physical location for each piece of Computer Hardware and Control
    Hardware.

d. Version and service pack number for all software and for all Control
    Hardware firmware.

3.3.3   As-Built Drawings

Prepare draft as-built drawings consisting of Points Schedule drawings for
the entire UMCS, including Points Schedules for each Gateway, and an
updated Design Drawing including details of the actual installed system as
it is at the conclusion of Start-Up and Start-Up Testing. Provide
As-Built Drawings which include details of all hardware components,
including contractor provided and Government furnished components. In
addition to the details shown in the design drawings, the as-built drawing
must include:

a. IP address(es) and Ethernet MAC address(es) as applicable for each
    piece of Control Hardware (including but not limited to each BACnet

Supervisory Controller, Niagara Framework Supervisory Gateway, Control Protocol Gateway, Control Protocol Router, and Monitoring and Control (M&C) Controller).

b. IP address and Ethernet MAC address for each computer server, workstation, and networked printer.

c. Network identifier (name) for each printer, computer server and computer workstation.

d. List of ports, protocols and network services for each device connected to an IP network.

****
          NOTE: The following paragraph uses tailoring
          options for BACNET, LONWORKS, MODBUS and NIAGARA
          FRAMEWORK and includes requirements only when the
          associated tailoring option is selected.
****

e. Network Addresses: CEA-709.1-D address (domain, subnet, node address) for all Control Hardware using CEA-709.1-D.ASHRAE 135 address and Object_ID of the Device Object for all Control Hardware using ASHRAE 135. MODBUS Protocol/MODBUS TCP/IP address for all Control Hardware using MODBUS Protocol/MODBUS TCP/IP. Niagara Framework Station ID for all Niagara Framework components including but not limited to Niagara Framework Supervisory Gateways and the Niagara Framework M&C Software.

Prepare Draft As-Built Drawings upon the completion of Start-Up and Start-Up Testing and Final As-Built Drawings upon completion of PVT Phase II.

3.4   INSTALLATION REQUIREMENTS

3.4.1   General

****
          NOTE: Indicate the location of telecommunications
          closets on the contract drawings.
****

Install system components as shown and specified and in accordance with the manufacturer's instructions and provide necessary interconnections, services, and adjustments required for a complete and operable system. Install communication equipment and cable grounding as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. Install Fiber Optic cables and wiring in exposed areas, including low voltage wiring but not including network cable in telecommunication closets, in metallic raceways or EMT conduit as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Do not install equipment in any space which experiences temperatures or humidity outside of the rated operating range of the equipment.

3.4.2   Isolation, Building Penetrations and Equipment Clearance

Provide dielectric isolation where dissimilar metals are used for connection and support. Make all penetrations through and mounting holes in the building exteriors watertight. Drill or core drill holes in

concrete, brick, steel and wood walls with proper equipment. Seal
conduits installed through openings with materials which are compatible
with existing materials. Seal openings with materials which meet the
requirements of NFPA 70 and SECTION 07 84 00 FIRESTOPPING.

3.4.3   Nameplates

Provide Nameplates for all Control Hardware and all Computer Hardware.
Attach Nameplates to the device in a conspicuous location.

3.5   INSTALLATION OF EQUIPMENT

3.5.1   Wire and Cable Installation

Install system components and appurtenances in accordance with NFPA 70,
manufacturer's instructions and as indicated. Provide necessary
interconnections, services, and adjustments required for a complete and
operable signal distribution system. Label components in accordance with
TIA-606. Firestop Penetrations in fire-rated construction in accordance
with Section 07 84 00 FIRESTOPPING. Install conduits, outlets and
raceways in accordance with Section 26 20 00 INTERIOR DISTRIBUTION
SYSTEM. Install wiring in accordance with TIA-568.1 and as specified in
Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Mark wiring terminal
blocks and outlets in accordance with TIA-606. Do not install
non-fiber-optic cables in the same cable tray, utility pole compartment,
or floor trench compartment with power cables. Properly secure and
install neat in appearance cables not installed in conduit or raceways.

3.5.2   Grounding

Install signal distribution system ground in accordance with TIA-607 and
Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Connect equipment racks to
the electrical safety ground.

3.5.3   Power-Line Surge Protection

Protect equipment connected to ac circuits must be protected against or
withstand power-line surges. Provide equipment protection which meets the
requirements of IEEE C62.41. Do not use fuses for surge protection.

3.5.4   IP Addresses

****
          NOTE: Select the appropriate option to do one of
          the following:
          1) require the contractor to coordinate IP Addresses
          with NEC (the IT group)

          2) require the contractor use IP addresses from a
          list of supplied IP addresses. In this case,
          include a list of IP addresses.

          3)(not applicable to Air Force) require the
          contractor to configure control hardware to obtain
          IP addresses from a DHCP server.
****

For all Control Hardware requiring an IP address on the UMCS IP Network,
[coordinate with the [NEC] [_____] to obtain IP addresses] [use the

following IP addresses:[_____]][obtain static IP addresses from a DHCP server].

3.5.5   Computer Hardware and Software

****
            NOTE: If computer hardware is Government installed
            remove the bracketed text requiring hardware
            installation.
****

[3.5.5.1   Hardware Installation

Install Computer Hardware as specified and indicated. Power Computer
Servers through a UPS, and install and configure them such that the server
automatically undergoes a clean shutdown upon low battery signal from the
UPS.

