SECTION 23 09 23.13 20

BACnet DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC
11/15

PART 1   GENERAL

1.1   REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D   (2012) Laboratory Methods of Testing Dampers
                              for Rating

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

ASHRAE 135   (2012; Addenda AR 2013; Errata 1 2013; INT 1-
                              9 2013; Errata 2 2013; INT 10-12 2014; Errata
                              3-4 2014; Addenda AI-AY 2014; INT 13-17 2015;
                              Errata 5 2015) BACnet—A Data Communication
                              Protocol for Building Automation and Control
                              Networks

ASHRAE 135.1   (Errata 1 2015; INT 1 2013; Addenda O 2014)
                              Method of Test for Conformance to BACnet

ARCNET TRADE ASSOCIATION (ATA)

ATA 878.1   (1999) Local Area Network: Token Bus

ASME INTERNATIONAL (ASME)

ASME B16.18   (2012) Cast Copper Alloy Solder Joint
                              Pressure Fittings

ASME B16.22   (2013) Standard for Wrought Copper and Copper
                              Alloy Solder Joint Pressure Fittings

ASME B16.26   (2013) Standard for Cast Copper Alloy
                              Fittings for Flared Copper Tubes

ASME B16.34   (2013) Valves - Flanged, Threaded and Welding
                              End

ASME B16.5   (2013) Pipe Flanges and Flanged Fittings:
                              NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B31.1   (2014; INT 1-47) Power Piping

ASME B40.100   (2013) Pressure Gauges and Gauge Attachments

ASME BPVC   (2010) Boiler and Pressure Vessels Code

  ASTM INTERNATIONAL (ASTM)

ASTM A126   (2004; R 2014) Standard Specification for
                                Gray Iron Castings for Valves, Flanges, and
                                Pipe Fittings

ASTM B117   (2011) Standard Practice for Operating Salt
                                Spray (Fog) Apparatus

ASTM B32   (2008; R 2014) Standard Specification for
                                Solder Metal

ASTM B75/B75M   (2011) Standard Specification for Seamless
                                Copper Tube

ASTM B88   (2014) Standard Specification for Seamless
                                Copper Water Tube

ASTM B88M   (2013) Standard Specification for Seamless
                                Copper Water Tube (Metric)

ASTM D1238   (2013) Melt Flow Rates of Thermoplastics by
                                Extrusion Plastometer

ASTM D1693   (2015) Standard Test Method for Environmental
                                Stress-Cracking of Ethylene Plastics

ASTM D635   (2014) Standard Test Method for Rate of
                                Burning and/or Extent and Time of Burning of
                                Self-Supporting Plastics in a Horizontal
                                Position

ASTM D638   (2014) Standard Test Method for Tensile
                                Properties of Plastics

ASTM D792   (2013) Density and Specific Gravity (Relative
                                Density) of Plastics by Displacement

  CONSUMER ELECTRONICS ASSOCIATION (CEA)

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

  INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1   (2002; R 2008) Guide on the Surges
                                Environment in Low-Voltage (1000 V and Less)
                                AC Power Circuits

IEEE C62.41.2   (2002) Recommended Practice on
                                Characterization of Surges in Low-Voltage
                                (1000 V and Less) AC Power Circuits

IEEE C62.45   (2002; R 2008) Recommended Practice on Surge
                                Testing for Equipment Connected to Low-
                                Voltage (1000v and less)AC Power Circuits

        INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 8802-3   (2000) Information Technology -
                                Telecommunications and Information Exchange
                                Between Systems - Local and Metropolitan Area
                                Networks - Specific Requirements - Part 3:
                                Carrier Sense Multiple Access with Collision
                                Detection (CSMA/CD)Access Method and Physical
                                Layer Specifications

        NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70   (2014; AMD 1 2013; Errata 1 2013; AMD 2 2013;
                                Errata 2 2013; AMD 3 2014; Errata 3-4 2014;
                                AMD 4-6 2014) National Electrical Code

NFPA 72   (2013) National Fire Alarm and Signaling Code

NFPA 90A   (2015) Standard for the Installation of Air
                                Conditioning and Ventilating Systems

        SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
        (SMACNA)

SMACNA 1966   (2005) HVAC Duct Construction Standards Metal
                                and Flexible, 3rd Edition

        UNDERWRITERS LABORATORIES (UL)

UL 1449   (2014;Reprint Mar 2015) Surge Protective
                                Devices

UL 506   (2008; Reprint Oct 2013) Specialty
                                Transformers

UL 508A   (2013; Reprint Jan 2014) Industrial Control
                                Panels

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

1.2   DEFINITIONS

1.2.1   ANSI/ASHRAE Standard 135

ANSI/ASHRAE Standard 135: BACnet - A Data Communication Protocol for
Building Automation and Control Networks, referred to as "BACnet". ASHRAE
developed BACnet to provide a method for diverse building automation devices
to communicate and share data over a network.

1.2.2   ARCNET

ATA 878.1 - Attached Resource Computer Network. ARCNET is a deterministic
LAN technology; meaning it's possible to determine the maximum delay before
a device is able to transmit a message.

1.2.3   BACnet

Building Automation and Control Network; the common name for the
communication standard ASHRAE 135. The standard defines methods and
protocol for cooperating building automation devices to communicate over a
variety of LAN technologies.

1.2.4   BACnet Building Controller (B-BC)

ASHRAE 135 building controller that is the main interface for the building
control system.

1.2.5   BACnet/IP

An extension of BACnet, Annex J, defines this mechanism using a reserved UDP
socket to transmit BACnet messages over IP networks. A BACnet/IP network is
a collection of one or more IP subnetworks that share the same BACnet
network number. See also "BACnet Broadcast Management Device".

1.2.6   BACnet Internetwork

Two or more BACnet networks, possibly using different LAN technologies,
connected with routers. In a BACnet internetwork, there exists only one
message path between devices.

1.2.7   BACnet Network

One or more BACnet segments that have the same network address and are
interconnected by bridges at the physical and data link layers.

1.2.8   BACnet Segment

One or more physical segments of BACnet devices on a BACnet network,
connected at the physical layer by repeaters.

1.2.9   BBMD

BACnet Broadcast Management Device (BBMD). A communications device,
typically combined with a BACnet router. A BBMD forwards BACnet broadcast
messages to BACnet/IP devices and other BBMDs connected to the same
BACnet/IP network. Every IP subnetwork that is part of a BACnet/IP network
must have only one BBMD. See also "BACnet/IP".

1.2.10   BAS

Building Automation Systems, including DDC (Direct Digital Controls) used
for facility automation and energy management.

1.2.11   BAS Owner

The regional or local user responsible for managing all aspects of the BAS
operation, including: network connections, workstation management,

submittal review, technical support, control parameters, and daily
operation. The BAS Owner for this project is Keesler AFB.

1.2.12   BIBBs

BACnet Interoperability Building Blocks. A collection of BACnet services
used to describe supported tasks. BIBBs are often described in terms of "A"
(client) and "B" (server) devices. The "A" device uses data provided by
the "B" device, or requests an action from the "B" device.

1.2.13   BI

BACnet International, formerly two organizations: the BACnet Manufacturers
Association (BMA) and the BACnet Interest Group - North America (BIG-NA).

1.2.14   BI/BTL

BACnet International/BACnet Testing Laboratories (Formerly BMA/BTL). The
organization responsible for testing products for compliance with the BACnet
standard, operated under the direction of BACnet International.

1.2.15   Bridge

Network hardware that connects two or more network (or BACnet internetwork)
segments at the physical and data link layers. A bridge may also filter
messages.

1.2.16   Broadcast

A message sent to all devices on a network segment.

1.2.17   Device

Any control system component, usually a digital controller, that contains a
BACnet Device Object and uses BACnet to communicate with other devices. See
also "Digital Controller".

1.2.18   Device Object

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.

1.2.19   Device Profile

A collection of BIBBs determining minimum BACnet capabilities of a device,
defined in ASHRAE Standard 135-2004, Annex L. Standard device profiles
include BACnet Operator Workstations (B-OWS), BACnet Building Controllers
(B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application
Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and
BACnet Smart Sensor (B-SS). Each device used in new construction is
required to have a PICS statement listing BIBBs supported.

1.2.20   Digital Controller

An electronic controller, usually with internal programming logic and
digital and analog input/output capability, which performs control
functions. In most cases, synonymous with a BACnet device described in this
specification. See also "Device".

1.2.21   Direct Digital Control (DDC)

Digital controllers performing control logic. Usually the controller
directly senses physical values, makes control decisions with internal
programs, and outputs control signals to directly operate switches, valves,
dampers, and motor controllers.

1.2.22   DDC System

A network of digital controllers, communication architecture, and user
interfaces. A DDC system may include programming, sensors, actuators,
switches, relays, factory controls, operator workstations, and various other
devices, components, and attributes.

1.2.23   Ethernet

A family of local-area-network technologies providing high-speed networking
features over various media.

1.2.24   Firmware

Software programmed into read only memory (ROM), flash memory, electrically
erasable programmable read only memory (EEPROM), or erasable programmable
read only memory (EPROM) chips.

1.2.25   Middleware

Communication hardware and software connecting two or more different
protocols, similar to human language translators. The Middleware translates
one protocol into equivalent concepts for the other protocol. In BACnet
applications, a middleware has BACnet on one side and non-BACnet protocols
on the other side.

1.2.26   Half Router

A device that participates as one partner in a BACnet point-to-point (PTP)
connection. Two half-routers in an active PTP connection combine to form a
single router.

1.2.27   Hub

A common connection point for devices on a network.

1.2.28   Internet Protocol (IP, TCP/IP, UDP/IP)

A communication method, the most common use is the World Wide Web. At the
lowest level, it is based on Internet Protocol (IP), a method for conveying
and routing packets of information over various LAN media. Two common
protocols using IP are User Datagram Protocol (UDP) and Transmission Control
Protocol (TCP). UDP conveys information to well-known "sockets" without
confirmation of receipt. TCP establishes "sessions", which have end-to-end
confirmation and guaranteed sequence of delivery.

1.2.29   Input/Output (I/O)

  Physical inputs and outputs to and from a device, although the term
  sometimes describes software, or "virtual" I/O. See also "Points".

1.2.30   I/O Expansion Unit

  An I/O expansion unit provides additional point capacity to a digital
  controller.

1.2.31   IP subnet

  Internet protocol (IP) identifies individual devices with a 32-bit number
  divided into four groups from 0 to 255. Devices are often grouped and share
  some portion of this number. For example, one device has IP address
  209.185.47.68 and another device has IP address 209.185.47.82. These two
  devices share Class C subnet 209.185.47.00

1.2.32   Local-Area Network (LAN)

  A communication network that spans a limited geographic area and uses the
  same basic communication technology throughout.

1.2.33   LonTalk

  CEA-709.1-D. A communication protocol developed by Echelon Corp. LonTalk
  is an optional physical and data link layer for BACnet.

1.2.34   MAC Address

  Media Access Control address. The physical node address that identifies a
  device on a Local Area Network.

1.2.35   Master-Slave/Token-Passing (MS/TP)

  ISO 8802-3. One of the LAN options for BACnet. MSTP uses twisted-pair
  wiring for relatively low speed and low cost communication (up to 4,000 ft
  at 76.8K bps).

1.2.36   Native BACnet Device

  A device that uses BACnet as its primary, if not only, method of
  communication with other BACnet devices without intermediary gateways. A
  system that uses native BACnet devices at all levels is a native BACnet
  system.

1.2.37   Network

  Communication technology for data communications. BACnet approved network
  types are BACnet over Internet Protocol (IP), Point to Point (PTP) Ethernet,
  ARCNET, MS/TP, and LonTalk®.

1.2.38   Network Number

A site-specific number assigned to each network segment to identify for
routing. This network number must be unique throughout the BACnet
internetwork.

1.2.39   Object

The concept of organizing BACnet information into standard components with
various associated properties. Examples include analog input objects and
binary output objects.

1.2.40   Object Identifier

An object property used to identify the object, including object type and
instance. Object Identifiers must be unique within a device.

1.2.41   Object Properties

Attributes of an object. Examples include present value and high limit
properties of an analog input object. Properties are defined in ASHRAE 135;
some are optional and some are required. Objects are controlled by reading
from and writing to object properties.

1.2.42   Peer-to-Peer

Peer-to-peer refers to devices where any device can initiate and respond to
communication with other devices.

1.2.43   Performance Verification Test (PVT)

The procedure for determining if the installed BAS meets design criteria
prior to final acceptance. The PVT is performed after installation,
testing, and balancing of mechanical systems. Typically the PVT is
performed by the Contractor in the presence of the Government.

1.2.44   PID

Proportional, integral, and derivative control; three parameters used to
control modulating equipment to maintain a setpoint. Derivative control is
often not required for HVAC systems (leaving "PI" control).

1.2.45   PICS

Protocol Implementation Conformance Statement (PICS), describing the BACnet
capabilities of a device. See BACnet, Annex A for the standard format and
content of a PICS statement.

1.2.46   Points

Physical and virtual inputs and outputs. See also "Input/Output".

1.2.47   PTP

Point-to-Point protocol connects individual BACnet devices or networks using
serial connections like modem-to-modem links.

1.2.48   Repeater

A network component that connects two or more physical segments at the
physical layer.

1.2.49   Router/Protocol Gateway

A BACnet router is a component that joins together two or more networks
using different LAN technologies and protocols. Examples include joining a
BACnet RS485 field bus (serial network) to an IP or Ethernet network..

In the above case the protocol gateway encapsulates BACnet data from the
field bus within UDP headers for transport over IP

1.2.50   Stand-Alone Control

Refers to devices performing equipment-specific and small system control
without communication to other devices or computers for physical I/O,
excluding outside air and other common shared conditions. Devices are
located near controlled equipment, with physical input and output points
limited to 64 or less per device, except for complex individual equipment or
systems. Failure of any single device or communications will not cause
other network devices to fail. Internal time clocks and onboard scheduling
are required to allow for stand-alone control. BACnet "Smart" actuators (B-
SA profile) and sensors (B-SS profile) communicating on a network with a
parent device are exempt from stand-alone requirements. Provide stand-alone
control routines to provide for energy saving sequences such as free
cooling. Provide stand-alone control routines that operate without
connection to the BACnet/IP and MS/TP networks during a loss of
communication.

1.3   BACNET DIRECT DIGITAL CONTROL SYSTEMS FOR HVAC DESCRIPTION

a.   provide new BACnet DDC systems including associated equipment and
     accessories. All new devices are accessible using a Web browser
     interface and communicate using ASHRAE 135 BACnet communications
     without the use of gateways, unless gateways are shown on the design
     drawings and specifically requested by the Government. Where gateways
     are allowed, they must support ASHRAE 135, including all object
     properties and read-write services shown on Government approved
     interoperability schedules. Manufacturer's products, including design,
     materials, fabrication, assembly, inspection, and testing shall be in
     accordance with ASHRAE 135, ASME B31.1, and NFPA 70, except where
     indicated otherwise.

b.   Provide DDC systems that are compatible with Johnson Controls Metasys,
Provide a fiber optic-to-ethernet converter to interface with the new
connection to the existing base system(s) *The finished DDC system shall allow
for 100% remote monitoring and remote adjusting and programming of not only
the system at McClelland Hall, but also the relationship of that facility and
the central plan that serves it. This includes, but is not limited to,
McClelland Hall's virtual plant designation. The contractor shall
demonstrate that the new system is 100% compatible and performs all existing
functions before the system is accepted. Any additional material and labor
required to achieve compatibility will be at the contractor's expense.*

1.3.1   Design Requirements

1.3.1.1   Control System Drawings Title Sheet

  Provide a title sheet for the control system drawing set. Include the
  project title, project location, contract number, the controls contractor
  preparing the drawings, an index of the control drawings in the set, and a
  legend of the symbols and abbreviations used throughout the control system
  drawings.

