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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 13.00 40

FIRE DETECTION AND ALARM CONTROL, GUI, AND LOGIC SYSTEMS

08/10

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Reference Wizard's Check Reference feature to update the issue dates.

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

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

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.41 (1990; R 2008) Audible Emergency Evacuation Signal (ASA 96)

ASME INTERNATIONAL (ASME)

ASME A17.1/CSA B44 (2007; Addenda a 2008) Safety Code for Elevators and Escalators

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
http://www.approvalguide.com/CC_host/pages/public/custom

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

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

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2009; TIA 09-1; TIA 09-2) Life Safety Code

NFPA 1221 (2010) Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems

NFPA 241 (2009) Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 70	(2008; TIA 08-1) National Electrical Code
NFPA 72	(2010; TIA 10-1; TIA 10-2; TIA 10-3; TIA 10-4) National Fire Alarm and Signaling Code
NFPA 90A	(2009; Errata 09-1) Standard for the Installation of Air Conditioning and Ventilating Systems

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

47 CFR 15	Radio Frequency Devices
47 CFR 90	Private Land Mobile Radio Services

UNDERWRITERS LABORATORIES (UL)

UL 1242	(2006; R 2001 thru 2007) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1971	(2002; R thru 2008) Signaling Devices for the Hearing Impaired
UL 228	(2006; R 2008) Door Closers-Holders, With or Without Integral Smoke Detectors
UL 268	(2009) Smoke Detectors for Fire Alarm Systems
UL 268A	(2008; R 2009) Smoke Detectors for Duct Application
UL 38	(2008; R 2008) Manual Signaling Boxes for Fire Alarm Systems
UL 464	(2009) Standard for Audible Signal Appliances
UL 521	(1999; R thru 2010) Heat Detectors for Fire Protective Signaling Systems
UL 6	(2007) Electrical Rigid Metal Conduit-Steel
UL 632	(2000) Standard for Electrically-Actuated Transmitters
UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 864	(2003; R thru 2010) Standard for Control Units and Accessories for Fire Alarm Systems
UL Electrical Constructn	(2009) Electrical Construction Equipment Directory
UL Fire Prot Dir	(2010) Fire Protection Equipment Directory

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Provide six complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. [The [_____] Division] [Engineering Field Activity (EFA) [_____]], Naval Facilities Engineering Command, Fire Protection Engineer, will review and approve submittals.

SD-02 Shop Drawings

NOTE: Provide 25 percent spare capacity where buildings are presently sprinkler protected throughout or where such protection is being provided under this design. Where automatic sprinkler protection will be provided later, use 50 percent spare capacity.

Provide point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems which are supervised or controlled by the system. Diagrams shall show connections from field devices to the FACP and remote fire alarm control units, initiating circuits, switches, relays and terminals.

Provide plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each conduit, and circuit layouts for all floors.

Provide a complete description of the system operation [in matrix format] on the drawings.

Provide a complete list of device addresses and corresponding messages.

Provide detailed drawings of the graphic annunciator.

Include annotated catalog data, in table format on the drawings, showing manufacturer's name, model, voltage, and catalog numbers for equipment and components.

Provide complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

Battery Power Calculations

Submit shop drawings not smaller than 600 by 900 mm 24 by 36 inches. As a minimum, include the items listed above in the shop drawings.

Detail Drawings

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level [3] [4] Fire Alarm Technician, as specified.

SD-03 Product Data

Fire Alarm Control Panel (FACP)[; G][; G, [_____]]

Printers, covers, console rack, video display unit (VDU), etc.[; G][; G, [_____]]

Terminal Cabinets/assemblies[; G][; G, [_____]]

Manual Stations[; G][; G, [_____]]

Transmitters (including housing)[; G][; G, [_____]]

Batteries[; G][; G, [_____]]

Battery Chargers[; G][; G, [_____]]

Smoke Sensors[; G][; G, [_____]]

- Thermal Sensors[; G][; G, [_____]]
- Wiring and cable[; G][; G, [_____]]
- Notification Appliances[; G][; G, [_____]]
- Addressable Interface Devices[; G][; G, [_____]]
- [Graphic Annunciator[; G][; G, [_____]]]
- [Amplifiers[; G][; G, [_____]]]
- [Tone Generators[; G][; G, [_____]]]
- [Digitalized Voice Generators[; G][; G, [_____]]]
- [Firefighter Telephone[; G][; G, [_____]]]
- Waterflow Detectors[; G][; G, [_____]]
- Tamper Switches[; G][; G, [_____]]
- [Electromagnetic Door Holders[; G][; G, [_____]]]
- [Remote Fire Alarm Control Units[; G][; G, [_____]]]
- Smoke Sensor Testing Procedures[; G][; G, [_____]]
- [Radio Transmitter And Interface Panels[; G][; G, [_____]]]
- [Digital Alarm Communicator Transmitter (DACT)[; G][; G, [_____]]]
- [Telegraphic Transmitter[; G][; G, [_____]]]

Submit data on proposed equipment, including, but not limited to the items listed above. Include UL or FM listing cards for equipment provided.