]3.5.5.2   Software Installation

Install software as follows:

****
            NOTE: Due to tailoring options the numbering of the
            following items may be incorrect and require editing.
****

****
            NOTE: The following TWO list paragraphs are included
            only if the LONWORKS tailoring option is selected
****
a.   CEA-852-C Configuration Server: Install and configure one CEA-852-C
     Configuration Server. Install the CEA-852-C Configuration Server on
     Server Hardware or on an CEA-709.1-D TP/FT-10 to IP Router.

b. CEA-709.1-D Network Configuration Tool: Install the CEA-709.1-D
     Network Configuration Tool software as shown. Install the CEA-709.1-D
     Network Configuration Tool on workstation or server hardware.

****
            NOTE: The following designer note and list paragraph
            are included only if the BACNET tailoring option is
            selected
****

****
            NOTE: The BACnet Network Browser may or may not be
            needed by the installation. The M&C Software
            already has this functionality, but in general a
            copy of a BACnet Network Browser installed on a
            laptop is beneficial for the installation for O&M,
            troubleshooting and commissioning.

            Keep the bracketed option and show the BACnet
            Network Browser on the drawings to require it.
****

[c. BACnet Network Browser: Install the BACnet Network Browser software as

indicated. Install the BACnet Network Browser on workstation hardware.
]

  d. Niagara Framework Engineering Tool: Install the Niagara Framework
     Engineering Tool on the M&C Software Server[and as indicated.
     Install the Niagara Framework Engineering Tool on workstation
     hardware].

  e. Monitoring and Control Software: Install the monitoring and control
      (M&C)software as shown. Except for M&C Software performing Point
      Calculations or Electrical Peak Demand Limiting, install M&C Software
      on server hardware. Install M&C Software performing Point
      Calculations or Electrical Peak Demand Limiting on either server
      hardware or Monitoring and Control (M&C) Controller Hardware. Install
      M&C Software in a manner consistent with its B-AWS listing such that
      it provides all functionality of a B-AWS.

      Provide sufficient computer hardware and M&C Controller Hardware and
      install M&C Software to support the number of points required in PART
      2 (PRODUCTS), regardless of the number of points integrated under this
      project specification. Note that meeting this requirement may entail
      the installation of unused hardware or spare point licenses to
      accommodate the full number of required points in order to allow for
      integration of future field control systems.

  f. M&C Controller Hardware Configuration Software: Install the M&C
      Controller Hardware Configuration Software on server hardware.

[g.   Operating system: Install the OS on each Server and Workstation and
       configure usernames and passwords. Coordinate with [_____] for
       usernames and passwords.

][h.   Office Automation Software: Install the office automation software on
       each server and workstation.

][i.   Virus Protection software: Install the virus protection software on
       each server and workstation and configure weekly virus scans.
       [Configure the virus protection software to update virus definitions
       automatically [from the update server at [_____]][. Coordinate with
       [the NEC][_____] to obtain update server information.]]

][j.   Disk Imaging (Backup) Software: Install the disk imaging (backup)
       software on each server and configure for imaging the internal hard
       drive to external hard drive.]

   Where software requires connection to an IP device outside of the UMCS,
   coordinate with [the project site NEC][_____] to obtain access to a
   Government-furnished server to provide the needed functionality. Do not
   connect to any device outside of the UMCS without explicit permission from
   [the project site NEC][_____].

3.5.5.3   Monitoring and Control (M&C) Software Configuration

    Configure the Monitoring and Control (M&C) Software as specified, as
    indicated and as follows:

    a. Set up M&C Software user accounts[and passwords]. Coordinate user
        accounts[, passwords] and permissions with [the [Controls] [HVAC]
        [Electrical] shop supervisor][____].

    b. Change the default password on all accounts. Remove or disable any
        accounts which do not require authentication (such as guest accounts).

    c. Configure e-mail capability to use [the government furnished SMTP
        server using the following server information[____].][a Government
        furnished SMTP server. Coordinate with [the project site NEC]
        [____]for SMTP server information.]

    d. Disable all ports, protocols, and network services other than those
        required or specifically permitted by this Section. Services to be
        disabled include but are not limited to: FTP, Telnet and SSH.

    e. Install web server certificate. Obtain certificate from [the project
        site NEC][____].

3.5.5.4   Control Hardware Installation

    Install Control Hardware [in an enclosure] [in a lockable enclosure] and
    as specified. Configure Control Hardware as specified, as required to meet
    the functions for which the hardware is used and as follows:

        ****

a. Disable all ports, protocols, and network services other than those
    required or specifically permitted by this Section. Services to be
    disabled include but are not limited to: FTP, Telnet, SSH, and HTTP[
    except for HTTP originating in Niagara Framework Supervisory Gateways].
    When disabling of ports, protocols and services is not supported by a
    product, obtain an exception from this requirement prior to using the
    product and document non-compliance on the Product Data Sheets and
    As-Built drawings.

b. Change the default passwords in all Control Hardware which have
    passwords. Coordinate new passwords with [the [Controls] [HVAC]
    [Electrical] shop supervisor][_____].

3.6   INTEGRATION OF FIELD CONTROL SYSTEMS

Fully integrate the field control systems in accordance with the following
three step sequence and as specified and shown.