1.3.1.2   List of I/O Points

  Also known as a Point Schedule, provide for each input and output point
  physically connected to a digital controller: point name, point
  description, point type (Analog Output (AO), Analog Input (AI), Binary
  Output (BO), Binary Input (BI)), point sensor range, point actuator range,
  point address, BACnet object, associated BIBBS (where applicable), and point
  connection terminal number. Typical schedules for multiple identical
  equipment are allowed unless otherwise requested in design or contract
  criteria.

1.3.1.3   Control System Components List

  Provide a complete list of control system components installed on this
  project. Include for each controller and device: control system schematic
  name, control system schematic designation, device description,
  manufacturer, model, part number, firmware version, serial number, and
  physical location (e.g. Building 4, room 112 overhead). For sensors,
  include point name, sensor range, and operating limits. For valves, include
  body style, Cv, design flow rate, pressure drop, valve characteristic
  (linear or equal percentage), and pipe connection size. For actuators,
  include point name, spring or non-spring return, modulating or two-position
  action, normal (power fail) position, nominal control signal operating range
  (0-10 volts DC or 4-20 milliamps), and operating limits.

1.3.1.4   Control System Schematics

  Provide control system schematics. Typical schematics for multiple
  identical equipment are allowed unless otherwise requested in design or
  contract criteria.   Include the following:

  a. Location of each input and output device

  b. Flow diagram for each piece of HVAC equipment

  c. Name or symbol for each control system component, such as V-1 for a
      valve

  d. Setpoints, with differential or proportional band values

  e. Written sequence of operation for the HVAC equipment

  f. Valve and Damper Schedules, with normal (power fail) position

1.3.1.5   HVAC Equipment Electrical Ladder Diagrams

Provide HVAC equipment electrical ladder diagrams. Indicate required
electrical interlocks.

1.3.1.6   Component Wiring Diagrams

Provide a wiring diagram for each type of input device and output device.
Indicate how each device is wired and powered; showing typical connections
at the digital controller and power supply. Show for all field connected
devices such as control relays, motor starters, actuators, sensors, and
transmitters.

1.3.1.7   Terminal Strip Diagrams

Provide a diagram of each terminal strip. Indicate the terminal strip
location, termination numbers, and associated point names.

1.3.1.8   BACnet Communication Architecture Schematic

Provide a schematic showing the project's entire BACnet communication
network, including Internet Protocol (IP), Media Access Control (MAC),
BACnet network, Device ID, field bus address, BBMDs, any devices using
BACnet FDR, and Firmware version / Operating System, LAN devices including
routers and bridges, gateways, controllers, workstations, and field
interface devices. If applicable, show connection to existing networks.

1.4   SUBMITTALS

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

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for Contractor Quality Control
approval. Submittals with an "S" are for inclusion in the Sustainability
Notebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING.
Submit the following in accordance with Section 01 33 00 SUBMITTAL
PROCEDURES:

    SD-02 Shop Drawings

        Include the following in the project's control system drawing
        set:

        Control System Drawings Title Sheet; G

        List of I/O Points; G

        Control System Components List; G

        Control System Schematics; G

        HVAC Equipment Electrical Ladder Diagrams; G

        Component Wiring Diagrams; G

        Terminal Strip Diagrams; G

        BACnet Communication Architecture Schematic; G

    SD-03 Product Data

        Direct Digital Controllers; G

          Include BACnet PICS for each controller/device type, including
        smart sensors (B-SS) and smart actuators (B-SA).

         Software; G

        Sensors and Input Hardware; G

        Output Hardware; G

    SD-07 Certificates

        Contractor's Qualifications; G

    SD-10 Operation and Maintenance Data

          Comply with requirements for data packages in Section 01 78
        23OPERATION AND MAINTENANCE DATA, except as supplemented and
        modified in this specification.

        BACnet Direct Digital Control Systems, Data Package 4; G

        Controls System Operators Manuals, Data Package 4; G

    SD-11 Closeout Submittals

        Training Documentation; G

1.5   QUALITY ASSURANCE

1.5.1   Standard Products

Provide material and equipment that are standard manufacturer's products
currently in production and supported by a local service organization.

1.5.2   Delivery, Storage, and Handling

Handle, store, and protect equipment and materials to prevent damage before
and during installation according to manufacturer's recommendations, and as
approved by the Contracting Officer. Replace damaged or defective items.

1.5.3   Operating Environment

Protect components from humidity and temperature variation, dust, and
contaminants. If components are stored before installation, keep them
within the manufacturer's limits.

1.5.4   Finish of New Equipment

New equipment finishing shall be factory provided. Manufacturer's standard
factory finishing shall be proven to withstand 125 hours in a salt-spray fog

test. Equipment located outdoors shall be proven to withstand 500 hours in
a salt-spray fog test.

Salt-spray fog test shall be according to ASTM B117, with acceptance
criteria as follows: immediately after completion of the test, the finish
shall show no signs of degradation or loss of adhesion beyond 0.125 inch on
either side of the scratch mark.

1.5.5   Verification of Dimensions

The contractor shall verify all dimensions in the field, and advise the
Contracting Officer of any discrepancy before performing work.

1.5.6   Contractor's Qualifications

Submit documentation certifying the controls Contractor performing the work
has completed at least three DDC systems installations of a similar design
to this project, and programmed similar sequences of operation for at least
two years.

1.5.7   Modification of References

The advisory provisions in ASME B31.1 and NFPA 70 are mandatory. Substitute
"shall" for "should" wherever it appears and interpret all references to the
"authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.5.8   Project Sequence

The control system work for this project shall proceed in the following
order:

a. Submit and receive approval on the Shop Drawings, Product Data, and
    Certificates specified under the paragraph SUBMITTALS.

b. Perform the control system installation work, including all field
    check-outs and tuning.

c. Provide support to TAB personnel as specified under the paragraph TEST
    AND BALANCE SUPPORT.

d. Submit and receive approval of the Controls System Operators Manual
    specified under the paragraph CONTROLS SYSTEM OPERATORS MANUALS.

e. Submit and receive approval of the Performance Verification Testing
    Plan and the Pre-PVT Checklist specified under the paragraph
    PERFORMANCE VERIFICATION TESTING.

f. Perform the Performance Verification Testing.

g. Submit and receive approval on the PVT Report.

h. Submit and receive approval on the Training Documentation specified
    under the paragraph INSTRUCTION TO GOVERNMENT PERSONNEL. Submit at
    least 30 days before training.

i. Deliver the final Controls System Operators Manuals.

j. Conduct the Phase I Training.

k. Conduct the Phase II Training.

l. Submit and receive approval of Closeout Submittals.

PART 2   PRODUCTS

2.1 DDC SYSTEM

a. Provide an extension of the networked DDC system in compliance with the
    latest revision of the ASHRAE 135 BACnet standard. Include all
    programming, objects, and services required to meet the sequence of
    control. Provide BACnet communications between the DDC system and
    native BACnet devices furnished with HVAC equipment and plant equipment
    including boilers and chillers. Devices provided shall be certified in
    the BACnet Testing Laboratories (BTL) Product Listing and in accordance
    with ASHRAE 135.1 Method of Test for Conformance to BACnet.

2.1.1   Direct Digital Controllers

Direct digital controllers shall be UL 916 rated.

2.1.1.1   I/O Point Limitation

The total number of I/O hardware points used by a single stand-alone digital
controller, including I/O expansion units, shall not exceed 64, except for
complex individual equipment or systems. Place I/O expansion units in the
same cabinet as the digital controller.

2.1.1.2   Environmental Limits

Controllers shall be suitable for, or placed in protective enclosures
suitable for the environment (temperature, humidity, dust, and vibration)
where they are located.

2.1.1.3   Stand-Alone Controllers

Provide stand-alone direct digital controllers with internal time clocks.
Each piece of equipment shall be controlled by a single controller to
provide stand-alone control in the event of any building communication
failure. All I/O points specified for a piece of equipment shall be
integral to its controller and serial connected expansion modules. Provide
stable and reliable stand-alone control using default values or other method
for values normally read over the network.

2.1.1.4   Internal Clock

Provide internal clocks and scheduling for all Direct Digital Controllers.
Provide controllers with BTL listed profiles for all BACnet Building
Controllers (B-BC) and BACnet Advanced Application Controllers (B-AAC) using
BACnet time synchronization services. This includes but is not limited to
VAV Controllers, Fan Coil controllers, Heat Pump controllers and any
terminal controllers. BACnet Application specific controllers (B-ASC) will
only be accepted for dedicated small exhaust system control such as restroom
and mechanical room exhaust fans. Automatically synchronize system clocks

daily from an operator-designated controller. The system shall
automatically adjust for daylight saving time.

2.1.1.5   Memory

Provide sufficient memory for each controller to support the required
control, communication, trends, alarms, and messages. Protect programs
residing in memory with EEPROM, flash memory, or by an uninterruptible power
source (battery or uninterruptible power supply). The backup power source
shall have capacity to maintain the memory during a 72-hour continuous power
outage. Rechargeable power sources shall be constantly charged while the
controller is operating under normal line power. Batteries shall be
replaceable without soldering. Trend and alarm history collected during
normal operation shall not be lost during power outages less than 72 hours
long.

2.1.1.6   Immunity to Power Fluctuations

Controllers shall operate at 90 percent to 110 percent nominal voltage
rating.

2.1.1.7   Transformer

The controller power supply shall be fused or current limiting and rated at
125 percent power consumption.

2.1.1.8   Wiring Terminations

Use screw terminal wiring terminations for all field-installed controllers.
Provide field-removable modular terminal strip or a termination card
connected by a ribbon cable for all controllers other than terminal units.

2.1.1.9   Input and Output Interface

Provide hard-wired input and output interface for all controllers as
follows:

a.   Protection: Shorting an input or output point to itself, to another
     point, or to ground shall cause no controller damage. Input or output
     point contact with sources up to 24 volts AC or DC for any duration
     shall cause no controller damage.

b.   Binary Inputs: Binary inputs shall have a toggle switch and monitor on
     and off contacts from a "dry" remote device without external power, and
     external 5-24 VDC voltage inputs.

c.   Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to
     binary input requirements and accumulate pulses at a resolution
     suitable to the application.

d.   Analog Inputs: Analog inputs shall monitor low-voltage (0-10 VDC),
     current (4-20 mA), or resistance (thermistor or RTD) signals.

e.   Binary Outputs: Binary outputs shall have a toggle switch and send a
     pulsed 24 VDC low-voltage signal for modulation control, or provide a
     maintained open-closed position for on-off control. For HVAC equipment
     and plant controllers, provide for manual overrides, either with three-

position (on-off-auto) override switches and status lights, or with an
adjacent operator display and interface. Where appropriate, provide a
method to select normally open or normally closed operation.

f. Analog Outputs: Analog outputs shall send modulating 0-10 VDC or 4-20
    mA signals to control output devices.

g. Tri-State Outputs: Tri-State outputs shall provide three-point
    floating control of terminal unit electronic actuators.

2.1.1.10   Digital Controller BACnet Internetwork

Provide a BACnet internetwork with control products, communication media,
connectors, repeaters, hubs, and routers. Controller and operator interface
communication shall conform to ASHRAE 135, BACnet. If a controller becomes
non-responsive, the remaining controllers shall continue operating and not
be affected by the failed controller.

2.1.1.11   Communications Ports

a. Direct-Connect Interface Ports: Provide at least one extra
    communication port at each local BACnet network for direct connecting a
    notebook computer or BACnet hand-held terminal so all network BACnet
    objects and properties may be viewed and edited by the operator.

b. BACnet routers supporting ARCnet shall also be capable of supporting
    MS/TP.

2.1.2   DDC Software

2.1.2.1   Programming

Provide programming to execute the sequence of operation indicated. Provide
all programming and tools to configure and program all controllers. Provide
programming routines in simple, easy-to-follow logic with detailed text
comments describing what the logic does and how it corresponds to the
project's written sequence of operation. All logic programming and control
functions shall be closed loop, command and feedback for fault detection and
alarming when status != command.

a. Graphic-based programming shall use a library of function blocks made
    from pre-programmed code designed for BAS control. Function blocks
    shall be assembled with interconnecting lines, depicting the control
    sequence in a flowchart. If providing a computer with device
    programming tools as part of the project, graphic programs shall be
    viewable in real time showing present values and logical results from
    each function block.

b. Menu-based programming shall be done by entering parameters,
    definitions, conditions, requirements, and constraints.

c. For line-by-line and text-based programming, declare variable types
    (variable types include but are not limited to the following: local,
    global, real, and integer) at the beginning of the program. Use
    descriptive comments frequently to describe the programming.

d. If providing a computer with device programming tools as part of the
    project, provide a means for detecting program errors and testing
    software strategies with a simulation tool. Simulation may be inherent
    within the programming software suite, or provided by physical
    controllers mounted in a NEMA 1 test enclosure. The test enclosure
    shall contain one dedicated controller of each type provided under this
    contract, complete with power supply and relevant accessories.

2.1.2.2   Parameter Modification

   All writeable object properties, and all other programming parameters needed
   to comply with the project specification shall be adjustable for devices at
   any network level, including those accessible with web-browser
   communication, and regardless of programming methods used to create the
   applications.

2.1.2.3   Short Cycling Prevention

   Provide setpoint differentials and minimum on/off times to prevent equipment
   short cycling.

2.1.2.4   Equipment Status Delay

   Provide an adjustable delay from when equipment is commanded on or off and
   when the control program looks to the status input for confirmation.

2.1.2.5   Run Time Accumulation

   Use the Elapsed Time Property to provide re-settable run time accumulation
   for each Binary Output Object connected to mechanical loads greater than 1
   HP, electrical loads greater than 10 KW, or wherever else specified.

2.1.2.6   Timed Local Override

   Provide an adjustable override time for each push of a timed local override
   button.

2.1.2.7   Time Synchronization

   Provide time synchronization, including adjustments for leap years, daylight
   saving time, and operator time adjustments.

2.1.2.8   Scheduling

   Provide operating schedules as indicated, with equipment assigned to groups.
   Changing the schedule of a group shall change the operating schedule of all
   equipment in the group. Groups shall be capable of operator creation,
   modification, and deletion. Provide capability to view and modify schedules
   in a seven-day week format. Provide capability to enter holiday and
   override schedules one full year at a time.

2.1.2.9   Object Property Override

   Allow writeable object property values to accept overrides to any valid
   value. Where specified or required for the sequence of control, the Out-Of-
   Service property of Objects shall be modifiable using BACnet's write

property service. When documented, exceptions to these requirement are
allowed for life, machine, and process safeties.

2.1.2.10   Alarms and Events

Alarms and events shall be capable of having programmed time delays and
high-low limits. When a computer workstation or web server is connected to
the BACnet internetwork, alarms/events shall report to the computer,
printer, e-mail, as defined by an authorized operator. Otherwise
alarms/events shall be stored within a device on the BACnet network until
connected to a user interface device and retrieved. Provide alarms/events
in agreement with the point schedule, sequence of operation, and the BAS
Owner. At a minimum, provide programming to initiate alarms/events any time
a piece of equipment fails to operate, a control point is outside normal
range or condition shown on schedules, communication to a device is lost, a
device has failed, or a controller has lost its memory.

2.1.2.11   Trending

Provide BACnet trend services capable of trending all object present values
set points, and other parameters indicated for trending on project
schedules. Trends may be associated into groups, and a trend report may be
set up for each group. Trends are stored within a device on the BACnet
network, with operator selectable trend intervals from 10 seconds up to 60
minutes. The minimum number of consecutive trend values stored at one time
shall be 100 per variable. When trend memory is full, the most recent data
shall overwrite the oldest data.

The BACnet system shall allow for Change-Of-Value (COV) subscription based
trending at user defined thresholds.

The operator workstation shall upload trends automatically upon reaching 3/4
of the device buffer limit (via Notification_Threshold property), by
operator request, or by time schedule for archiving. Archived and real-time
trend data shall be available for viewing numerically and graphically for
at the workstation and connected notebook computers.

2.1.2.12   Device Diagnostics

Each controller shall have diagnostic LEDs for power, communication, and
device fault condition. The DDC system shall recognize and report a non-
responsive controller.