Storage Batteries

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Low Battery Voltage

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts

Spare parts data for each different item of material and equipment specified, not later than [3] [_____] months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced

after [1] [_____] year of service.

Training

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level [3] [4] Fire Alarm Technician, for the fire detection and alarm system [60] [_____] days prior to performing system tests.

SD-06 Test Reports

Furnish preliminary test results to the Contracting Officer. Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information.

SD-07 Certificates

Qualifications of Installer

Qualifications

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

Equipment

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

SD-10 Operation and Maintenance Data

Interior Fire Alarm System, Data Package [5] [_____] [; G] [; G, [_____]]

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

Record Drawing Software

Operating and Maintenance Instructions [; G] [; G, [_____]]

[Six] [_____] copies of operating manual outlining step-by-step

procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. [Six] [_____] copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

SD-11 Closeout Submittals

Prepare and submit to the Contracting Officer six sets of [Detailed As-Built Drawings](#). Include complete wiring diagrams in the drawings showing connections between devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built location of devices and equipment. The drawings shall show the system as installed, including deviations from both the project drawings and the approved shop drawings. Prepare the drawings on uniform sized mylar sheets not less than [760 by 1065 mm with 200 by 100 mm 30 by 42 inches with 8 by 4 inch](#) title block similar to contract drawings. Submit these drawings within 2 weeks after the final acceptance test of the system. Provide at least one set of as-built (marked-up) drawings at the time of, or prior to the final acceptance test.

Submit the [Record Of Installer'S Training History For The Employees](#) involved with this contract.

1.3 ADDITIONAL SUBMITTAL REQUIREMENTS

1.3.1 [Battery Power Calculations](#)

Verify that battery capacity exceeds supervisory and alarm power requirements.

- a. Provide complete battery calculations for both the alarm and supervisory power requirements. Submit ampere hour requirements for each system component with the calculations.
- b. Provide data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, [25] [50] percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.
- [c. Provide data to indicate that the amplifiers have sufficient capacity to simultaneously drive fire alarm speakers at their 1/2 watt tap plus 50 percent spare capacity. Annotate data for each circuit on the drawings.
-]d. Provide a detailed description of the final acceptance testing procedures (including equipment necessary for testing smoke detectors using real smoke).

1.3.2 Record Drawing Software

Furnish one set of floppy diskettes containing CAD based drawings in DXF format of as-built drawings and schematics.

1.4 DESCRIPTION OF WORK

1.4.1 Scope

NOTE: Indicate the location of fire alarm system devices and riser locations on floor plans. Provide a fire alarm system riser diagram indicating circuits and risers.

This work includes designing and providing [a new, complete,] [and] [modifying the existing] analog/addressable fire alarm system as described herein and on the contract drawings for the [Building name]. The system shall include wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, supervising station fire alarm system transmitter, and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide system[s] complete and ready for operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 72 [and] [_____] except as modified herein. [The system layout on the drawings show the intent of coverage and are shown in suggested locations. Final quantity, layout, and coordination is the responsibility of the Contractor.] [A single fire alarm control panel is indicated with terminal cabinets at each floor at each riser location. Where remote fire alarm control units are needed, provide them at a terminal cabinet location.] Power each remote fire alarm control unit from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.

1.5 GENERAL REQUIREMENTS

1.5.1 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.5.2 Tags

Furnish tags with stamped identification number for keys and locks.

1.5.3 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

1.5.4 Compliance

Configure the fire detection and alarm system and the central reporting system in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.5.5 Qualifications

NOTE: Since some states require that persons performing the installation of Fire Alarm Systems be NICET certified, the number of certified NICET Fire Alarm technicians will vary from state to state. The actual number of NICET certified technicians should be checked with the state fire marshal. If the availability of NICET technicians is a problem, delete all references to NICET.

NICET level 4 Fire Alarm Technicians should be required for hospitals and large complex systems.

1.5.5.1 Engineer and Technician

- a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.
- b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.
- c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.5.5.2 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.
- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.