  STEP 1: Install and configure Control Hardware as necessary to connect
      the field control system to the FPOC, which is part of the UMCS IP
      network, and to provide control protocol translation and supervisory
      functionality.

  STEP 2: Add Field Control System to M&C Software: Perform system
      discovery, system database merges, or any other actions necessary to
      allow M&C Software access to the field control system.

  STEP 3: Configure M&C Software to provide monitoring and control of the
      field control system, including but not limited to the creation of
      system displays and the configuration of scheduling, alarming, and
      trending.

3.6.1   Integration Step 1: Install Control Hardware

is typically managed by the project site IT staff.
Provide a POC for making this connection.
****

Install Control Hardware as specified at the FPOC location [as
shown][____] to connect the field control system to the UMCS IP network
via the FPOC and, if necessary, to provide control protocol translation
and supervisory functionality. Coordinate all connections and other
activities related to an FPOC with [____]. Depending on the field control
system media and protocol this must be accomplished through one of the
following:

a. Connect the existing field control network hardware at the FPOC
    location to the FPOC.

****
          NOTE: The following list paragraph uses tailoring
          options.
          1) "Control Protocol Gateway" is included if the
          BACNET, LONWORKS, MODBUS or OPC tailoring option is
          selected.

          2) "Niagara Framework Supervisory Gateway" is
          included if the NIAGARA FRAMEWORK tailoring option
          is selected.

          3) The "either" and "or" are included if the NIAGARA
          FRAMEWORK tailoring option AND any of the other 4
          protocol tailoring options are selected.
****

b. Install either a Control Protocol Gateway or Niagara Framework
    Supervisory Gateway connected to both the field control network and
    the FPOC.

****
          NOTE: The following TWO list paragraphs are included
          if the BACNET, LONWORKS, MODBUS or OPC tailoring
          option is selected.
****

c. Install a Control Protocol Router connected to both the field control
    network and the FPOC.

d. Install a Control Protocol Gateway connected to the field control
    network. Then install a Control Protocol Router connected to both the
    Control Protocol Gateway and the FPOC.

****
          NOTE: The following paragraph is included if the
          BACNET tailoring option is selected.

****
In addition, for integration of field control systems via ASHRAE 135, also
install a BACnet Supervisory Controller as needed to implement scheduling,
alarming and trending in the field control system. The BACnet
supervisory controller may be the same device as the control protocol
gateway or router.

3.6.1.1   Installation of Control Protocol Gateway

If the field control system uses a protocol which is not supported by the
M&C Software, install a gateway to convert the field control system
protocol to ASHRAE 135, or to CEA-709.1-D, or to MODBUS Protocol/
MODBUS TCP/IP, or to OPC DA. Install additional field control system
network media and hardware as needed to connect the Gateway to the field
control system. Connect the Gateway according to one of the two following
methods:

a. Connect the Gateway to the field control network and to the FPOC.

b. Connect the Gateway to the field control network and to a BACnet/IP
    Router, or to a LonWorks/IP Router, or to a Modbus/IP Router installed
    as specified.

Create and configure points and establish network communication between
the Control Protocol Gateway and the field control system to provide
points from the field control system to the M&C software.

3.6.1.2   Installation of Niagara Framework Supervisory Gateway

Install Niagara Framework Supervisory Gateway hardware to connect the
field control network to the FPOC. Install additional field control
system network media and hardware as needed to connect the Niagara
Framework Supervisory Gateway to the field control system.

3.6.1.3   Installation of Control Protocol Router

If there is not an existing connection between the FPOC and the field
control network, install a BACnet/IP Router, or a LonWorks/IP Router, or a
Modbus/IP Router to connect the field control network to the FPOC.

Install additional field control system network media as needed to connect the Router to the field control system.

3.6.1.4   Installation of BACnet Supervisory Controller

```
**************************************************************************
          NOTE:  This subpart only applies to BACnet systems
          and is only included when the BACNET tailoring
          option is selected.
**************************************************************************
```

If required for implementation of scheduling, alarming and trending, install a BACnet Supervisory Controller connected to the building control system IP network and configure it to provide scheduling, alarming and trending functions for the field control system. When the BACnet Supervisory Controller is the same device as a control protocol router or gateway, install it in accordance with the installation requirements for a router or gateway.

3.6.2   Integration Step 2: Add Field Control System to M&C Software

Perform system discovery, system database merges, or any other actions necessary to allow M&C Software access to points and data in the field control system.

3.6.2.1   Integration of Field Control Systems Via ANSI-709.1-C

```
**************************************************************************
          NOTE:  This subpart only applies to integration via
          LonWorks and is only included when the LONWORKS
          tailoring option is selected.
**************************************************************************
```

a.   When a LNS Database of the field control system is not available, use the Network Configuration Tool software to discover the field control system and create an LNS Database for the field control system.

b.   When the UMCS does not already contain an LNS Server, provide an LNS Server to support the UMCS LNS Database.

c.   When there is no existing UMCS LNS Database, use the field control system database as the UMCS Database.

d.   When there is an existing UMCS LNS Database, merge the field control system with the UMCS LNS database.

3.6.2.2   Integration of Field Control Systems Via ASHRAE 135

```
**************************************************************************
          NOTE:  This subpart only applies to integration via
          BACnet and is only included when the BACNET
          tailoring option is selected.
**************************************************************************
```

Use the M&C Software to fully discover the field control system. Full discovery of a field control system includes but is not limited to discovery of all ASHRAE 135 devices, all standard ASHRAE 135 Objects and Properties of each device, and all standard ASHRAE 135 services supported by each device.