2.1.2.13   Device Management

System shall be capable of managing devices remotely to include
updating/loading firmware, restarting, and network configuration. These
capabilities shall be restricted to authorized roles. The system shall
support, either natively or with provided add-on software, remote read/write
and management of BBMD tables.

2.1.2.14   Power Loss

Upon restoration of power, the DDC system shall perform an orderly restart
and restoration of control.

2.1.3   Software

2.1.3.1   Web-Based User Interface (UI) and Graphics

Graphic displays shall have full-screen resolution when viewed on the
workstation and notebook computers. Dynamic data on graphics pages shall
refresh within 10 seconds using an Internet connection, or 30 seconds using
a dial-up modem connection. Web-based user interface shall not rely on
additional third-party browser "plug-in" software like Adobe Flash. Java
client side applets may be used if appropriately signed. If Java client
side runtimes are used they shall not require deprecated or otherwise
unsupported Java runtime environments.

The graphics shall show the present value and object name for each of the
project's I/O points on at least one graphic page. Arrange point values and
names on the graphic displays in their appropriate physical locations with
respect to the floor plan or equipment graphic displayed. Graphics shall
allow the operator to monitor current status, view zone and equipment
summaries, use point-and-click navigation between graphic pages, and edit
setpoints and parameters directly from the screens. Items in alarm shall be
displayed using a different color or other obvious visual indicator.
Provide graphics with the following:

a. Graphic Types: Provide at least one graphic display for each piece of
    HVAC equipment, building floor, and controlled zone. Indicate dynamic
    point values, operating statuses, alarm conditions, and control
    setpoints on each display. Provide summary pages where appropriate.

    (1) Building Elevation: For buildings more than one story, provide an
        elevation view of the building with links to each of the building's
        floor plans. Simulate the building's architecture and include the
        building number and floor numbers. If possible, use an actual
        photograph of the building.

    (2) Building Floor Plans: Provide a floor plan graphic for each of the
        building's floors with dynamic display of space temperature and
        other important data. If used, indicate and provide links to sub-
        plan areas. If possible, use the project's electronic drawing
        files for the graphic backgrounds. Provide clear names for
        important areas, such as "Main Conference Room." Include room
        names and numbers where applicable. Include features such as
        stairwells, elevators, and main entrances. Where applicable,
        include the mechanical room, HVAC equipment, and control component
        locations, with corresponding links to the equipment graphics.

    (3) Sub-plan Areas: Where a building's floor plan is too large to
        adequately display on the screen, sub-divide the plan into distinct
        areas, and provide a separate graphic display for each area.
        Provide same level of detail requested in building floor plan
        section above.

    (4) HVAC Equipment: Provide a graphic display for each piece of HVAC
        equipment, such as a fan coil unit, VAV terminal, or air handling
        unit. Equipment shall be represented by a two or three-dimensional
        drawing. Where multiple pieces of equipment combine to form a
        system, such as a central chiller plant or central heating plant,
        provide one graphic to depict the entire plant. Indicate the

equipment, piping, ductwork, dampers, and control valves in the
installed location. Include labels for equipment, piping,
ductwork, dampers, and control valves. Show the direction of air
and water flow. Include dynamic display of applicable object data
with clear names in appropriate locations.

(5) Sequence of Operation: Provide a graphic screen displaying the
written out full sequence of operation for each piece of HVAC
equipment. Provide a link to the sequence of operation displays on
their respective equipment graphics. Include dynamic real-time
data within the text for setpoints and variables.

b. Graphic Title: Provide a prominent, descriptive title on each graphic
page.

c. Dynamic Update: When the workstation is on-line, all graphic I/O
object values shall update with change-of-value services, or by
operator selected discrete intervals.

d. Graphic Linking: Provide forward and backward linking between floor
plans, sub-plans, and equipment.

e. Graphic Editing: Provide installed software to create, modify, and
delete the DDC graphics. Include the ability to store graphic symbols
in a symbol directory and import these symbols into the graphics.

f. Dynamic Point Editing: Provide full editing capability for deleting,
adding, and modifying dynamic points on the graphics.

2.2   SENSORS AND INPUT HARDWARE

Coordinate sensor types with the BAS Owner to keep them consistent with
existing installations.

2.2.1   Field-Installed Temperature Sensors

Where feasible, provide the same sensor type throughout the project. Avoid
using transmitters unless absolutely necessary.

2.2.1.1   Thermistors

Precision thermistors may be used in applications below 200 degrees F.
Sensor accuracy over the application range shall be 0.36 degree F or less
between 32 to 150 degrees F. Stability error of the thermistor over five
years shall not exceed 0.25 degrees F cumulative. A/D conversion resolution
error shall be kept to 0.1 degrees F. Total error for a thermistor circuit
shall not exceed 0.5 degrees F.

2.2.1.2   Resistance Temperature Detectors (RTDs)

Provide RTD sensors with platinum elements compatible with the digital
controllers. Encapsulate sensors in epoxy, series 300 stainless steel,
anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1
percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature
sensor stability error over five years shall not exceed 0.25 degrees F
cumulative. Direct connection of RTDs to digital controllers without
transmitters is preferred. When RTDs are connected directly, lead

resistance error shall be less than 0.25 degrees F. The total error for a
RTD circuit shall not exceed 0.5 degrees F.

2.2.1.3   Temperature Sensor Details

a. Room Type: Provide the sensing element components within a decorative
    protective cover suitable for surrounding decor. Provide room
    temperature sensors with timed override button, setpoint adjustment
    lever, digital temperature display. Provide a communication port or
    802.11x wireless support for a portable operator interface like a
    notebook computer or PDA.

2.3   OUTPUT HARDWARE

2.3.1   Control Valves

2.3.1.1   Three-Way Valves

Three-way valves shall have an equal percentage characteristic.

2.3.1.2   Valves for Hot Water Service

Valves for hot water service below 250 Degrees F:

a. Bodies for valves 1-1/2 inches and smaller shall be brass or bronze,
    with threaded or union ends. Bodies for valves from 2 inches to 3
    inches inclusive shall be of brass, bronze, or iron. Bodies for 2 inch
    valves shall have threaded connections. Bodies for valves from 2-1/2
    to 3 inches shall have flanged connections. Internal trim for valves
    controlling water 210 degrees F or less shall be brass or bronze.
    Valve stems shall be Type 316 stainless steel.

b. Non-metallic parts of hot water control valves shall be suitable for a
    minimum continuous operating temperature of 250 degrees F or 50 degrees
    F above the system design temperature, whichever is higher.

c. Unless indicated otherwise, provide modulating valves sized for 2 psi
    minimum and 4 psi maximum differential across the valve at the design
    flow rate.

2.3.2   Actuators

Provide direct-drive electric actuators for all control applications, except
where indicated otherwise. as percent open/closed. Actuator status shall be
derived from actuator position; however, effect may be used in cases where
direct feedback is not practical such as VAV coils and dampers.

2.4   ELECTRICAL POWER AND DISTRIBUTION

2.4.1   Transformers

Transformers shall conform to UL 506. For control power other than terminal
level equipment, provide a fuse or circuit breaker on the secondary side of
each transformer.

2.4.2   Wiring

Provide complete electrical wiring for the DDC System, including wiring to
transformer primaries. Unless indicated otherwise, provide all normally
visible or otherwise exposed wiring in conduit. Where conduit is required,
control circuit wiring shall not run in the same conduit as power wiring
over 100 volts. Circuits operating at more than 100 volts shall be in
accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Run all
circuits over 100 volts in conduit, metallic tubing, covered metal raceways,
or armored cable. Use plenum-rated cable for circuits under 100 volts in
enclosed spaces. Examples of these spaces include HVAC plenums, within
walls, above suspended ceilings, in attics, and within ductwork.

2.4.2.1   Power Wiring

The following requirements are for field-installed wiring:

   a. Wiring for 24 V circuits shall be insulated copper 18 AWG minimum and
       rated for 300 VAC service.

   b. Wiring for 120 V circuits shall be insulated copper 14 AWG minimum and
       rated for 600 VAC service.

2.4.2.2   Analog Signal Wiring

Field-installed analog signal wiring shall be 18 AWG single or multiple
twisted pair. Each cable shall be 100 percent shielded and have a 20 AWG
drain wire. Each wire shall have insulation rated for 300 VAC service.
Cables shall have an overall aluminum-polyester or tinned-copper cable-
shield tape.

PART 3   EXECUTION

3.1   INSTALLATION

3.1.1   BACnet Naming and Addressing

Coordinate with the BAS Owner and provide unique naming and addressing for
BACnet networks and devices.

   a. MAC Address

       Every BACnet device shall have an assigned and documented MAC Address
       unique to its network. For Ethernet networks, document the MAC Address
       assigned at its creation. For ARCNET or MS/TP, assign from 01 to 64.

   b. Network Numbering

       Assign unique numbers to each new network installed on the BACnet
       internetwork. Provide ability for changing the network number; either
       by device switches, network computer, or field operator interface. The
       BACnet internetwork (all possible connected networks) can contain up to
       65,534 possible unique networks.

   c. Device Object Identifier Property Number

Assign unique Device "Object_Identifier" property numbers or device
instances for each device on the BACnet internetwork. Provide for
future modification of the device instance number; either by device
switches, network computer, or field interface. BACnet allows up to
4,194,302 possible unique devices per internetwork.

d. Device Object Name Property Text

The Device Object Name property field shall support 32 minimum
printable characters. Assign unique Device "Object_Name" property
names with plain-English descriptive names for each device
For example, the Device Object Name that for the device controlling the
chiller plant at Building 3408 would be:

Device Object_Name = CW System B3408

A Device Object Name for a VAV box controller might be:

Device Object_Name = VAV BOX25

e. Object Name Property Text (Other than Device Objects)

The Object Name property field shall support 32 minimum printable
characters. Assign Object Name properties with plain-English names
descriptive of the application using camelCase. Abbreviations, while
necessary, shall be standard throughout the control environment and
unique (i.e. Don't use SA for supply air temperature everywhere there
is air blowing. Use it for FAN supply air temperature, and use a
different abbreviation for VAV supply air temperature). Examples
include "Zone 1 Temperature" and "Fan Start/Stop".

f. Object Identifier Property Number (Other than Device Objects)

Assign Object Identifier property numbers according to design drawings
or tables if provided. If not provided, Object Identifier property
numbers may be assigned at the Contractor's discretion but must be
approved by the Government. In this case they must be documented and
unique for like object types within the device.

3.1.2   Minimum BACnet Object Requirements

a. Use of Standard BACnet Objects

For the following points and parameters, use standard BACnet objects,
where all relevant object properties can be read using BACnet's Read
Property Service, and all relevant object properties can be modified
using BACnet's Write Property Service:
all device physical inputs and outputs, all set points, all PID tuning
parameters, all calculated pressures, flow rates, and consumption
values, all alarms, all trends, all schedules, and all equipment and
lighting circuit operating status.

b. BACnet Object Description Property

The Object Description property shall support 32 minimum printable
characters. For each object, complete the description property field
using a brief, narrative, plain English description specific to the

object and project application. For example: "HW Pump 1 Proof."
Document compliance, length restrictions, and whether the description
is writeable in the device PICS.

c. Analog Input, Output, and Value Objects

Support and provide Description and Device_Type text strings matching
signal type and engineering units shown on the points list.

d. Binary Input, Output, and Value Objects

Support and provide Inactive_Text and Active_Text property descriptions
matching conditions shown on the points list.

e. Calendar Object

For devices with scheduling capability, provide at least one Calendar
Object with ten-entry capacity. All operators may view Calendar
Objects; authorized operators may make modifications from a
workstation. Enable the writeable Date List property and support all
calendar entry data types.

f. Schedule Object

Use Schedule Objects for all building system scheduling. All operators
may view schedule entries; authorized operators may modify schedules
from a workstation.

g. Loop Object or Equal

Use Loop Objects or equivalent BACnet objects in each applicable field
device for PID control. Regardless of program method or object used,
allow authorized operators to adjust the Update Interval, Setpoint,
Proportional Constant, Integral Constant, and Derivative Constant using
BACnet read/write services.

3.1.3   Minimum BACnet Service Requirements

a. Command Priorities

Use commandable BACnet objects to control machinery and systems,
providing the priority levels listed below. If the sequence of
operation requires a different priority, obtain approval from the
Contracting Officer.

Priority Level	Application
1	Manual-Life Safety
2	Automatic-Life Safety
3	(User Defined)
4	(User Defined)
5	Critical Equipment Control

Priority Level	Application
6	Minimum On/Off
7	(User Defined)
8	Manual Operator
9	(User Defined)
10	(User Defined)
11	Load Shedding
12	(User Defined)
13	(User Defined)
14	(User Defined)
15	(User Defined)
16	(User Defined)

   b. Alarming

       (1) Alarm Priorities - Coordinate alarm and event notification with the
           BAS Owner.

       (2) Notification Class -   Enable writeable Priority, Ack Required, and
           Recipient List properties of Notification Class objects.

       (3) Event Notification Message Texts - Use condition specific narrative
           text and numerical references for alarm and event notification.

   c. Updating Displayed Property Values

       Allow workstations to display property values at discrete polled
       intervals, or based on receipt of confirmed and unconfirmed Change of
       Value notifications. The COV increment shall be adjustable by an
       operator using BACnet services, and polled intervals shall be
       adjustable at the operator workstation.

3.1.4   Local Area Networks

 Obtain Government approval before connecting new networks with existing
 networks. Network numbers and device instance numbers shall remain unique
 when joining networks. Do not change existing network addressing without
 Government approval. See also "BACnet Naming and Addressing".

3.1.5   BACnet Routers and Protocol Gateways

Provide the quantity of BACnet routers necessary for communications shown on
the BACnet Communication Architecture schematic. Provide BACnet routers
with BACnet Broadcast Message Device (BBMD) capability on each BACnet
internetwork communicating across an IP network. Configure BBMD tables to
enable unicast forwarding of broadcast messaging across Layer-3 IP subnets.

3.1.6   Wiring Criteria

  a. Run circuits operating at more than 100 volts in rigid or flexible
      conduit, metallic tubing, covered metal raceways, or armored cable.

  b. Do not run binary control circuit wiring in the same conduit as power
      wiring over 100 volts. Where analog signal wiring requires conduit, do
      not run in the same conduit with AC power circuits or control circuits
      operating at more than 100 volts.

  c. Provide circuit and wiring protection required by NFPA 70.

  d. Run all wiring located inside mechanical rooms in conduit.

  e. Do not bury aluminum-sheathed cable or aluminum conduit in concrete.

  f. Input/output identification: Permanently label each field-installed
      wire, cable, and pneumatic tube at each end with descriptive text using
      a commercial wire marking system that fully encircles the wire, cable,
      or tube. Locate the markers within 2 inches of each termination.
      Match the names and I/O number to the project's point list. Similarly
      label all power wiring serving control devices, including the word
      "power" in the label. Number each pneumatic tube every six feet.
      Label all terminal blocks with alpha/numeric labels. All wiring and
      the wiring methods shall be in accordance with UL 508A.

  g. For controller power, provide new 120 VAC circuits, with ground.
      Provide each circuit with a dedicated breaker, and run wiring in its
      own conduit, separate from any control wiring. Connect the
      controller's ground wire to the electrical panel ground; conduit
      grounds are not acceptable.

  h. Surge Protection: Install surge protection according to manufacturer's
      instructions. Multiple controllers fed from a common power supply may
      be protected by a common surge protector, properly sized for the total
      connected devices.

  i. Grounding: Ground controllers and cabinets to a good earth ground as
      specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Conduit
      grounding is not acceptable; all grounding shall have a direct path to
      the building earth ground. Ground sensor drain wire shields at the
      controller end.

  j. The Contractor shall be responsible for correcting all associated
      ground loop problems.

  k. Run wiring in panel enclosures in covered wire track.

3.1.7   Accessibility

Install all equipment so that parts requiring periodic inspection,
operation, maintenance, and repair are readily accessible. Install digital
controllers, data ports, and concealed actuators, valves, dampers, and like
equipment in locations freely accessible through access doors.

3.1.8   Digital Controllers

a. Install as stand alone control devices (see definitions).

b. Locate control cabinets at the locations shown on the drawings. If not
    shown on the drawings, install in the most accessible space, close to
    the controlled equipment.

3.1.9   Temperature Sensors

Install temperature sensors in locations that are accessible and provide a
good representation of sensed media. Installations in dead spaces are not
acceptable. Calibrate sensors according to manufacturer's instructions. Do
not use sensors designed for one application in a different application.

3.1.9.1   Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at
the locations indicated. Avoid locations near heat sources such as copy
machines or locations by supply air outlet drafts. Mount the center of the
sensor 54 inches above the floor to meet ADA requirements.

3.1.10   Component Identification Labeling

Using an electronic hand-held label maker with white tape and bold black
block lettering, provide an identification label on the exterior of each new
control panel, control device, actuator, and sensor. Also provide labels on
the exterior of each new control actuator indicating the (full) open and
(full) closed positions. For labels located outdoors, use exterior grade
label tape, and provide labels on both the inside and outside of the panel
door or device cover. Acceptable alternatives are white plastic labels with
engraved bold black block lettering permanently attached to the control
panel, control device, actuator, and sensor. Have the labels and wording
approved by the BAS Owner prior to installation.

3.1.11   Network and Telephone Communication Lines

When telephone lines or network connections by the Government are required,
provide the Contracting Officer at least 60 days advance notice of need.

3.2   TEST AND BALANCE SUPPORT

The controls contractor shall coordinate with and provide on-site support to
the test and balance (TAB) personnel specified under Section 23 05 93
TESTING, ADJUSTING AND BALANCING. This support shall include:

a. On-site operation and manipulation of control systems during the
    testing and balancing.

b. Control setpoint adjustments for balancing all relevant mechanical
    systems, including VAV boxes.

c. Tuning control loops with setpoints and adjustments determined by TAB
    personnel.

3.3   CONTROLS SYSTEM OPERATORS MANUALS

Provide four electronic and printed copies of a Controls System Operators
Manual. The manual shall be specific to the project, written to actual
project conditions, and provide a complete and concise depiction of the
installed work. Provide information in detail to clearly explain all
operation requirements for the control system.

Provide with each manual: CDs of the project's control system drawings,
control programs, data bases, graphics, and all items listed below. Include
gateway back-up data and configuration tools where applicable. Provide CDs
in jewel case with printed and dated project-specific labels on both the CD
and the case. For text and drawings, use Adobe Acrobat or MS Office file
types. When approved by the Government, AutoCAD and Visio files are
allowed. Give files descriptive English names and organize in folders.

Provide printed manuals in sturdy 3-ring binders with a title sheet on the
outside of each binder indicating the project title, project location,
contract number, and the controls contractor name, address, and telephone
number. Each binder shall include a table of contents and tabbed dividers,
with all material neatly organized. Manuals shall include the following:

a. A copy of the as-built control system (shop) drawings set, with all
    items specified under the paragraph SUBMITTALS. Indicate all field
    changes and modifications.

b. A copy of the project's mechanical design drawings, including any
    official modifications and revisions.

c. A copy of the project's approved Product Data submittals provided under
    the paragraph SUBMITTALS.

d. A copy of the project's approved Performance Verification Testing Plan
    and Report.

e. A copy of the project's approved final TAB Report.

f. Printouts of all control system programs, including controller setup
    pages if used. Include plain-English narratives of application
    programs, flowcharts, and source code.

g. Printouts of all physical input and output object properties, including
    tuning values, alarm limits, calibration factors, and set points.

h. A table entitled "AC Power Table" listing the electrical power source
    for each controller. Include the building electrical panel number,
    panel location, and circuit breaker number.

i. The DDC manufacturer's hardware and software manuals in both print and
    CD format with printed project-specific labels. Include installation
    and technical manuals for all controller hardware, operator manuals for
    all controllers, programming manuals for all controllers, operator
    manuals for all workstation software, installation and technical

     manuals for the workstation and notebook, and programming manuals for
     the workstation and notebook software.

  j. A list of qualified control system service organizations for the work
      provided under this contract. Include their addresses and telephone
      numbers.

  k. A written statement entitled "Technical Support" stating the control
      system manufacturer or authorized representative will provide toll-free
      telephone technical support at no additional cost to the Government for
      a minimum of two years from project acceptance, will be furnished by
      experienced service technicians, and will be available during normal
      weekday working hours. Include the toll-free technical support
      telephone number.

  l. A written statement entitled "Software Upgrades" stating software and
      firmware patches and updates will be provided upon request at no
      additional cost to the Government for a minimum of two years from
      contract acceptance. Include a table of all DDC system software and
      firmware provided under this contract, listing the original release
      dates, version numbers, part numbers, and serial numbers.

3.4   TRAINING REQUIREMENTS

  Provide a qualified instructor (or instructors) with two years minimum field
  experience with the installation and programming of similar BACnet DDC
  systems. Orient training to the specific systems installed. Coordinate
  training times and location with the Contracting Officer and BAS Owner after
  receiving approval of the training course documentation. Training shall
  take place at the job site or a nearby Government-furnished location. A
  training day shall occur during normal working hours, last no longer than 8
  hours and include a one-hour break for lunch and two additional 15-minute
  breaks. The project's approved Controls System Operators Manual shall be
  used as the training text. The Contractor shall ensure the manuals are
  submitted, approved, and available to hand out to the trainees before the
  start of training.

3.4.1   Training Documentation

  Submit training documentation for review 30 days minimum before training.
  Documentation shall include an agenda for each training day, objectives, a
  synopses of each lesson, and the instructor's background and qualifications.
  The training documentation can be submitted at the same time as the
  project's Controls System Operators Manual.

3.4.2   Phase I Training - Fundamentals

  The Phase I training session shall last one day and be conducted in a
  classroom environment with complete audio-visual aids provided by the
  contractor. Provide each trainee a printed 8.5 by 11 inch hard-copy of all
  visual aids used. Upon completion of the Phase I Training, each trainee
  should fully understand the project's DDC system fundamentals. The training
  session shall include the following:

  a. BACnet fundamentals (objects, services, addressing) and how/where they
      are used on this project

    b. This project's list of control system components

    c. This project's list of points and objects

    d. This project's device and network communication architecture

    e. This project's sequences of control, and:

    f. Alarm capabilities

    g. Trending capabilities

    h. Troubleshooting communication errors

    i. Troubleshooting hardware errors

3.4.3   Phase II Training - Operation

Provide Phase II Training shortly after completing Phase I Training. The
Phase II training session shall last one day and be conducted at the DDC
system workstation, at a notebook computer connected to the DDC system in
the field, and at other site locations as necessary. Upon completion of the
Phase II Training, each trainee should fully understand the project's DDC
system operation. The training session shall include the following:

    a. A walk-through tour of the mechanical system and the installed DDC
        components (components include but are not limited to the following:
        controllers, valves, dampers, surge protection, switches, thermostats,
        and sensors)

    b. A discussion of the components and functions at each DDC panel

    c. Logging-in and navigating at each operator interface type

    d. Using each operator interface to find, read, and write to specific
        controllers and objects

    e. Modifying and downloading control program changes

    f. Modifying setpoints

    g. Creating, editing, and viewing trends

    h. Creating, editing, and viewing alarms

    i. Creating, editing, and viewing operating schedules and schedule objects

    j. Backing-up and restoring programming and data bases

    k. Modifying graphic text, backgrounds, dynamic data displays, and links
        to other graphics

    l. Creating new graphics and adding new dynamic data displays and links

    m. Alarm and Event management

    n. Adding and removing network devices

-- End of Section --

SECTION 28 08 10

ELECTRONIC SECURITY SYSTEM ACCEPTANCE TESTING
05/16

PART 1   GENERAL

1.1   SUMMARY

  This specification defines the process and procedures for initial
  acceptance testing of electronic security systems (ESS) to include video
  surveillance systems as well as associated power and communications.
  Requirements to plan, conduct, and document all testing activities are
  covered along with the Government responsibility to witness testing and
  review and approve submittals. During the course of the acceptance test,
  demonstrate that, without exception, the completed and integrated ESS
  complies with the contract requirements.

  The intrusion detection/access control system shall be Government
  Furnished/Government Installed (GFGI). Integration between the surveillance
  system and the GFGI intrusion detection/access control system shall be by
  the GFGI contractor.

1.2   DEFINITIONS

  The Government Representative is a qualified individual given specific
  authority to witness system acceptance testing and evaluate the results.

1.3   SUBMITTALS

  Government approval is required for submittals with a "G" designation;
  submittals not having a "G" designation are for Contractor Quality Control
  approval. Submittals with an "S" are for inclusion in the Sustainability
  Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING.
  Submit the following in accordance with Section 01 33 00 SUBMITTAL
  PROCEDURES:

      SD-05 Design Data

          Test Plan; G

      SD-06 Test Reports

          Draft Test Report

          Final Test Report; G

      SD-07 Certificates

          Qualifications

1.4   QUALITY ASSURANCE

1.4.1   Qualifications

1.4.1.1   General

  The Test Director, Operator, and Technician must have prior experience with
  the specific equipment, hardware and software installed under the contract.

1.4.1.2   Test Director

  The Test Director must have at least five years of hands-on ESS experience
  to include any combination of design, installation, testing and maintenance.

1.4.1.3   Operator

  The Operator must have at least two years of hands-on experience installing
  and maintaining ESS workstations to include both hardware and software.
  The Operator must be capable of demonstrating all workstation features and
  capabilities.

1.4.1.4   Technician

  The technician must have at least two years of hands-on experience
  installing and maintaining ESS field equipment to include sensors, card
  readers, cameras, local processors, and communications equipment. The
  Technician must be capable of demonstrating all features and capabilities
  of ESS field equipment. Qualifications may be met by the individual
  experience of one technician or by the combined experience of a team of
  technicians.

PART 2   PRODUCTS

  Not Used

PART 3   EXECUTION

3.1   TEST PLAN

  Clearly establish the scope for ESS testing prior to beginning testing.
  Submit a Test Plan that addresses the following topics:

3.1.1   Personnel

  Identify the Test Director, Operator, Technician, , and any other personnel
  that will be performing test activities.

3.1.2   Equipment

  List all equipment that is required to support testing. State the purpose
  of each piece of equipment. Describe equipment that will be used to enable
  voice communications between the monitoring location and the field.

3.1.3   Procedures

  Provide a step-by-step procedure for conducting each functional test.
  Describe actions and expected results. Ensure that functional test
  procedures address performance standards described in contract
  specifications.

Download example procedures from
http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf and review for applicability
and completeness. Adapt example procedures to meet specific project
requirements and develop additional ones as needed. Follow
TEST-MASTERTP0023-005 for Air Force projects.

3.1.4   Special Provisions

Discuss any special test provisions such as facility access, safety,
integration with existing systems, and coordination with other work.

3.1.5   Test Logs

Provide logs for recording all data from functional testing and burn-in
testing.

Download example logs from http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf
and review for applicability and completeness. Adapt example logs to meet
specific project requirements and develop additional ones as needed.

3.1.6   Schedule

Provide an overall schedule that includes all testing milestones.

3.2   PRE-ACCEPTANCE TESTING

Conduct a complete test of all field equipment, workstations, and central
system hardware and software in accordance with the approved Test Plan.
The Test Director must be on site to conduct a pre-test inspection and
oversee all testing activities. Prior to testing, visually inspect all ESS
components and correct workmanship and neatness deficiencies as needed.
During the pre-test inspection, verify the accuracy of redline drawings and
update drawings as needed. Conduct testing in two phases - functional
testing followed by burn-in testing.

3.2.1   Phased Testing

3.2.1.1   Functional Testing Phase

During the functional testing phase, verify system performance in
accordance with approved Test Plan. Record results in approved Test Logs,
and provide a written explanation of each failure to include cause,
corrective action, and retest result. Continue functional testing until
all tests have been successfully completed with no unresolved failures.

3.2.1.2   Burn-In Testing Phase

Begin burn-in testing after successful completion of all functional
testing.During the burn-in testing phase, place the ESS in normal operating
mode and evaluate system performance for a continuous 72-hour period.
During this time, the ESS must be fully functional and programmed such that
all features can be exercised and evaluated through normal use. Record all
system anomalies in approved Test Logs. Include a description of each
anomaly along with any actions taken in response. Immediately correct
minor deficiencies observed during the course of testing and continue with
burn-in testing.   Determine the root cause of any failures and make
necessary repairs or modifications to restore full functionality. After a
failure is corrected repeat functional tests for components and features

associated with the failure, and repeat the entire burn-in testing phase .

3.2.2   Draft Test Report

Prepare and submit a Draft Test Report detailing the results of the testing. Refer to paragraph FINAL TEST REPORT for required content. Include a cover letter signed by the Test Director stating that pre-acceptance testing has been completed and that the system is ready for acceptance testing.

3.3   SYSTEM ACCEPTANCE

Test the ESS in accordance with the approved Test Plan in the presence of the Government Representative to certify acceptable performance. Verify that the total system meets all requirements of the specification and complies with the specified standards.

Begin acceptance testing upon arrival of the Government Representative at the project site. Place the ESS in normal operating mode and evaluate system performance during the testing period. Immediately report any deficiencies observed during testing to the Government Representative and discuss possible causes and corrective measures. Obtain Government approval prior to making any adjustments, repairs or modifications. The Government retains the right to terminate testing at any time the ESS is found to be incomplete or fails to perform as specified. Such termination of acceptance testing constitutes a FAILED system acceptance test.

3.3.1   Preparation

Nofity the Contracting Officer of system readiness 15 days prior to the expected start date of acceptance testing. Prior to acceptance testing, complete all clean-up and patch work requirements. Ensure that security equipment closets and similar areas are free of accumulation of waste materials or rubbish caused by prior installation work.

3.3.2   Personnel

Ensure that the following personnel are on site to perform test activities: Test Director, Operator, Technician. Ensure that the Quality Control Manager is on site during acceptance testing.

3.3.3   Visual Inspection

Assist the Government Representative in conducting a visual inspection of ESS equipment and wiring. This inspection will focus on the general neatness and quality of workmanship and compliance with applicable codes and manufacturers' recommended installation methods. Provide a comprehensive listing of installed equipment and software along with a complete set of ESS red line drawings to be used during the inspection. Document deficiencies identified during the inspection.

3.3.4   Functional Testing

Comply with requests from the Government Representative to repeat functional tests performed previously during pre-acceptance testing. The Government reserves the right to request the Contractor to repeat all functional tests or a representative sampling thereof as a means of performance verification.   Add all test results to approved Test Logs.

3.3.5   System Activity Reports

  Retrieve archived data from the system and provide activity reports as
  requested by the Government Representative. Reports may address any type
  of activity to include alarms, portal transactions, and video archives.
  Assist with analyzing reports to identify trends and anomalies.

3.3.6   Corrective Actions

  Correct any deficiencies in coordination with the Government
  Representative. Maintain a punch list and review status at the end of each
  day. Work diligently to complete corrective actions the same day that
  deficiencies are observed. Add deficiencies not corrected on the same day
  to the rework items list maintained by the Quality Control Manager.
  Failure to resolve punch list items to the satisfaction of the Government
  constitutes a FAILED system acceptance test.

3.4   FINAL TEST REPORT

  Submit a Final Test Report following the successful completion of
  acceptance testing to include resolution of all punch list items. Address
  the following topics in the Final Test Report:

3.4.1   Summary

  Provide a chronological summary of all testing. Describe test activities
  and results in narrative form.

3.4.2   Personnel

  Provide a list of all Contractor and Government personnel who participated
  in the testing.

3.4.3   Test Logs

  Provide all completed test logs along with a test log verification signed
  by the Test Director.