3.6.2.3   Integration of Field Control Systems Via Niagara Framework

For each Niagara Framework Supervisory Gateway installed in integration
step 1 for this project do both of the following:

a.   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.

b.   Create and configure points and establish network communication
     between the Niagara Framework Supervisory Gateway and the field
     control system to provide points from the field control system to the
     M&C software and to provide support for supervisory functions,
     including but not limited to schedule objects, trend logs and alarming.

For each Niagara Framework Supervisory Gateway to be integrated as part of
this project, make all information in the Niagara Framework Supervisory
Gateway available to the M&C Software.

3.6.2.4   Integration of Field Control Systems Via Modbus

[Survey the field control system to create Points Schedules. Using these
Points Schedules][Using the [contract document Points Schedule][field
control system documentation Points Schedules][____],] make all points[as
shown on the Points Schedule] from the field control system available in
the M&C Software.

3.6.2.5   Integration of Field Control Systems Via OPC DA

Establish a connection between the M&C Software OPC DA client and the
field control system OPC DA server and make all points[as shown on the
Points Schedule] from the field control system available in the M&C
Software.

3.6.2.6   [Enter Appropriate Subpart Title Here]Integration of Field Control
Systems Via Other (non-Niagara Framework (Fox Protocol), non-ASHRAE 135,
non-CEA-709.1-D, non-Modbus, non-OPC DA) Protocols

Perform all actions necessary to make all points[as shown on the Points
Schedule] from the field control system available in the M&C Software.

3.6.3   Integration Step 3: Configure M&C Software

  Configure M&C Software to provide monitoring and control of the field
  control system, including but not limited to the creation of system
  displays and the configuration of scheduling, alarming, and trending.

3.6.3.1   Configure M&C Software Communication

  Create and configure points and establish network communication between
  M&C Software and Field Control Systems as specified to support M&C
  Software functionality:

  a. Update points on currently active displays via polling as necessary to
      meet M&C Software display refresh requirements.

      ****
             NOTE: The following list paragraph uses tailoring
             options.
             1) LonWorks requirements are included only when the
             LONWORKS tailoring option is selected.
             2) BACnet requirements are included only when the
             BACNET tailoring option is selected.
      ****

  b. Send points used for overrides to the device receiving the override as
      shown on the Points Schedule. For LonWorks systems, for points used
      for overrides use the network variable and SNVT type indicated on the
      Points Schedule. For SNVTs for overriding schedules (via the Simple
      Scheduler) use SNVT type SNVT_occupancy and support the following
      values: OC_OCCUPIED, OC_UNOCCUPIED, OC_STANDBY and OC_NUL. For SNVTs
      used to override schedules or setpoints for Demand Limiting functions
      use the acknowledged service. For BACnet systems write operator
      overrides with a priority of 8 and demand limiting overrides with a
      priority of 10.

      ****
             NOTE: The following list paragraph uses tailoring
             options.
             1) BACnet requirements are included only when the
             BACNET tailoring option is selected.
             2) LonWorks requirements are included only when the
             LONWORKS tailoring option is selected.
             3) MODBUS requirements are included only when the
             MODBUS tailoring option is selected.
             4) OPC requirements are included only when the OPC
             tailoring option is selected.
      ****

  c. For Notification Class Objects used for Alarms, configure the
      Recipient_List Property to point to the appropriate M&C Software
      process. Use the ConfirmedEventNotification service for events from
      ASHRAE 135 field control systems used for alarms. Bind points from
      CEA-709.1-D field control systems used using acknowledged service or
      poll the point at 5 minute intervals. Poll points from MODBUS Protocol
      /MODBUS TCP/IP field control systems used for alarms at 5 minute
      intervals. For points from OPC DA field control systems used for
      alarms use a subscription or poll the point at 5 minute intervals.

d.   Update points used for currently active trends via polling as
     necessary to meet trend interval requirements.

e.   Send points used for scheduling to the field control system with a
     maximum time between subsequent transmissions of the point of 30
     minutes. For LonWorks field control systems, send points used for
     scheduling to the appropriate System Scheduler using SNVTs of type
     SNVT_occupancy which support the following values: OC_OCCUPIED,
     OC_UNOCCUPIED and OC_STANDBY.

[Edit the Description field of each point to include the Real Property
  Unique IDs (RPUID) associated with that point as shown on the Points
  Schedule

]3.6.3.2   Configure M&C Software Functionality

  Fully configure M&C Software functionality using the M&C Software
  capabilities specified in PART 2 of this Section.

a.   Create System Displays [using the [project site] sample displays,
     ]including overrides, as shown on the Points Schedule and as
     specified. Label all points on displays with [full English language
     descriptions][the point name as shown on the Points Schedule][the
     point description as shown on the Points Schedule][_____]. Configure

user permissions for access to and executions of action using graphic pages. Coordinate user permissions with [the [Controls] [HVAC] [Electrical] shop supervisor][____]

b. Configure alarm generation and alarm handling as shown on the Points Schedule, as shown on the Alarm Routing Schedule, and as specified. Create and configure Objects in BACnet Supervisory Controllers and in the field control system to support alarming as shown on the Points Schedule and as specified. Alarm events with priority 112 are critical and events with priority 224 are non-critical. For alarm events with other priorities, treat events with priorities of 200 or above as non-critical, and all others as critical. For alarms requiring notification via text message or e-mail, configure the alarm notification to use the specified Government furnished SMTP server to send the alarm notification.

c. Configure scheduling as indicated and as shown on the points schedule. Configure M&C Software scheduling functionality to schedule Modbus systems andOPC systems. Configure M&C Software scheduling functionality for LonWorks field control systems which do not use the Simple Scheduler Object. For LonWorks field control systems which do use the Simple Scheduler Object, configure the Simple Scheduler Objects in the field control system. Create and configure Schedule Objects in BACnet Supervisory Controllers or in the field control system.