        -- End of Section --

SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)
05/16

PART 1   GENERAL

1.1   REFERENCES

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)

ASC/X9 X9.52   (1998) Triple Data Encryption Algorithm
                                Modes of Operation

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M   (2013) Standard Specification for Zinc
                                (Hot-Dip Galvanized) Coatings on Iron and
                                Steel Products

ASTM B32   (2008; R 2014) Standard Specification for
                                Solder Metal

ASTM D709   (2016) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3   (2015; BW 2015) Standard Information
                                Technology--Telecommunications and
                                Information Exchange Between
                                Systems--Specific Requirements Part 3:
                                CSMA/CD Access Method and Physical Layer
                                Specifications

IEEE C2   (2012; Errata 1 2012; INT 1-4 2012; Errata
                                2 2013; INT 5-7 2013; INT 8-10 2014; INT
                                11 2015; INT 12 2016) National Electrical
                                Safety Code

INTELLIGENCE COMMUNITY STANDARD (ICS)

ICS 705-1   (2010) Physical and Technical Security
                                Standard for Sensitive Compartmented
                                Information Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250   (2014) Enclosures for Electrical Equipment
                                (1000 Volts Maximum)

NEMA ICS 1   (2000; R 2015) Standard for Industrial
                                Control and Systems: General Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70   (2014; AMD 1 2013; Errata 1 2013; AMD 2
                                2013; Errata 2 2013; AMD 3 2014; Errata
                                3-4 2014; AMD 4-6 2014) National
                                Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2   (2001) Security Requirements for
                                Cryptographic Modules

NIST FIPS 197   (2001) Advance Encryption Standard

OPEN NETWORK VIDEO INTERFACE FORUM (ONVIF)

ONVIF   (2015) Core Specification Version 2.6

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-222   (2009g; Add 1 2007; Add 2 2009; R 2012; R
                                2013; R 2014) Structural Standards for
                                Antenna Supporting Structures and Antennas

TIA-568-C.2   (2009; Errata 2010) Balanced Twisted-Pair
                                Telecommunications Cabling and Components
                                Standards

TIA-606   (2012b; Add 1 2015) Administration
                                Standard for the Telecommunications
                                Infrastructure

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8500.01   (2014) Cybersecurity

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15   Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1037   (1999; Reprint Dec 2009) Safety Antitheft
                                Alarms and Devices

UL 1076   (1995; Reprint Mar 2015) Proprietary
                                Burglar Alarm Units and Systems

UL 437   (2013) Key Locks

UL 50   (2007; Reprint Apr 2012) Enclosures for
                                Electrical Equipment, Non-environmental
                                Considerations

UL 681   (2014) Installation and Classification of
                                Burglar and Holdup Alarm Systems

UL 796   (2010; Reprint Sep 2013) Standard for
                                Printed-Wiring Boards

UL 969   (1995; Reprint Sep 2014) Standard for
                                Marking and Labeling Systems

1.2   SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for Contractor Quality Control
approval. Submittals with an "S" are for inclusion in the Sustainability
Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING.
Submit the following in accordance with Section 01 33 00 SUBMITTAL
PROCEDURES:

     SD-02 Shop Drawings

          ESS Components; G

          Overall System Schematic; G

     SD-03 Product Data

          Cameras; G

          Camera Lenses; G

          Camera Housing and Mounts; G

          Video Recording; G

          Communications Interface Devices; G

          Network Switch; G

          Video and ESS Transmission; G

          Batteries; G

          Equipment Rack; G

     SD-05 Design Data

          Backup Battery Capacity Calculations; G

          CCTV Storage Calculations

     SD-07 Certificates

          Contractor Qualifications; G

          Instructor Qualifications; G

          Data Encryption; G

     SD-10 Operation and Maintenance Data

          Training Plan; G

          Training Content; G

       ESS Components and ESS Software: Data Package 4; G

       ESS Software and ESS Components: Data Package 4; G

        Submit data package in accordance with Section 01 78 23
       OPERATION AND MAINTENANCE DATA

    SD-11 Closeout Submittals

       As-Built Drawings; G

1.3   QUALITY ASSURANCE

1.3.1   Regulatory Requirements

The advisory provisions in each of the publications referred to in this
specification are mandatory. Interpret these publications as though the
word "must" has been substituted for "should" wherever it appears.
Interpret references in these publications to the "authority having
jurisdiction," or words of similar meaning, to mean the Contracting Officer.

Equipment, materials, installation, and workmanship must be in accordance
with the mandatory and advisory provisions of NFPA 70 unless more stringent
requirements are specified or indicated.

1.3.2   Standard Products

Provide materials and equipment that are products of manufacturers
regularly engaged in the production of such products which are of equal
material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years
    prior to bid opening, and have been utilized in applications of
    equipment and materials under similar circumstances and of similar size.

b. Have been available on the commercial market through advertisements,
    manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required,
    provide products of a single manufacturer.

d. Provide commercial off-the-shelf (COTS) products in which the
    manufacturer allows a network of qualified distributors to sell,
    install, integrate, maintain, and repair the hardware and software
    products that make up the system.

1.3.2.1   Alternative Qualifications

Products having less than a 2 year field service record will be acceptable
if a certified record of satisfactory field operation for not less than
6000 hours, exclusive of the manufacturers' factory or laboratory tests, is
furnished.

1.3.2.2   Material and Equipment Manufacturing Date

Products manufactured more than one year prior to date of delivery to the
site are not acceptable.

1.3.2.3   Product Safety

System components are to conform to applicable rules and requirements of
NFPA 70. Equip system components with instruction stickers including
warnings and cautions describing physical safety, and special or important
procedures to be followed in operating and servicing system equipment.

1.3.3   Shop Drawings

1.3.3.1   ESS Components

Submit the ESS Components, Data Package 4 with the ESS Software submittal
package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE
DATA.Submit drawings that clearly and completely indicate each ESS
component function that includes:

a.   Termination device points

b.   Interconnections required for system operation

c.   Interconnections between modules and devices

d.   Proposed wireway or conduit systems to be used including:

     (1) Locations

     (2) Sizes

     (3) Types

e.   Drawings showing:

     (1) Device locations and spacing

     (2) Mounting and positioning details

     (3) Riser Diagrams with cable sizes and types

     (4) Bill of Materials (Device make, model and quantities)

     (6) CCTV and sensor coverage areas

     (7) Spare capacity

1.3.3.2   Overall System Schematic

Indicate the relationship of integrated components on one-line diagram and
show:

a.   Power source

b.   System controls

c.   Impedance matches

d.   Interconnecting wire data including:

     (1) Number

     (2) Size

     (3) Identification

     (4) Maximum lengths

1.3.4   Evidence of Experience and Qualifications

1.3.4.1   Contractor Qualifications

Submit experience and certified qualifications data prior to installation.
Show that specific installers who will perform the work have a minimum of 2
years of experience successfully installing ESS of the same type and
similar design as specified. Include the names, locations, and points of
contact of at least two installations of similar type and design as
specified in this document where the installer has installed such systems.
Indicate the type of each system installed. Certify that each system has
performed satisfactorily in the manner intended for a period of at least 12
months.

1.3.4.2   Instructor Qualifications

Submit the instructor's experience and certified qualifications data prior
to installation. Show that the instructor has received a minimum of 24
hours of ESS training from a technical organization such as the National
Burglar and Fire Alarm Association, and 2 years experience in installing
the specified ESS type.

1.4   Environmental Conditions

1.4.1   Interior Conditions

Equipment installed in environmentally protected interior areas must meet
performance requirements specified for the following ambient conditions:

1.4.1.1   Temperature

32 to 120 degrees F. Components installed in unheated security protected
areas must meet performance requirements for temperatures as low as 0
degrees F

1.4.1.2   Pressure

Sea level to 15,000 feet above sea level

1.4.1.3   Relative Humidity

5 to 95 percent

1.4.1.4   Fungus

Components must be constructed of nonfungus nutrient materials or be
treated to inhibit fungus growth

1.4.1.5   Acoustical Noise

Components must be suitable for use in high noise areas above 100 dB,
without adversely affecting their performance

1.4.2   Exterior Conditions

  Components in enclosures must meet performance requirements when exposed to
  the following ambient conditions:

1.4.2.1   Temperature

  Minus 25 to 140 degrees F

1.4.2.2   Pressure

  Sea level to 15,000 feet above sea level

1.4.2.3   Solar Radiation

  Six hours of solar radiation per day at dry bulb temperature of 120 degrees
  F including 4 hours of solar radiation at 104 watts per square foot

1.4.2.4   Sand and Dust

  Wind driven for up to 6 miles per hour (mph)

1.4.2.5   Rain

  2 inches per hour and 5 inches per hour cyclic with wind plus one period of
  12 inches per hour

1.4.2.6   Humidity

  5 to 95 percent

1.4.2.7   Fungus

  Warm, humid atmosphere conducive to the growth of heterotropic plants

1.4.2.8   Salt Fog

  Salt atmosphere with 5 percent salinity

1.4.2.9   Wind

  Continual velocity up to 50 mph with gusts to 66 mph, except that fence
  sensors must detect intrusions up to 35 mph

1.4.2.10   Acoustical Noise

  Components must be suitable for use in high noise areas above 110 dB
  without adversely affecting their performance. Examples areas include
  flight lines, runup pads, and generator sites.

1.5   SYSTEM CALCULATIONS AND ANALYSIS

1.5.1   Backup Battery Capacity Calculations

  Submit calculations showing that backup battery capacity exceeds sensor
  operation, communications supervision, and alarm annunciation power
  requirements for proposed equipment plus 25 percent spare capcity.

1.5.2   CCTV Storage Calculations

  Submit calculations showing the required storage capacity for each video
  storage device.

1.6   ESS SOFTWARE, DATA PACKAGE 4

  Submit the ESS software, Data Package 4 with the ESS Components submittal
  package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE
  DATA. Describe the functions of all software in the software manual and
  include:

  a. All information necessary to enable proper loading, testing, and
      operation

  b. Terms and functions definitions

  c. Use of system and application software

  d. Procedures for system initialization, start-up and shutdown

  e. Alarm reports

  f. Reports generation

  g. Database format and data entry requirements

  h. Directory of all files

  i. All communication protocol descriptions, including data formats,
      command characters, and a sample of each type of data transfer

  j. Interface definition

  k. List of software keys

1.7   AS-BUILT DRAWINGS

  Maintain a separate set of drawings, elementary diagrams, and wiring
  diagrams of the system to be used for as-built drawings. Keep this set
  accurately and neatly up-to-date with all changes and additions. This set
  is not to be used for installation purposes.

  Finish the final drawings submitted with the endurance test report in
  accordance with Section 01 78 00 CLOSEOUT SUBMITTALS for as-built
  requirements.

PART 2   PRODUCTS

2.1   SYSTEM DESCRIPTION

  Provide a complete and integrated electronic security system (ESS) that the
  meet requirements of UFC 04-010-05 and ICD/ICS 705. ESS must be compatible
  with the Installation's central monitoring system and monitored within the
  secure/protected area, SSO Office 106, and at the Installation central
  monitoring station.   ESS consisting of the following subsystems and
  features:

  c. Closed-circuit Television System (CCTV)

    e. Communications System

Include materials not normally furnished by the manufacturer with the ESS
equipment as specified in:

    a. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION

    c. Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

2.2   PERFORMANCE REQUIREMENTS

The surveillance system shall integrate into the GFGI access
control/intrusion detection system. Integration shall be performed by the
GFGI contractor. The CCTV system shall be capabable of video analytics as
specified below. Provide electronic equipment that complies with 47 CFR 15
and are suitable for the environment where they will be installed.

2.2.1   Growth Capability

Provide capability for modular ESS expansion of inputs, outputs, and remote
control stations with minimal equipment modification. Software must be able
to handle design requirements plus 25 percent spare capacity. Growth
capability is not to be limited by the provided products.

2.2.2   Network Certification

Certify all Platform Information Technology (PIT) in accordance with
DODI 8500.01 and the individual service implementation policy.

2.2.3   Maintainability

Provide components that can be maintained using commercially available
tools and equipment. Arrange and assemble components to be readily
accessible to maintenance personnel without compromising system defeat
resistance and with no degradation in tamper protection, structural
integrity, EMI or RFI attenuation, or line supervision after maintenance
when it is performed in accordance with manufacturer's instructions.

2.2.4   Availablity

Provide components rated for continuous operation. Provide solid-state
electronic components mounted on printed circuit boards, conforming to
UL 796. Provide boards that are plug-in, quick-disconnect type. Do not
impede maintenance with densely packed circuitry. Provide
power-dissipating components with safety margins of not less than 25
percent with respect to dissipation ratings, maximum voltages, and
current-carrying capacity. Provide solid-state type or hemetically sealed
electromechanical type light duty relays and similar switching devices.

2.2.5   Fail-Safe Capability

Provide fail-safe capability in critical elements of the ESS including, but
not be limited to, the capability to monitor communication link integrity
and to provide self-test. Provide fault annunciation when diminished
functional capabilities are detected. Annunciate fail-safe alarms to
clearly distinguish from other types of alarms.

2.2.6   Power Loss Detection

  Detect AC and DC power loss and generate an alarm when a critical component
  of the system experiences temporary or permanent loss of power. Annunciate
  the alarm in the Secured Area, SSO Office 106the Security Command Center to
  clearly identify the component experiencing power loss.

2.2.7   Controls and Designations

  Provide controls and designations as specified in NEMA ICS 1.

2.2.8   Special Test Equipment

  Provide all special test equipment, special hardware, software, tools, and
  programming or initialization equipment needed to start or maintain any
  part of the system and its components. Special test equipment is defined
  as any test equipment not normally used in an electronics maintenance
  facility.

2.2.9   Electromagnetic Interference (EMI)

  Configure and provide ESS components employing electromagnetic radiation
  constructed to provide minimal vulnerability to electronic countermeasures.

2.2.10   Electromagnetic Radiation (EMR)

  Provide only ESS communication components which are Federal Communications
  Commission (FCC) licensed and approved. Provide system components which
  are electromagnetically compatible.

2.2.11   Interchangeability

  Use off-the-shelf components which are physically, electrically, and
  functionally interchangeable with equivalent components as complete items.
  Equivalent, replacement components must not require new or other component
  modification. Do not use custom designed or one-of-a-kind items.
  Interchangeable components or modules must not require trial and error
  matching in order to meet integrated system requirements, system accuracy,
  or restore complete system functionality.

2.3   INTRUSION DETECTION SYSTEM (IDS)

  The intrusion detection system components shown on the plans are FOR
  REFERENCE ONLY. The IDS raceways, compnents, installation, and testing
  shall be Government-Furnished, Government-Installed. The CCTV system shall
  be capable of interfacing with the IDS, record alarm events, store recorded
  footage from alarm events, and send a notification to the local secuirty
  officer and the central monitoring station.

  Final integration shall be by the GFGI IDS contractor.2.4   ACCESS CONTROL
SYSTEM (ACS)

  The access control system components shown on the plans are FOR REFERENCE
  ONLY. The ACS compnents, installation, and testing shall be
  Government-Furnished, Government-Installed. The CCTV system shall be
  capable of interfacing with the ACS, record alarm events (i.e. door hold
  open alarm, door forced open alarm, access granted alarm, etc.), store
  recorded footage from alarm events, and send a notification to the local
  secuirty officer and the central monitoring station.

Final system integration shall be by the GFGI ACS contractor.
2.5   CLOSED-CIRCUIT TELEVISION (CCTV) SYSTEM

Select system components that conform to the Open Network Video Interface
Forum (ONVIF) specification. Provide compatible UL listed CCTV components
to provide visual assessment of ESS alarms automatically upon alarm or upon
SCC operator selection. Otherwise, the subsystem is to continuously
display the coverage area. Display alphanumeric camera location ID on all
monitors. Provide the number of alarm monitors as required. The scene
from each camera must appear clear, crisp, and stable on the respective
monitor during both daytime and nighttime operation. Provide component
equipment that minimizes both preventive and corrective maintenance.
Provide components from a single manufacturer or justify mixing
manufacturer components and demonstrate compatibility in submittal
information.

2.5.1   Cameras

2.5.1.1   CCTV Camera

Provide cameras of digital fixed or pan-tilt-zoom (PTZ) as identified on
the drawings.

   a.   Day-Night Color fixed or PTZ cameras are to be used in all outdoor
        environments. Standard fixed or PTZ cameras are to be used for all
        indoor applications except when backlighting issues are observed. Use
        Day-Night cameras or standard cameras with backlighting compensation
        for backlighting or high contrast applications.

   b.   Provide PTZ cameras with a direct drive motor assembly. Belt driven
        PTZ camera units are not acceptable. Equip PTZ cameras with a slip
        ring assembly having an optical interface and be rated for continuous
        duty. PTZ cameras have to be fully integrated units. The pan-tilt
        mechanism must be an integral part of the camera.

   c.   Provide cameras that operate over a voltage range of 24 VDC/ 24 VAC at
        60 Hz Power over Ethernet (PoE) IEEE 802.3.

   d.   All cameras must be constructed to provide rigid support for electrical
        and optical systems so that unintentional changes in alignment or
        microphonic effects do not occur during operation, movement, or lens
        adjustments.

   e.   Video Frame Rate: 30 frames per second (fps)

   f.   Minimum essential requirements for cameras include the following:

2.5.1.1.1   Sensitivity

Minimum Illumination: 0.08 foot-candles at F1.4 color mode; 0.01
foot-candles at F1.4 in the B&W mode.

2.5.1.1.2   Signal-To-Noise Ratio

Show a signal-to-noise ratio of not less than 50 decibels (dB) at Automatic
Gain Control (AGC) "Off", weight "On".

2.5.1.1.3   Resolution

  Provide a minimum of 2.1 megapixel resolution. The imager must have a
  minimum of 1920 horizontal x 1080 picture in progressive scan format.
  Resolution is to be maintained over the specified input voltage and
  frequency range, and not vary from minimum specification over the specified
  operating temperature range.

2.5.1.1.4   Synchronization

  Provide cameras that have internal and line lock.

2.5.1.1.5   Low Light Level

  Provide Day-Night cameras that have a B-W mode that may be automatically
  engaged on low light level and permit the use of an external infrared
  illuminator. Electronic removal of the color signal is not acceptable.
  The camera must have an infrared cut filter capable of being removed
  automatically upon low light threshold or manually.

2.5.1.2   Camera Lenses

  Camera lenses are to be all glass with coated optics. Provide lens mount
  that is C or CS mount, integrated with the cameras. Provide lens with the
  camera that have a maximum f-stop opening of f/1.2 or the maximum available
  for the focal length specified. The lens is to have an auto-iris mechanism
  unless otherwise specified. Lenses having auto iris, manual iris, or zoom
  and focus functions are to be supplied with connectors, wiring, receiver
  and driver units, and controls as needed to operate the lens functions.
  Provide lenses with sufficient circle of illumination to cover the image
  sensor evenly. Lenses are not to be used on a camera with an image format
  larger than the lens is configured to cover. Provide lens with focal
  lengths as specified in the manufacturer's lens selection tables.

2.5.1.3   Camera Housing and Mounts

  The camera and lens are to be enclosed in a tamper resistant housing
  installed on a camera support. Any ancillary housing mounting hardware
  needed to install the housing at the camera location is to be provided as
  part of the housing. The camera support must be capable of supporting the
  mounted equipment and withstanding wind and ice loads normally encountered
  at the site.

2.5.1.3.1   Environmentally Sealed Camera Housing

  The housing is to provide an environment needed for camera operation and be
  condensation free; dust and water tight; keep the viewing window free of
  fog, snow, and ice, and be fully operational in 100 percent condensing
  humidity. Provide housing equipped with a sunshield. Both the housing and
  sunshield are to be white. Purge the housing of atmospheric air and
  pressurized with dry nitrogen, equipped with a fill valve, overpressure
  valve, and include a humidity indicator visible from the exterior. Housing
  must not have a leak rate greater than 2 psi at sea level within a 90 day
  period.

  Provide housing equipped with supplementary camera mounting blocks or
  supports needed to position the camera and lens to maintain the proper
  optical centerline. All electrical and signal connections required for
  camera and lens operation are to be supplied. Provide a mounting bracket

as part of the housing which allows weight adjustment to center the weight of the assembly.

2.5.1.3.2   Indoor Camera Housing

Provide housing with a tamper resistant enclosure for indoor camera operation and with the proper mounting brackets for the specified camera and lens. The housing and appurtenances color are not to conflict with the building interior color scheme.

2.5.1.3.3   Interior Mount

Provide camera mount suitable for either wall or ceiling mounting and have an adjustable head for mounting the camera. The wall mount and head must be constructed of aluminum or steel with a corrosion-resistant finish. Provide adjustable head with 360 degrees of pan and plus or minus 90 degrees of tilt.

2.5.1.3.4   Interior Dome Housing

The dome housing is to be capable of being mounted by pendant, pole, ceiling, surface, or corner as shown on the drawings. The lower dome is to be black opaque acrylic and have a light attenuation factor of not more than 1 f-stop. Provide housing with:

a. Integral pan-tilt complete with wiring

b. Wiring harnesses

c. Connectors

d. Receiver-driver

e. Pan-tilt control system

f. Pre-position cards

g. Heavy duty bearings

i. Permanent lubrication

j. Motors that are thermally or impedance protected against overload damage.

k. Any other hardware and equipment as needed to provide a fully functional pan-tilt dome. Provide pan movement of 360 degrees and tilt movement of at least plus or minus 90 degrees. Pan speed must be at least 20 degrees per second and tilt speed be at least 10 degrees per second.

2.5.1.3.5   Exterior Dome Housing

Provide dome housing capable of being mounted by pendant, pole, ceiling, surface, or corner as shown on the drawings and constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. Purge the housing of atmospheric air and pressurize with dry nitrogen. Provide a fill valve and overpressure valve with a pressure indicator visible from the exterior. The housing is to be equipped with supplementary camera mounting blocks or supports as needed to position the

specified camera and lens to maintain the proper optical centerline.

Provide all electrical and signal connections required for camera and lens operation. The housing is to provide the environment needed for camera operation. The lower dome is to be black opaque acrylic with a light attenuation factor of not more than 1 f-stop. Provide housing with:

a. Integral pan-tilt complete with wiring

b. Wiring harnesses

c. Connectors

d. Receiver-driver

e. Pan-tilt control system

f. Pre-position cards

g. Heavy duty bearings

h. Hardened steel gears

i. Permanent lubrication

j. Motors that are thermally or impedance protected against overload damage.

k. Any other hardware and equipment as needed to provide a fully functional pan-tilt dome. Provide pan movement of 360 degrees and tilt movement of at least plus or minus 90 degrees. Pan speed must be at least 20 degrees per second and tilt speed be at least 10 degrees per second.

2.5.1.3.6   Exterior Wall Mount

Provide exterior camera wall mount that is 16 inches long, and has an adjustable head for mounting the camera. The wall mount and head must be constructed of aluminum, stainless steel, or steel with a corrosion-resistant finish. Provide adjustable head for at least plus and minus 90 degrees of pan, and at least plus and minus 45 degrees of tilt. If to be used in conjunction with a pan-tilt, provide bracket without the adjustable mounting head, and a bolt hole pattern to match the pan-tilt base.

2.5.1.3.7   Pan-Tilt Mount

a. Provide pan-tilt mount capable of supporting the camera, lens, and housing specified that is weatherproof and sized to accommodate the camera, lens and housing weight plus maximum wind loading encountered at the installation site if the pan-tilt is to be mounted outdoors. Provide pan-tilt with:

    (1) Heavy duty bearings

    (2) Hardened steel gears

    (3) Externally adjustable limit stops for pan and tilt

   (4) Mechanical, dynamic, or friction brakes

   (5) Permanent lubrication

   (6) Motors that are thermally or impedance protected against overload damage.

 b. Provide pan movement of 360 degrees pan rotation, a minimum tilt movement of plus and minus 90 degrees. Manual pan speed must be a minimum of 0 to 80 degrees per second, and a minimum tilt speed of 10 degrees per second. A minimum automatic pan speed of 280 degree per second and tilt speed of 160 degree per second.

 c. The pan-tilt is to be supplied complete with wiring, wiring harnesses, connectors, receiver-driver, pan-tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan-tilt mount to fulfill the site design requirements.

2.5.2   Video Analytics (VA)

2.5.2.1   Software

Provide capability range from basic activity detection to the search through databases to pre-empt serious incidents. The VA is to provide graphic identified movement identification, user-selectable monitored areas, compensation for environmental movement, and other features specified when provided as a capability of the NVR. Provide the following feures:

2.5.2.1.1   Basic Motion Detection

 a. Adaptive Motion

 b. Abandoned Object

 c. Object Removal

 d. Camera Sabotage

 e. Directional Motion

 f. Object Counting

 g. Loitering Detection

 h. Stopped Vehicle

2.5.2.1.2   Advanced VA

2.5.2.1.2.1   Intruder Identification

This refers to identifying unauthorized humans in specified areas within the field of view.

2.5.2.1.2.2   Environmental Compensation

Recognizing and ignoring wind-blown debris, animals, background traffic, and so on.

2.5.2.1.2.3   Counting

  This refers to recognizing a quantity of a particular object moving or
  activity performed.

2.5.2.1.2.4   Item Recognition

  This refers to activation when specific user-selected items are removed
  from, placed in, or passed through the field of view.

2.5.2.1.2.5   Subject Tracking

  Highlighting and following a specific person or item as it moves about the
  field of view, or from the field of view of one camera to another.

2.5.2.1.2.6   Multiple Subject Tracking

  Highlighting and following multiple persons or items simultaneously as they
  move about the field of view, or from the field of view of one camera to
  another.

2.5.2.2   Embedded VA

2.5.2.2.1   Intelligent Video Analysis

  a. Provide camera capable of processing and analyzing video within the
      camera itself, with no extra hardware required.

  b. The camera is to be capable of detecting and sending alarms for
      abnormal events.

  c. The camera is to be configurable to analyze up to 10 different scenes
      for one or more of the following events:

      (1) Line Crossing

      (2) Loitering

      (3) Idle Object

         (4) Removed Object

      (5) Conditional Change

      (6) Trajectory Tracking

      (7) Filters

  d. The camera is to allow users to set up to 10 separate profiles and
      switch profiles based on a day, night, or holiday schedules.

  e. The camera is to support scene tours that automatically reposition the
      camera to each scene for a specified duration.

  f. The camera is to incorporate an Alarm Rule Engine, enabling abnormal
      events that VA detects to prompt the camera to take one or more actions:

      (1) Trigger a relay connected to an alarm siren, strobe, or both.

(2) Trigger a visual alert to be displayed on the operator's screen.

(3) Go to a specified scene (preset position).

2.5.2.2.2   Motion Tracking with PTZ Cameras

a. The camera is to offer Intelligent Tracking to continuously track an object using pan, tilt, and zoom actions.

b. The camera is to provide automatic motion tracking using intelligent video analytics.

c. Provide camera with the ability to follow an object continually when passing behind a privacy mask.

d. Provide camera with the ability to restart tracking if a target starts moving in the same area where the initial target stopped moving or if the camera detects an object moving along the last known trajectory.

e. The camera is to allow an operator to select an object to track in the live image view.

2.5.3   Color Video Monitors

Except as specified, provide video monitors that:

a. Are rated for continuous operation and incorporate printed circuit board modular construction.

b. Have printed circuit modules that are easily replaceable.

c. Use solid-state devices for electronic circuits.

d. Are constructed to provide rigid support for electrical systems so that unintentional changes in alignment or microphonic effects will not occur during operation or movement.

e. Incorporate circuit safety margins of not less than 25 percent where possible, with respect to power dissipation ratings, voltage ratings, and current carrying capacity.

f. Have a diagonal viewing angle that nominally measures 42 inches for monitors, LED displays.

g. Provide adequate safeguards to protect personnel from exposure to line voltage during operation or adjustment.

h. Have at least the following essential requirements:

(1) Resolution for LED monitors to be: 42 inch monitors - 1280x1024, 500 TV lines (maximum

(2) Geometry: No point in the active raster is to deviate from its correct position by more than 2 percent of raster height.

2.5.3.1   Mounting and Identification

a. Mount monitors and other devices to facilitate easy replacement.

b. The printed circuit board functions and component numbers or markings
    are to be easily read.

c. Mount monitors on a wall mounting bracket.

d. Protect monitors from circuit overloads by fuse or fuses in the power
    source line. Mount power source line fuses in finger-operated
    extractor fuse posts. Fuse holders are to be located in a readily
    accessible position.

2.5.3.2   Video and Signal Input

Monitors are to operate with video input requiring a one HDMI nominal
composite video signal switchable to either loop-through or internal 75-ohm
terminating impedance.

Signal input connectors must be HDMI type.

2.5.4   Ancillary Equipment

Equipment is to consist of the items specified below:

2.5.4.1   Video Date and Time Generator

The video time and date is to originate from either the camera, video,
video recorder.

2.5.4.2   Camera Identifiers

Label video signal from each camera using alphanumeric identifiers. Camera
alphanumeric identifiers may originate from either the camera or the video
recorder.

2.5.4.3   Video Recording

2.5.4.3.1   Network Video Recorder (NVR)

a. Provide NVR with an integral software ESS-CCTV server function.
    Dedicated CCTV monitors and authorized computers networked to the NVR
    are to be capable of viewing recorded and live video from the network.
    The NVR is to be able to record and transmit video with up to 30 fps at
    maximum camera resolution. The NVR is to network with and utilize
    smaller, non-server computers at off-site camera locations as local
    recorders.

b. Provide NVR with the capability to de-warp live and recorded images.

c. The storage memory capacity of the NVR (including local recorders) is
    to be sufficient to store a minimum of 30 days of video at 15 fps, 2.1
    megapixel resolution and be expandable for an increased capacity of 4TB
    and be capable of including Redundant Array of Independent Disc (RAID)
    arrays 5.

d. The NVR must have the capacity to address and process up to 16
    dual-streaming cameras. The NVR must record all cameras onto a hard
    drive and allow remote network viewing via internet or intranet
    browser. Hard drive capability must be sized to store all cameras
    recording 24 hours a day 7 days a week at 15 frames per second per
    camera for 4 weeks.

2.5.4.3.2   Video Recording Performance

   The video recording performance is to be as follows:

  a.   The NVR is to use modular hard disk media, with a digital format
       capacity of 250GB per module.

  b.   Provide a 16 channel triplex video multiplexer capable of performing
       encoding, recording and multiscreen viewing modes simultaneously.
       Provide 16 channels of live, simultaneous video images in which all 16
       channels are refreshed at 15 frames per second.

  c.   Provide a 10-100Base-T connection for record review and camera view and
       control that is compatible for a PC workstation equipped with latest
       Microsoft Windows Professional operating system software,Microsoft
       Internet Explorer version 11 .

  d.   PC workstation Viewing: Include direct access from the ESS PC
       workstations to each NVR via a Microsoft Internet Explorer Web
       Browser. All necessary descriptive bookmarks and shortcuts are to be
       prepared on each PC workstation to allow this direct access. All
       functions are to be accessible through HTML commands from a user's web
       browser interface. Pictures are to be available for attachment via a
       user-provided SMTP-based email transport system, and included
       capability for 16 users and 3 user access levels (admin, control and
       user).

  e.   Include sampling at 720(H) by 480(V) and 320(H) by 240(V) (Pixel
       Memory) with 15 frames per second and 3-D scan conversion to enable
       jitter-free stabilized pictures in a single frame. Modes include:

       (1) Emergency

       (2) Event

       (3) Schedule

       (4) Manual Recording

  f.   Each camera is to support individual Recording Rate and Image Quality
       settings for each mode (Emergency, Event, Schedule and Manual
       Recording). This array of Camera Recording Rate and Image Quality
       settings by the Recording Modes is to form one of four Program
       Actions. The Program Action is to be assignable to a Time Table to
       form one of 16 Independent Recording Profiles. Allow each Recording
       Profile to be manually activated, activated via RS-232C interface,
       automatically activated by Time Table, or activated by separate alarm
       or emergency inputs.

  g.   Digital display on the monitor and also recording of the following
       information to included:

       (1) Year

       (2) Month

       (3) Day

(4) Hour

(5) Minute

(6) Second

(7) Alphanumeric camera location ID up to 8 characters. The NVR is
    to feature video loss detection on all channels.

h. Pre-event recording: Buffer at least 20 seconds of pre-event pictures
    simultaneously for all individual camera channels.

i. Motion-based Recording: Advanced integrated VMD is to be used to
    detect a specific area, direction and motion duration for each camera
    channel, independently and simultaneously. Motion Search may be
    executed for a single camera channel for a selected area on the image.

j. Disk Partitioning: Provide within the NVR an automated disk management
    and a RTOS (real-time operating system) platform to include up to 4.8
    TB of digital video storage on a single partition.