Create and configure displays for configuration of M&C Software schedules and Simple Scheduler Objects in the field control system and Schedule Objects in the field control system. Label schedules and scheduled points with full English-language descriptors. Provide a separate configuration capability for each schedule. A single configuration display may be used to configured multiple schedules, provided that each schedule is separately configurable from the display.

    d. Create M&C Software trends for required points as shown on the Points
        Schedule and as specified. Create and configure Trend Objects in
        BACnet Supervisory Controllers and in the field control system as
        shown on the Points Schedule and as specified. Trend points at [15]
        [_____] minute intervals.

        Create and configure displays for creation and configuration of trends
        and for display of all trended points.

    e. Configure Demand Limiting as shown on the Demand Limit Schedule and
        Points Schedule and as specified.

    f. Configure M&C Software standard reports.

3.7   START-UP AND START-UP TESTING

    Test all equipment and perform all other tests necessary to ensure the
    system is installed and functioning as specified. Prepare a Start-Up and
    Start-Up Testing Report documenting all tests performed and their results
    and certifying that the system meets the requirements specified in the
    contract documents.

3.8   PERFORMANCE VERIFICATION TEST (PVT)

3.8.1   PVT Phase I Procedures

    Provide PVT Procedures which include:.

    a. Network bandwidth usage and available bandwidth (throughput)
        measurements. Network bandwidth usage must reference the normal usage
        network Bandwidth Calculations.

    b. Test System Reaction during PVT: The total system response time from
        initiation of a control action command from the workstation, to
        display of the resulting status change on the workstation must not
        exceed 20 seconds under system normal heavy load conditions assuming a
        zero response time for operation of the node's control device.

    c. Verification of IP Connectivity.

d. Verification of configuration of M&C Software functionality.

3.8.2   PVT Phase I

   Demonstrate compliance of the control system with the contract documents.
   Using test plans and procedures previously approved by the Government,
   demonstrate all physical and functional requirements of the project. Upon
   completion of PVT Phase I and as specified, prepare and submit the PVT
   Phase I Report documenting all tests performed during the PVT and their
   results. In the PVT report, include all tests in the PVT Procedures and
   any other testing performed during the PVT. Document failures and repairs
   with test results.

3.8.3   PVT Phase II

   Include Basic Training as part of PVT Phase II. Failures or deficiencies
   of the UMCS during Basic Training are considered PVT failures. Upon
   completion of PVT Phase II, and as specified, prepare and submit the PVT
   Phase II Report documenting any failures which occurred and repairs
   performed during PVT Phase II.

3.9   MAINTENANCE AND SERVICE

   ****
                NOTE: The maintenance and service to be provided by
                the Contractor for the duration of the IDIQ or
                maintenance contract is specified in this
                paragraph. The Maintenance and Service may need to
                be a separate bid item funded by O&M funds.

                Some/many of these Maintenance and Service
                requirements may not apply if the UMCS networking
                equipment and supporting infrastructure is
                Government furnished equipment and maintained by the
                Government.The requirements here generally assume
                that the contractor is permitted access to the
                system and equipment, but the applicability of this
                assumption will vary site-by-site. It's critical to
                coordinate with the project site to determine to
                what extent the contractor will be responsible for
                system and equipment maintenance. Some notes have
                been included with bracketed text to provide general
                guidance, but careful editing of this entire subpart
                is needed.

                Requirements should be coordinated with "WARRANTY
                MANAGEMENT" in Section 01 78 00 CLOSEOUT SUBMITTALS
   ****

   Perform inspection, testing, cleaning, and part or component replacement
   as specified and as required to maintain the warranty. Work includes
   providing necessary preventive and unscheduled maintenance and repairs to
   keep the UMCS operating as specified, and accepted by the Government, and
   other services as specified. Perform work in compliance with
   manufacturer's recommendations and industry standards. Provide technical
   support via telephone during regular working hours.

3.9.1   Work Coordination

Schedule and arrange work to cause the least interference with the normal
Government business and mission. In those cases where some interference
may be essentially unavoidable, coordinate with the Government to minimize
the impact of the interference, inconvenience, equipment downtime,
interrupted service and personnel discomfort.

3.9.2   Work Control

Upon completion of work on a system or piece of equipment, that system or
piece of equipment must be free of missing components or defects which
would prevent it from functioning as originally intended and designed.
Replacements must conform to the same specifications as the original
equipment. During and at completion of work, do not allow debris to
spread unnecessarily into adjacent areas nor accumulate in the work area
itself.

3.9.3   Working Hours

Working hours are from [7:30 A.M.] [_____] to [4:00 P.M.] [_____] local
time Mondays through Fridays except Federal holidays.