    The video recording system is to provide a choice of Physical
    Partitioning as RAID 5 or Disk Mirroring redundant array recording.
    Allow the operator to be able to partition the available recording
    areas in a Virtual Partition by Regular, Event, and Copy Partitions.
    Manually and Scheduled recorded video information is to be assigned to
    a Regular Recording Partition, which may be overwritten. Event and
    Emergency Recording Data is to be assignable to an Event Partition,
    where image overwriting is be prohibited. Any copied data is to be
    able to be assigned to the Copy Partition, which may be overwritten or
    saved as required.

k. Playback: Permit direct camera selection for recording playback of any
    of 16 video sources at the same time as multiscreen viewing and
    multiplexed camera encoding (triplex multiplexer capability).

l. Multiplexer Functions: Include an integral, programmable switcher with
    programmable dwell time and camera order that automatically switches
    multiple camera images to enable sequential spot monitoring and
    simultaneous field recording. Provide switcher with separate spot,
    multiscreen, multiscreen-RGB, and cascaded video monitor outputs. The
    unit must have full screen, 16 multiscreen monitoring modes.

m. Outputs

    (1) Provide via BNC female connections 4 looping outputs for all video
        source connections to external monitoring systems including
        multiscreen and spot monitor video outputs.

    (2) Provide via RCA phone jacks four channels of audio connection,
        including audio loop through.

    (3) Provide via High Speed (480 Mbps) serial interface one External
        Storage connection.

    (4) Provide via High Speed (480 Mbps) serial interface one External
        Copy connection.

    (5) Provide two independent Video Outputs assignable to Multiscreen.

(6) Provide one Cascade output for connecting 3 additional digital video recorders for centralized control using a single video monitor.

(7) Provide virtual camera number programming capability to support 64 camera channels on a single system.

(8) Provide one independent RGB Video output, capable of monitoring all DVR functions.

n. All camera selection buttons are to have Tri-State Indication, corresponding to Recording, Viewing and Control functions on actual NVR hardware. PC emulation is not an acceptable alternative. Furnish the following indicators:

(1) Alarm

(2) Alarm Suspend

(3) Operate

(4) HDD1, Hard drive identifier

(5) Timer and Error indicators

(6) Camera Selection

(7) Iris

(8) Preset

(9) Camera Automatic Mode

(10) Pan-Tilt

(11) Set

(12) Jog Dial

(13) Shuttle Dial

(14) Setup-Esc

(15) Record

(16) Search

(17) Play-Pause

(18) Pan-Tilt Slow

(19) Stop

(20) Pan-Tilt Go to Last

(21) Zoom-Focus

(22) A-B

      (23) Repeat

      (24) Shift

      (25) Alarm Reset Buttons

  o. Networking: All NVR recording, review, playback, camera control and setup are to be available via the internally mounted Network Interface. A 10-100Base-T connection for record review and camera view and control will be required on a personal computer equipped with Internet Browser Software and an Ethernet 100Base-T connection. Permit direct camera selection for recording playback of any of 16 video sources at the same time as multiscreen viewing and multiplexed camera encoding (triplex multiplexer mode). Support a minimum of 8 simultaneous clients viewing and 2 simultaneous FTP sessions.

  p. Power: The video recording equipment must have a power source of 120 VAC at 60 Hz.

2.5.4.4   Camera Control

Provide access to camera functions and control for all cameras via the multiplexer for all camera control, set-up and alarm functions, including preset sequence, digital motion detector mask set, and back light compensation set-up. Controllable camera functions are to be accessible via front panel controls or the optional system controller. These functions are to include:

      (1) Direct access of preset position

      (2) Zoom (near/far)

      (3) Focus (near/far)

      (4) Iris (open/close)

      (5) Pan (left/right)

2.5.5   Camera Mounting Structures

Provide camera mounting structures designed specifically for CCTV cameras. The structure is to accommodate appropriate wiring pathways for power and communication as well as proper grounding and surge protection. Design loads for the camera mounting structure must conform to TIA-222 and all applicable addendums of the TIA standard. Allowable pole deflection is determined from the point of the camera mount and must not exceed 0.5 percent of the pole height under adjusted maximum wind load conditions. Adjusted maximum wind load conditions for deflection calcualtions must be 30 miles per hour (mph) or 35 percent of the basic wind speed as determined by TIA-222, whichever is greater. Confirm compliance to TIA standards by structure manufacturer data or by analysis. Provide additional measures as required to stabilize the camera if placed in an environment that is subject to induced vibrations such as heavy winds or excessive traffic.

2.6   SECURITY COMMAND CENTER (SCC)

The SCC must integrate all subsystems and communications, and provide operator control interface to the ESS system. The components are as

follows:

a.   ESS Software

b.   Monitoring Display Software

c.   Graphical Map Software

e.   Controls and Display Integration

2.6.1   ESS Software

a.   Provide commercial off-the-shelf ESS software that utilizes a single
     database for the subsystem integrations provided under a single
     operating environment. The system is to archive all events in a
     database stored either on a local hard drive or a networked database
     server. The software has to support configuration and simultaneous
     monitoring of all subsystems.

b.   Allow the networked PC workstation configurations connected via a
     TCP/IP network. Administrative tasks including configuration,
     monitoring, schedules, report generation and graphic display are
     provided from any PC workstation on the network. All system
     programming data must be instantly accessible to every PC Workstation
     connected to the network. The system is to utilize a non-proprietary
     SQL-based, ODBC-compliant database, managed by Sybase Adaptive Server
     Anywhere, Microsoft SQL Server, or Oracle.

c.   Utilize a preemptive multi-tasking operating system, such as the latest
     Microsoft Windows Professional environment, that is multitasking, with
     many processes running at the same time without interference with each
     other and with higher priority tasks taking precedence over lower
     priority tasks.

d.   Provide capabilities to define visual exclusion areas.

2.6.1.1   Alarm Call up

Support responses to alarms entering the system with each alarm capable of
initiating one or more of the following actions:

a.   Sending alarm commands to a CCTV system interface

b.   Triggering NVR event recording

c.   Activating output devices

d.   Playing PC audio files

e.   Controlling doors

f.   Display graphical maps associated with the alarm device

Provide mode of system operation that requires an operator to acknowledge
any alarm. While alarm is still active, the alarm cannot be cleared.

2.6.1.2   Programming

Provide the capability of, but not limited to, the following programming

and functionality:

2.6.1.2.1   Daylight Savings Time Adjustment

The ACU(s) and PCU(s) must not need to be connected to the ESS in order for the adjustment to occur.

2.6.1.2.2   Operator Privileges

Support an unlimited number of system operators, each with a unique login and password combination. Operators are to be assigned privileges based on the loops, commands, or programming features that are available to each individual operator.

2.6.1.2.3   Alarm Priorities

Provide the ability for each alarm device to be user configured to belong to one of 10,000 priority levels which are assigned to an alarm based on alarm importance. These priorities are to define which alarm events to display on individually specified ESS workstations.

2.6.1.2.4   Reports

Include integrated reporting capabilities as well as the ability to run Crystal Report templates.

2.6.1.2.5   User Interface

The ESS programming is to be menu-driven, with "wizards" to assist with software configuration, and include 'Help' information.

2.6.1.2.6   Messages

Permit the use of user-selected colors for event messages.

2.6.1.2.7   Graphics

Provide the capability to display a floor-plan graphic for card activity and alarm events as part of the ESS integration.

2.6.1.2.8   Device Status

Provide the capability to display the dynamic status of a user-selected list of devices, including doors, inputs, and outputs.

2.6.1.2.9   Diagnostics

Include diagnostic software tools that interface and query the hardware for information and to issue commands.

2.6.1.2.10   Mandatory Data Fields

Require any cardholder data field to be selected by the user as mandatory.

2.6.1.2.11   User Defined Data Fields

Provide 20 unassigned data fields for storing user-defined data that support user-defined labels, and are user-configurable as plain text fields or drop-down selection lists.

2.6.1.2.12   Archive Database

  Include a connection to an archive database which stores purged events and
  deleted programming and which can be accessed for reporting.

2.6.1.2.13   Programmable Database Backup

  Include the capability of performing user-scheduled database backups
  without the use of third-party backup software.

2.6.1.2.14   Programmable Database Purging

  Include the capability of performing user-scheduled database purging,
  moving selected events to an archive database when the events have aged a
  user-specified number of days.

2.6.1.2.15   Database Importing

  Include the capacity to import user data from an ODBC data source (Access,
  Excel, text).

2.6.1.2.16   Data Exporting

  Include the capacity to export data from any table in the database to
  either a text, HTML, or Excel file in any user-selected order.

2.6.1.2.17   Event Log Output

  Include the capacity to send a continuous stream of user-selected types of
  event messages to a text file, serial port, or TCP/IP address.

2.6.1.2.18   Data Audit Trail

  Record changes to programming, recording the date and time stamp of the
  change, the name of the operator making the change, and the nature of the
  change. This data audit is to be available in history for reporting.

2.6.2   ESS Monitor Display Software

  ESS Monitor display software is to provide for text and graphic map
  displays that include zone and device status integrated into the display.
  Different colors are to be used for the various components and real time
  data. Colors must be uniform on all displays. Follow the color coding as
  follows.

  a.   FLASHING RED to alert an operator that a zone has gone into an alarm or
       that primary power has failed.

  b.   RED to alert an operator that a zone is in alarm and that the alarm has
       been acknowledged.

  c.   YELLOW to advise an operator that a zone is in access.

  d.   GREEN to indicate that a zone is secure or that power is on.

2.6.3   Graphical Map Software

  a.   ESS graphical map software is to show the graphic and visual data of

all subsystem devices. Use a 42 inches, LED flat screen display with
messages displayed in the English language. Provide graphical maps
showing a layout of all the protected facilities. Highlight zones
corresponding to those monitored by the ESS on the graphical maps.
Display status of each zone using graphical icons as required within
each designated zone.

b. Provide capability for graphical maps to be linked together using a
layered tree structure. For example, a top-level map might be a top
view of the site and its buildings, the next level the individual
buildings floor, followed by a map of the area on a floor containing
the device in alarm. Allow for 6 layers of maps to be defined for any
given ESS device. To speed an incident location, each map level
contains a clearly visible indicator as to which sub map the operator
should select next to find the device that is in alarm.

c. The ESS may also be configured to display a map automatically on a new
alarm presentation, providing the operator with prompt visual
indication that an alarm has occurred.

d. The status of intrusion devices, access control readers, doors,
auxiliary monitor points, and auxiliary outputs is to be able to be
requested from any map by simply selecting the icon representing the
device and its current state will be displayed. CCTV camera control,
digital video review, alarm panel transactions and intercom requests
are to be available for inclusion on the map with the associated
management module installed.

e. Allow for SCC operators to change a current setting by pressing the
right mouse button anywhere on the screen or on a specific system
device icon. Pressing the right mouse button is to cause the
appropriate command options list to appear for selection. Confirmation
is provided by reflecting the change in status on the display after a
command is selected.

f. The display of intrusion or auxiliary door alarms may be automatically
enabled or disabled by the use of timed commands, either by device or
by a group of devices. This may be used, for example, to disable all
door alarms on internal doors, during normal office hours.

g. Create maps using standard office tools allowing drawings to be
imported in Jpeg, Bitmap, Windows metafile, PDF or DXF file formats to
provide maximum flexibility.

2.6.4   Control and Display Integration

Integrate human engineer SCC controls so the entire SCC can be operated by
a single or multiple operator(s). Integrate switching and monitoring
components of the assessment subsystem with the SCC so that SCC operator(s)
can effectively monitor, assess alarms and control the ESS. Method of
system integration must be as a single console. Provide chassis, and
modules required for console SCC configuration.

2.7   COMMUNICATIONS

a. Communications are to link together subsystems of the ESS and be in
accordance with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING
SYSTEM. Interfaces between subsystems cannot be accomplished by use of
an electro-mechanical relay assembly. Communications links must be

supervised. Provide common communications interface devices throughout the ESS. Provide dry contact sensor to control unit interface that is normally OPEN or normally CLOSED, except as specified otherwise.

b. Use digital, asynchronous, or multiplexed data control unit for central alarm reporting and display processor interface. Group individual data bits into word format and transmit as coded messages. Implement interface with network switches which function as a communications controller, perform data acquisition and distribution, buffering message handling, error checking, and signal regeneration as required to maintain communications.

c. Provide totally automatic status changes communication, commands, field initiated interrupts, and any other communications required for proper system operation. Do not require system communication operator initiation or response. System communication is to return to normal after any partial or total network interruption including power loss or transient upset. Automatically annunciate communication failures to the operator with communication link identification that has experienced a partial or total failure.

2.7.1   Link Supervision

2.7.1.1   Hardwire Direct Current Line Supervision

Provide only for the sensor to control unit links which are within the ESS protected area. Supervise circuits by monitoring changes in the current that flows through the detection circuit and a terminating resistor of at least 2.2 K ohms. Supervision circuitry is to initiate an alarm in response to opening, closing, shorting, or grounding of conductors by employing Class C standard line security. Class C circuit supervisor units are to provide an alarm response in the annunciator in not more than one second as a result of the following changes in normal transmission line current:

a. Five percent or more in normal line signal when it consists of direct current from 0.5 through 30 milliamperes.

b. Ten percent or more in normal line signal when it consists of direct current from 10 microamperes to 0.5 milliamperes.

c. Five percent or more of an element or elements of a complex signal upon which security integrity of the system is dependent. This tolerance will be applied for frequencies up to 100 Hz.

d. Fifteen percent or more of an element or elements of a complex signal upon which the security integrity of the system is dependent. This tolerance will be applicable for all frequencies above 100 Hz.

2.7.1.2   Hardwire Alternating Current Supervision

Supervision is not to be capable of compromise by use of resistance, voltage, or current substitution techniques. Use this method on circuits which employ a tone modulated frequency-shift keying (FSK), interrogate-and-reply communications method. Supervisory circuit are to be immune to transmission line noise, crosstalk, and transients. Terminate detection circuit by complex impedance. Maintain line supervision by monitoring current amplitude and phase. Size complex impedance so that current leads or lags the driving voltage by 45 plus or minus 5 degrees.

Alarm when rms current changes by more than 5 percent, or phase changes by
more than 5 degrees for supervision current of 0.5 to 30 milliamperes rms.
Alarm when rms current changes by more than 10 percent, or phase changes by
more than 8 degrees for lines with supervision currents of 0.01 to 0.5
milliamperes. Identified line supervision alarm must be communicated
within one second of the alarm.

2.7.1.3   Hardwire Digital Supervision

Local processors are to exchange digital data to indicate secure or alarm
at least every 2 seconds. Alarm if data is missed for more than one second
for passive supervisory circuits. Coding used for data cannot be
decipherable by merely viewing data on an oscilloscope. Supervisory
circuits are to asynchronously transmit bursts of digital data for
transponder schemes. Data pattern is to be random in nature. Remote
detectors are to receive data and encode a response based on a proprietary
coding scheme.

Provide a unique encoding scheme; an industry-wide or vendor standard is
not acceptable. Transmit encoded response back to supervisory circuit.
Supervisory circuit is to compare the response to an anticipated response.
Alarm on failure of the detector to return a data burst or return an
incorrect response.