[3.9.4   Equipment Repairs

****
            **NOTE: Coordinate with the project site to determine
            if equipment (computers and control hardware) repair
            will be done by the contractor or by local staff,
            and to what extent. If the equipment is Government
            furnished then the contractor may not be allowed
            access to some/all of the equipment for repair.
            Address Information Assurance (IA) or other
            equipment access requirements in "Access To UMCS
            Equipment" below.**

            Select repair times below.
****

Initiate and complete equipment repairs within the following time periods,
where time periods are measured as actual elapsed time from first
notification, including working and non-working hours:

a. for non-redundant computer server hardware, initiate within [4]
    [_____] hours and complete within [8] [_____] hours.

b. for non-redundant computer workstation hardware, initiate within [4]
    [_____] hours and complete within [8] [_____] hours.

c. for redundant computer server hardware, initiate within [36] [_____]
    hours and complete within [5] [_____] days.

d. for redundant computer workstation hardware, initiate within [2]
    [_____] days and complete within [5] [_____] days.

e. for active (powered) control hardware, initiate within [4] [_____]
    hours and complete within [6] [_____] hours.

f. for cabling and other passive network hardware, initiate within [16]

[_____] hours and complete within [5] [_____] days.

Repair is the restoration of a piece of equipment, a system, or a facility to such condition that it may be effectively used for its designated purposes. Repair may be overhaul, reprocessing, or replacement of nonfunctional parts or materials or replacement of the entire unit or system.

]3.9.5   Replacement, Modernization, Renovation

The Government may replace, renovate, or install new equipment as part of the UMCS at Government expense and by means not associated with this contract without voiding the system warranty. Replaced, improved, updated, modernized, or renovated systems and equipment interfaced to the system may be added to the Contractor's maintenance and service effort as a modification.

3.9.6   Access To UMCS Equipment

****
            **NOTE: Coordinate with the project site to determine
            any additional access requirements. Specifically,
            computer and/or control hardware access will likely
            require meeting certain Information Assurance (IA)
            requirements.**
****

Access to UMCS equipment must be in accordance with the following:

a.   Coordinate access to facilities and arrange that they be opened and closed during and after the accomplishment of the work effort. For access to a controlled facility contact the Government for assistance.

b.   The Government may provide keys for access to UMCS equipment where the Government determines such key issuance is appropriate. Establish and implement methods of ensuring that keys issued by the Government are not lost or misplaced, are not used by unauthorized persons, and are not duplicated.

c.   The Government may provide passwords or issue Common Access Cards (CAC) for access to UMCS computer equipment where the Government determines such issuance is appropriate. Establish and implement methods of ensuring that passwords and Common Access Cards issued by the Government are not used by unauthorized persons.

3.9.7   Records, Logs, and Progress Reports

Keep records and logs of each task, and organize cumulative chronological records for each major component, and for the complete system. Maintain a continuous log for the UMCS. Keep complete logs and be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the UMCS.

3.9.8   Preventive Maintenance Requirements

****
            **NOTE: If the contractor will not be responsible for
            Preventive Maintenance keep only the bracketed text
            requiring a plan "detailing" preventive maintenance**

[Perform maintenance procedures as described below, or more often if
required by the equipment manufacturer.] [Prepare a Preventive Maintenance
Work Plan as specified.]

3.9.8.1   Preventive Maintenance Work Plan

Prepare a Preventive Maintenance Work Plan [to schedule] [detailing] all
required preventive maintenance. Obtain Government approval of the Work
Plan as specified in paragraph PROJECT SEQUENCING.[Strictly adhere to
the approved work plan to facilitate Government verification of work.][
If it is necessary to reschedule maintenance, make a written request to
the Government detailing the reasons for the proposed change at least five
days prior to the originally scheduled date. Scheduled dates will be
changed only with the prior written approval of the Government.]

[3.9.8.2   Semiannual Maintenance

Perform the following Semiannual Maintenance as specified:

a. Perform data backups on all Server Hardware.

b. Run system diagnostics and correct diagnosed problems.

c. Perform fan checks and filter changes for UMCS hardware.

d. Perform all necessary adjustments on printers.

e. Resolve all outstanding problems.

f. Install new ribbons, ink cartridges and toner cartridges into
    printers, and ensure that there is at least one spare ribbon or
    cartridge located at each printer.

][3.9.8.3   Maintenance Procedures

3.9.8.3.1   Maintenance Coordination

Coordinate any scheduled maintenance event that [will][may] result in
component downtime with the Government as follows, where time periods are
measured as actual elapsed time from beginning of equipment off-line
period, including working and non-working hours:

   a. For non-redundant computer server hardware, provide [14] [_____] days
       notice, components must be off-line for no more than [8] [_____] hours.

   b. For non-redundant computer workstation hardware, provide [7] [_____]
       days notice, components must be off-line for no more than [8] [_____]
       hours.

   c. for redundant computer server hardware, provide [7] [_____] days
       notice, components must be off-line for no more than [36] [_____]
       hours.

   d. For redundant computer workstation hardware, provide [4] [_____] days
       notice, components must be off-line for no more than [48] [_____]
       hours.

   e. For active (powered) control hardware, provide [14] [_____] days
       notice, components must be off-line for no more than [6] [_____] hours.

   f. For cabling and other passive network hardware, provide [21] [_____]
       days notice, components must be off-line for no more than [12] [_____]
       hours.