2.7.2   Hardwire
start here
2.7.2.1   Electrical Conductor Lines

   a.   Use electrical conductor lines for hardwire that rely on current path
        except for electrical wires; neutral conductors of electrical
        distribution systems cannot be used as signal transmitters.

   b.   Conductors outside the protected area are to be shielded cable
        installed in rigid galvanized steel conduit as specified in Section
        26 20 00 INTERIOR DISTRIBUTION SYSTEM. Supervision circuitry is not to
        initiate nuisance alarms in response to normal line noise, transients,
        crosstalk, or in response to normal parametric changes in the line over
        a temperature range of minus 30 to 125 degrees F.

   c.   Ambient current levels chosen for line supervision must be sufficient
        to detect tampering and be within the normal operating range of
        electrical components. Report line supervision and tamper alarms
        regardless of mode of operation.

   d.   Provide hardwire links as specified in UL 1076 and Section 26 20 00
        INTERIOR DISTRIBUTION SYSTEM for interior applications with additions
        and modifications specified. Conductors are to be copper. Conductors
        for links which also carry AC voltage, are to be No. 12 AWG minimum;
        single conductors for low-voltage DC links are to be No. 14 AWG
        minimum. Conductors are to be color coded. Conceal wiring in finished
        areas of new construction and wherever practical in existing
        construction if not otherwise precluded by the Government.

   e.   Identify conductors within each enclosure where a tap, splice, or
        termination is made. Identify conductors by plastic-coated,
        self-sticking, printed markers or by heat-shrink type sleeves. Connect
        sensors, control units, and communication devices so that removal will
        cause a tamper alarm to sound. Pigtail or "T" tap connections are not

acceptable. Each conductor used for identical functions is to be
distinctively color-coded. Each circuit color-coded wire is to remain
uniform throughout circuit. Tamper switches meet requirements of
paragraph TAMPER SWITCHES.

2.7.2.2   Communication Link

a. Provide a dedicated circuit communication link from sensor to control
    unit. Opening or closing a relay contact will indicate an alarm.
    Convert analog signals to digital values or a relay closure or opening
    within 250 feet of the sensing point. Communications from control unit
    to central alarm reporting and display processor are to operate in a
    continuous interrogation and response mode, using time-multiplexed
    digital communications techniques at a data rate of 5.12 kilobaud.

b. Interrogation and response communications between the control unit and
    central processor is to be half-duplex and bidirectional on one dual
    twisted pair cable (one pair for interrogation and one for response),
    which may have one or more parallel branches. Individual control unit
    lines are to be at least 22 AWG wire. Connect control wires in
    parallel to the hardwire link. Communication system is to provide as
    many as 255 control unit connections.

c. The communication system must maintain specified performance over a
    link length of 7500 feet when operating without line repeaters or other
    signal regenerating or amplifying devices. The communications system
    must maintain specified performance over a link length of 75,000 feet
    when operating with signal-regenerating line repeaters.

d. Control unit to central alarm reporting and display processor
    communications link is to also be capable of operating over a maximum
    of two standard voice grade telephone leased or proprietary lines.
    Link is to be capable of operating half duplex over a Type 3002 data
    transmission pair and be capable of modular expansion. Telephone lines
    will be provided by the Government. Coordinate and check out system
    operation. General characteristics and telephone line service are to
    be as follows:

Connections	Two- or four-wire
Impedance at 1000 Hz	600 ohms
Transmitting level	0 to 12 dBm
Transmitting level adjustment	3 dB increments
Type	Data
Direction	Two-way alternate (half duplex)
Maximum speed	5.12 kilobaud
Maximum loss at 1000 Hz	33 dB

2.7.3   Data Encryption

Incorporate data encryption equipment on data transmission circuits as
shown on the drawings. The algorithm used for encryption must be the
Advanced Encryption Standard (AES) algorithm described in NIST FIPS 197 of
TDES, ASC/X9 X9.52, as a minimum. Data encryption must be in accordance
with NIST FIPS 140-2.

2.7.4   Network Switch

The small form-factor pluggable (SFP) is to provide full-duplex
1000/100/10-Mbps connectivity between switches over multimode fiber (MMF)
infrastructures. Provide mounting accessories for a typical rack. Rack
requirements as specified in paragraph EQUIPMENT RACK.

2.7.4.1   Inside Plant

Provide a network switch for ESS system with 24 SFP Ethernet ports. Allow
dynamic port base security and rapid spanning tree protocol with VLAN
assignments for specific users regardless of where the switch is
connected. The switch will use AC input voltage nominal of 120 VAC at 60
Hz. The switch is to be less than 2 Rack Units (RU) and Layer 3 capable.
The switch is to have the capability of commanding a self-healing ring
configuration. 1000Base-LX SFP Fast Ethernet Interface Converter is to be
a hot swappable device that plugs into a Gigabit fiber SFP uplink port on
the switch. The switch is to be a fully managed power over Ethernet (PoE)
to all ports. Provide switch capable of using a Layer 3 (routed) port to
connect to a LAN gateway port for Internet and web base access. The Mean
Time Between Failure (MTBF) must be greater than 210,000 hours.

2.7.5   Video and ESS Transmission

Transmission is to be by optical fiber dedicated to the associated
circuit. Video and ESS transmission cables must conform to the industry
standards in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

Install interior cable in Rigid Metal Conduit (RMC) (where outside of the
secure perimeter) and Electrical Metallic Tubing (EMT)(where inside the
secure perimeter) to the serving non-secure cable tray. Cable is to be
rated for the installation method intended.

2.7.6   Wire and Cable

Provide all wire and cable not indicated as Government-furnished
equipment. Wiring must meet NFPA 70 standards and as indicated in the Wire
and Cable Data Sheets Attachment at the end of this section.

2.7.7   Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at
the SCC or at a secondary control and monitoring site is to be optical
fiber cable. Interconnecting cables conform to the industry standards in
Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.7.8   Local Area Network (LAN) Cabling

Cabling must be in accordance with TIA-568-C.2, Category 6.

2.7.9   Cable Construction

  Provide all cable components that will withstand the environment in which
  the cable is installed for a minimum of 20 years.

2.8   BACKUP POWER

  a.   Provide a power switching indication and on-line source at the
       surveillance monitor.

  b.   The system is to automatically switch back to the primary source upon
       primary power restoration. Detect and report failure of an on-line
       battery as a fault condition. Power products must be in accordance
       with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

  c.   Provide backup power to the primary power by backup batteries in each
       element or subsystem and a back-up generator.

2.8.1   Batteries

  Provide backup by dedicated batteries in remotely located system elements
  including control units. Batteries are to be an integral part of dispersed
  system elements when radio frequency (RF) operation is required. Batteries
  are to be capable of operation in any position and be protected against
  venting caustic chemicals or fumes within an equipment cabinet. Provide
  batteries capable of continuous operation for up to 4 hours without
  recharge or replacement.

2.9   SURGE SUPPRESSION DEVICES

  Comply with requirements in Section 33 82 00 TELECOMMUNICATION OUTSIDE
  PLANT (OSP).

2.10   EQUIPMENT RACK

  Provide standard 19 inch electronic rack cabinets conforming to UL 50 for
  the ESS system at the SCC and remote control and monitoring sites as shown
  on the drawings. Equipment rack must be in accordance with Section 27 10 00
   BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.10.1   Labels

  Provide a labeling system for cabling as required by TIA-606 and UL 969.
  Provide stenciled lettering for voice and data circuits using thermal ink
  transfer process.

2.11   LOCKS AND KEY LOCK

2.11.1   Lock

  Provide locks on system enclosures for maintenance purposes that meet
  UL 437 and are round-key type, with three dual, one mushroom, and three
  plain pin tumblers. Keys must be stamped "U.S. GOVT. DO NOT DUP.". Keys
  are only to be withdrawn when in the locked position. Key all maintenance
  locks alike and furnish only two keys for all of these locks.

2.11.2   Key-Lock Operated Switches

  All key-lock-operated switches required to be installed on system

components are to be UL 437, with three dual, one mushroom, and three plain pin tumblers,. Keys must be stamped "U.S. GOVT. DO NOT DUP.". Key-lock-operated switches are to have two positions, with the key removable in either position. Key all key-lock-operated switches differently and furnish only two keys for each key-lock-operated-switch.

2.11.3   Construction Locks

Use a set of temporary locks during installation and construction. Do not include any of the temporary locks in the final set of locks installed and delivered to the Government.

2.12   FIELD FABRICATED NAMEPLATES

Nameplates must comply with ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription is to identify the function and, when applicable, the position.

Nameplates are to be melamine plastic, 0.125 inch thick, white with black center core. Surface is to be matte finish. Corners are to be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be 1 by 2.5 inches. Provide lettering a minimum of 0.25 inch high normal block style. Nameplates are not be required for devices smaller than 1 x 3 inches.

2.12.1   Manufacturer's Nameplate

Each item of equipment is to have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.13   FACTORY APPLIED FINISH

Electrical equipment is to have factory-applied painting systems which meetsthe requirements of the NEMA 250 corrosion-resistance test as a minimum.

PART 3   EXECUTION

3.1   INSTALLATION

Install the system in accordance with safety and technical standards NFPA 70, UL 681, UL 1037, and UL 1076. Configure components within the system with appropriate service points to pinpoint system trouble in less than 20 minutes.

Install all system components, including any equipment that is furnished by the Government, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown on the drawings, and furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

3.1.1   Existing Equipment

Connect to and utilize existing equipment, control signal transmission lines, and devices as shown on the drawings. Any equipment and signal lines that are usable in their original configuration without modification

may be reused with Government approval.

Make written requests and obtain approval prior to disconnecting any signal
lines and equipment that creates equipment outage. Such work can proceed
only after receiving Government approval of these requests. If any device
fails after work has commenced on that device, signal, or control line,
diagnose the failure and perform any necessary corrections to the
equipment. The Government is responsible for maintenance and repair of
Government equipment. The Contractor will be held responsible for repair
costs due to negligence or abuse of Government equipment on their part.

3.1.2   Software Installation

Load software as specified and required for an operational system,
including databases and specified programs. Provide original and backup
copies on optic discs of all accepted software, including diagnostics, upon
successful endurance test completion.

3.1.3   Enclosure Penetrations

Enclosures are to be penetrated from the bottom unless shown otherwise.
Penetrations of interior enclosures having transitions of conduit from
interior to exterior, and penetrations of exterior enclosures are to be
sealed with rubber silicone sealant to preclude the entry of water.
Terminate conduit risers in a hot-dipped galvanized metal cable terminator
that is filled with a sealant as recommended by the cable manufacturer, and
in a manner that does not damage the cable.

3.1.4   Cable and Wire Runs

Perform required cable and wire routings per NFPA 70 and Section 26 20 00
INTERIOR DISTRIBUTION SYSTEM, ICS 705-1, and as specified. Terminate
conduits including flexible metal and armored cable in the sensor or device
enclosure. Fit ends of conduit with insulated bushings. Exposed
conductors at ends of conduits external to sensors and devices are not
acceptable.

3.1.5   Soldering

Soldered electrical connections must use composition Sn60, Type AR or S,
for general purposes; use composition Sn62 or Sn63, Type AR or S, for
special purposes. Flux must conform to ASTM B32 when Type S solder is used
for soldering electrical connections.

3.1.6   Galvanizing

Ferrous metal is to be hot-dip galvanized in accordance with ASTM A123/A123M.
Provide screws, bolts, nuts, and other fastenings and supports that are
corrosion resistant.

Field welds or brazing on factory galvanized boxes, enclosures, conduits,
and so on, are to be coated with a cold galvanized paint containing at
least 95 percent zinc by weight.

3.1.7   Conduits

Install interior conduits in accordance with NFPA 70, Section 26 20 00
INTERIOR DISTRIBUTION SYSTEM and ICS 705-1. Install exterior conduits in
accordance with NFPA 70, Section 33 71 02 UNDERGROUND ELECTRICAL

DISTRIBUTION and ICS 705-1.

3.1.8   Field Applied Painting

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2   ADJUSTMENT, ALIGNMENT, SYNCHRONIZATION, AND CLEANING

a.   Clean each system component of dust, dirt, grease, or oil incurred during and after installation or accrued subsequent to installation from other project activities subsequent to installation.

b.   Prepare for system activation by manufacturer's recommended procedures for adjustment, alignment, or synchronization.

c.   Prepare each component in accordance with appropriate provisions of component installation, operations, and maintenance manuals.

d.   Remove large vegetation that may sway in the wind and touch fencing.

3.3   SYSTEM STARTUP

Do not apply power to the system until after:

a.   Set up system equipment items and communications in accordance with manufacturer's instructions.

b.   Conduct a system visual inspection to ensure that defective equipment items have not been installed and that there are no loose connections.

c.   Test and verify system wiring as correctly connected.

d.   Verify system grounding and transient protection systems as properly installed.

e.   Verify the correct voltage, phasing, and frequency of the system power supplies.

Satisfaction of the requirements above does not relieve the contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as result of Contractor work or equipment.

3.4   SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

Provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the Contracting Officer. These representatives are to be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives are also to be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives are to participate in the system testing and validation and provide certification that their respective system portions meet the contractual requirements.

The above requirements supplement the quality control requirements specified elsewhere in the contract.

3.5   ESS SYSTEM TESTING

  All ESS Testing requirements are specified in Section 28 08 10 ELECTRICAL
  SECURITY SYSTEM ACCEPTANCE TESTING.

3.6   ESS TRAINING

  Conduct training courses for 10 designated personnel in system maintenance
  and operation. Coordinate training with the Government. The training is
  to be oriented to the specific system being installed. Training content is
  to include training manuals and audio-visual materials. Deliver training
  manuals for each trainee with 2 additional copies delivered for archiving
  at the project site. The manuals are to include an agenda, defined
  objectives for each lesson, and a detailed subject matter description for
  each lesson.

  Furnish audio-visual equipment and other training materials and supplies.
  Deliver copies of the audio-visual materials to the Government either as a
  part of the printed training manuals or on the same media as that used
  during the training sessions when course portions are presented using
  audio-visual material.

3.6.1   ESS Training Outline

  Submit a training plan for the training phases, including type of training
  to be provided, outline of training manuals, training course agendas, and a
  list of reference material, for Government approval.

3.6.2   Typical Training Day

  A training day is defined as:

  a.   Eight hours of classroom instruction, with

       (1) Two 15-minute breaks

       (2) One hour lunch break

  b.   Conducted:

       (1) Monday through Friday

       (2) During the daytime shift in effect at a Government-provided
           training facility

  For guidance in planning the required instruction, assume that attendees
  will have a high school education or equivalent, and are familiar with
  ESS. Approval of the planned training schedule is to be obtained from the
  Government at least 30 days prior to the training.

3.6.3   ESS Administrator Training

  b.   CCTV System Administrator Training includes:

       (1) One eight-hour session on site

       (2) Training is to include all administrator and operator functions,

and items unique to the installed CCTV System, and interfaces with other systems.

3.6.4   ESS Operator Training

Coordinate the operator training syllabus with the Government prior to conducting operator training.

b. CCTV Operator Training includes:

(1) Two (one-day) 8 hour on-site training sessions

(2) System operating procedures

(3) System configuration

(4) Video call-up

(5) Camera and monitor control

(6) Graphics functionality

(7) Basic device terminology and troubleshooting

3.6.5   Maintenance Personnel Training

The system maintenance course is to be taught at the project site after endurance test completion for a period of five training days. A maximum of five personnel, designated by the Government, will attend the course. The training includes:

a. Physical layout of each piece of hardware.

b. Troubleshooting and diagnostics procedures.

c. Component repair and replacement procedures.

d. Maintenance procedures and schedules to include system testing after repair.

e. Calibration procedures. Upon course completion, the students are to be proficient in system maintenance.

f. Review of site-specific drawing package, device location, communication, topology, and flow.

3.6.6   Follow-up Training

a. Provide One hour training session each month for two months after initial training.

b. Follow-up training is to begin one month after initial training.

c. Training is to include testing for system competence.

3.7 NAMEPLATE MOUNTING

Provide nameplate number, location, and letter designation as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or

rivets.

-- End of Section --