3.9.8.3.2   Software/Firmware

Software/firmware maintenance includes [____] [operating systems,
]application programs, and files required for the proper operation of the
UMCS regardless of storage medium. User (project site) developed software
is not covered by this contract, except that the UMCS software/firmware
must be maintained to allow user creation, modification, deletion, and
proper execution of such user-developed software as specified. Perform
diagnostics and corrective reprogramming as required to maintain total
UMCS operations as specified. Back up software before performing any
computer hardware and software maintenance. Do not modify any parameters
without approval from the Government. Properly document any approved
changes and additions, and update the appropriate manuals.

[3.9.8.3.3   Network

Network maintenance includes testing transmission media and equipment to verify signal levels, system data rates, errors and overall system performance.

]]3.9.9   Service Call Reception

****
          NOTE: Designer should coordinate with the project
          site to determine if they want the Contractor to be
          responsible for answering service calls only during
          working hours or 24-7.
****

   a.   A Government representative will advise the Contractor by phone or in
        person of all maintenance and service requests, as well as the
        classification of each based on the definitions specified. A
        description of the problem or requested work, date and time notified,
        location, classification, and other appropriate information will be
        placed on a Service Call Work Authorization Form by the Government.

   b.   Submit procedures for receiving and responding to service calls [24
        hours per day, seven days a week, including weekends and holidays]
        [during regular working hours]. Provide a single telephone number for
        receipt of service calls during regular working hours; service calls
        are to be considered received at the time and date the telephone call
        is placed by the authorized Government representative.

   c.   Separately record each service call request, as received on the
        Service Call Work Authorization form and complete the Service Call
        Work Authorization form for each service call. Include the following
        information in the completed form: the serial number identifying the
        component involved, its location, date and time the call was received,
        nature of trouble, names of the service personnel assigned to the
        task, instructions describing what has to be done, the amount and
        nature of the materials to be used, the time and date work started,
        and the time and date of completion.

   d.   Respond to each service call request within [two] [_____] working
        hours. Provide the status of any item of work within [four] [_____]
        hours of the inquiry during regular working hours, and within [16]
        [_____] hours after regular working hours or as needed to meet the
        Equipment Repair requirements as specified.

3.9.10   Service Call Work Warranty

   Provide a [1 year] [_____] unconditional warranty on service call work
   which includes labor and material necessary to restore the equipment
   involved in the initial service call to a fully operable condition. In
   the event that service call work causes damage to additional equipment,
   restore the system to full operation without cost to the Government.
   Provide response times for service call warranty work equivalent to the
   response times required by the initial service call.

3.9.11   System Modifications

   Make recommendations for system modification in writing to the
   Government. Do not make system modifications without prior approval of
   the Government. Incorporate any modifications made to the system into the

Operations and Maintenance Instructions, and any other documentation
affected. Make available to the Government software updates for all
software furnished under this specification during the life of this
contract. Schedule at least one update near the end of the contract
period, at which time make available the latest released version of all
software provided under this specification, and install and validate it
upon approval by the Government.

3.10   TRAINING

****
            NOTE: Training duration and content should be
            modified to fit the requirements of the specific
            job. For example, if this specification is to be
            used to add to an existing UMCS or to replace a
            portion of an existing UMCS the training
            requirements should be relaxed.
****

Conduct training courses for designated personnel in the maintenance,
service, and operation of the system as specified, including specified
hardware and software. The training must be oriented to the specific
system provided under this contract. Provide audiovisual equipment and
other training material and supplies required for the training. When
training is conducted at Government facilities, the Government reserves
the right to record the training sessions for later use. A training day
is defined as 8 hours of classroom instruction, excluding lunchtime,
Monday through Friday, during the daytime shift in effect at the training
facility. For guidance in planning the required instruction, the
Contractor should assume that attendees will be tradesmen such as
electricians or boiler operators. Obtain approval of the training
schedule from the Government at least [30] [_____] days prior to the first
day of training.

3.10.1   Training Documentation

Prepare and submit one set of Training manuals for each of Basic Training
Documentation, Advanced Training Documentation, and Refresher Training
Documentation, where each set of documentation consists of:

3.10.1.1   Course Attendance List

Course Attendance List developed in coordination with and signed by the
[Controls] [HVAC] [Electrical] shop supervisor.

3.10.1.2   Training Manuals

Include an agenda, defined objectives for each lesson, and a detailed
description of the subject matter for each lesson in the training
manuals. Where portions of the course material are presented by
audiovisuals, include copies of those audiovisuals as a part of the
printed training manuals.

3.10.2   Basic Training

Conduct a Basic Training course at the project site on the installed
system for a period of no less than [5] [_____] training days during Phase
2 of the PVT. A maximum of [ten] [_____] personnel will attend this
course. Design training targeted towards training personnel in the

day-to-day operation and basic maintenance of the system. Upon completion of this course, each student, using appropriate documentation, should be able to start the system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware architecture and operation of the system. Include the following topics at a minimum:

a. General system architecture.

b. Functional operation of the system, including workstations and system navigation.

c. System start-up procedures.

d. Failure recovery procedures.

e. Schedule configuration.

f. Trend configuration.

g. Perform point overrides and override release.

h. Reports generation.

i. Alarm reporting and acknowledgements.

j. Diagnostics.

k. Historical files.

l. Maintenance procedures:

   (1) Physical layout of each piece of hardware.

   (2) Troubleshooting and diagnostic procedures.

   (3) Preventive maintenance procedures and schedules.

3.10.3   Advanced Training

****
          NOTE: This subpart uses tailoring options to
          include requirements for selected protocols only.
          1) CEA-709.1-D Network Configuration Tool is
          included only when the LONWORKS tailoring option is
          selected.
          2) BACnet Network Browser is included only when the
          BACNET tailoring option is selected.
          3) Niagara Framework Engineering Tool is included
          only when the NIAGARA FRAMEWORK tailoring option is
          selected.
****

****
          NOTE: Coordinate with the project site to select
          the location of the Advanced Training (or leave it
          up to the Contractor). Select the duration of the
          training and the number of attendees.
****

Conduct an Advanced Operator Training course [at the project site] [off-site or at the project site] for a period of not less then [five] [_____] days. A maximum of [ten] [_____] personnel will attend this course. Structure the course to consist of "hands-on" training under the constant monitoring of the instructor. Include training on the M&C Software, and the CEA-709.1-D Network Configuration Tool , and the BACnet Network Browser, and the Niagara Framework Engineering Tool. Upon completion of this course, the students should be fully proficient in the operation and management of all system operations and must be able to perform all tasks required to integrate a field control system into the UMCS. Report the skill level of each student at the end of this course. Include the following topics at a minimum:

a. A review of all topics in Basic Training

b. Using the CEA-709.1-D Network Configuration Tool for Network Management and using the BACnet Network Browser for network discovery

c. M&C Software configuration, including but not limited to: creating and editing system displays, alarms, schedules, trends, demand limiting and calculations.

3.10.4   Refresher Training

****
        NOTE: Refresher Training should be timed to take
        place near the end of the 1-year warranty period.
        If the UMCS is contracted out via an IDIQ process,
        it may be desirable to repeat the Refresher Training
        periodically.
****

Conduct a Refresher Training course at the project site for a period of [two] [_____] training days when approved by the Government and as specified in paragraph PROJECT SEQUENCING. A maximum of [ten] [_____] personnel will attend the course. Structure the course to address specific topics that the students need to discuss and to answer questions concerning the operation of the system. Upon completion of the course, the students should be fully proficient in system operation and have no unanswered questions regarding operation of the installed UMCS. Correct any system failures discovered during the Refresher Training at no cost to the Government.

APPENDIX A

QC CHECKLIST		
This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.		
This checklist is for (check one:)		
Pre-Construction QC Checklist Submittal (Items 1-2)		( )
Post-Construction QC Checklist Submittal (Items 1-6)		( )
Close-out QC Checklist Submittal (Items 1-14)		( )
Instructions: Initial each item in the space provided (|____|) verifying that the requirement has been met.		
Verify the following items for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals:		
1 Contractor Design Drawing Riser Diagram includes location and types of all Control Hardware and Computer Hardware.		|____|
2 M&C Software supports the Niagara Framework, and ASHRAE 135, and CEA-709.1-D, and MODBUS Protocol/MODBUS TCP/IP, and OPC DA. M&C Software is BTL Listed as a B-AWS. M&C Software is LonWorks Network Services (LNS) based.		|____|
Verify the following items for Post-Construction and Closeout QC Checklist Submittal:		

QC CHECKLIST		
3	Communication between the M&C Software and Niagara Framework field control systems uses only Fox protocol.Communication between the M&C Software and ASHRAE 135 field control systems uses only ASHRAE 135. Communication between the M&C Software and CEA-709.1-D field control systems uses only CEA-709.1-D. Communication between the M&C Software and MODBUS Protocol/MODBUS TCP/IP field control systems uses only MODBUS Protocol/MODBUS TCP/IP. Communication between the M&C Software and OPC DA field control systems uses only OPC DA.	|____|
4	Connections to field control systems are via Niagara Framework Supervisory Gateways. [The following is NOT permitted when Niagara Framework is used and therefore IS NOT PERMITTED for this project: Connections to non-ASHRAE 135, non-CEA-709.1-D, non-Modbus, non-OPC DA field control systems are via a Gateway from the field control system to ASHRAE 135, or to CEA-709.1-D, or to Modbus, or to OPC DA, or via a UMCS supported protocol without the use of a hardware Gateway.]	|____|
5	Computer workstations and servers are installed as shown on the UMCS Riser Diagram.	|____|
6	Training schedule and course attendee lists have been developed and coordinated with shops and submitted.	|____|
Verify the following items for Closeout QC Checklists Submittal:		
7	LNS Database is up-to-date and accurately represents the final installed system. All points in field control systems have been discovered using the Niagara Framework Engineering Tool and are available at the M&C Software.	|____|
8	All software has been licensed to the Government.	|____|

QC CHECKLIST		
9	M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings.	|____|
10	Final As-built Drawings accurately represent the final installed system.	|____|
11	Default trends have been set up (per Points Schedule drawings).	|____|
12	Scheduling has been configured at the M&C Software (per Occupancy Schedule drawing).	|____|
13	O&M Instructions have been completed and submitted.	|____|
14	Basic Operator and Advanced Training courses have been completed.	|____|

_____   _____

(QC Representative Signature)   (Date)

-- End of Section --