- d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.5.5.3 Qualifications of Installer

[Design shall be by a National Institute for Certification in Engineering Technologies (NICET) Level III or Level IV Technician.] Installer shall have an office, which has been in existence for at least 3 years[, within a [_____] mile radius of the job site]. Submit [record of installer's training history for the employees](#) to the Contracting Officer. Installation shall be accomplished by an electrical contractor with a minimum of 5 years' experience in the installation of fire alarm systems. The Contracting Officer may reject any proposed installer who cannot show evidence of such qualifications. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system. The Contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization which carries a stock of repair parts for the system to be furnished. The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Contracting Officer and the receipt of [detailed as-built drawings](#) and schematics of all equipment. Prior to installation, submit data for approval by the [[_____] Division] [EFA [_____]], Naval Facilities Engineering Command, Fire Protection Engineer, showing that the Contractor has successfully installed addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least three installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

1.5.6 Detail Drawings

The Contractor shall submit detail drawings consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level [3] [4] Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

1.6 RELATED REQUIREMENTS

1.6.1 Basic Electrical Materials And Methods

Section [26 00 00.00 20](#) BASIC ELECTRICAL MATERIALS AND METHODS, applies to

this section, with the additions and modifications specified herein.

1.6.2 Predictive Testing And Inspection Technology Requirements

NOTE: The Predictive Testing and Inspection (PT&I) tests prescribed in section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS are MANDATORY for all [NASA] [_____] assets and systems identified as Critical, Configured, or Mission Essential. If the system is non-critical, non-configured, and not mission essential, use sound engineering discretion to assess the value of adding these additional test and acceptance requirements. See Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS for additional information regarding cost feasibility of PT&I.

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.7 QUALITY ASSURANCE

Equipment and devices shall be compatible and operable with existing station fire alarm system and not impair reliability or operational functions of existing supervising station fire alarm system. [Existing supervising station fire alarm system is [____].]

1.7.1 Regulatory Requirements

Devices and equipment for fire alarm service shall be listed by UL Fire Prot Dir or approved by FM APP GUIDE.

1.7.1.1 Requirements for Fire Protection Service

Equipment and material shall have been tested by UL and listed in UL Fire Prot Dir or approved by FM and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL Fire Prot Dir or FM APP GUIDE. Do not construe omission of these terms under the description of any item of equipment described as waiving this requirement.

1.7.1.2 Testing Services or Laboratories

Construct fire alarm and fire detection equipment in accordance with UL Fire Prot Dir, UL Electrical Constructn, or FM APP GUIDE.

1.7.2 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory, such as UL or FM, and listed or approved for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials.

1.7.3 Modification of References

- a. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the [_____] Division] [EFA [_____]], Naval Facilities Engineering Command, Fire Protection Engineer.
- [b. Consider the recommended practices stated in the manufacturer's literature or documentation as mandatory requirements.

]1.8 SPARE PARTS AND TOOLS

1.8.1 Interchangeable Parts

Spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Suitably package and identify spare parts by nameplate, tagging, or stamping. Deliver spare parts to the Contracting Officer at the time of the final acceptance testing.

1.8.2 Spare Parts

Furnish the following spare parts and accessories:

- a. [4][_____]audiovisual devices of each type installed
- b. [4] [_____] fuses for each fused circuit
- c. [1] [_____] electromagnetic door holders
- d. [1] [_____] manual stations
- e. [9] [_____] spare reams of paper for the system printer, plus sufficient paper for fire alarm acceptance tests
- f. [2] [_____] smoke sensors and base of each type installed
- g. [2] [_____] heat sensors and base of each type installed
- h. [3] [_____] spare printer ribbons
- i. [3] [_____] test magnets/devices for each type of sensors installed
- j. [3] [_____] break rods for manual stations

1.8.3 Parts List

Furnish a list, in duplicate, of all other parts and accessories which the manufacturer of the system recommends to be stocked for maintenance.

1.9 KEYS

Keys and locks for equipment shall be identical. Provide not less than six keys of each type required. Keys shall be CAT [60] [_____].

1.10 SYSTEM DESIGN

1.10.1 Operation

NOTE: If a small fire alarm system is required, the specification writer should consider utilizing Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP.

If an addition to an existing system is required, provide the make, model number, and other pertinent information on existing components that are to operate with the new equipment. Since new interfaces will have to be compatible with the existing system or to the central fire alarm reporting system, it may be necessary to edit major items out of this specification. If a new fire alarm panel is required, it has to be compatible with the existing central fire alarm reporting system.

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. Activate the system into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Connect alarm initiating devices [to initiating device circuits (IDC)], [Style B] [or] [Style D], to signal line circuits (SLC), Style [5] [6], in accordance with NFPA 72. Connect alarm notification appliances to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. Provide a looped conduit system so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

- a. Sufficient memory to perform as specified and as shown for addressable system.
- b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors.
- c. Capability of each addressable device being individually disabled or enabled from the panel.

- d. Size each SLC to provide 40 percent addressable expansion without hardware modifications to the panel.

1.10.2 Operational Features

**NOTE: For zoned fire alarm and detection systems,
the systems should be zoned by type of device and by
floor.**

**The designer will list zones and indicate the exact
wording of the descriptive zone labeling.**

Remove item j. below when elevators are not involved.

The system shall have the following operating features:

- a. Monitor electrical supervision of [IDC,] [SLC,] and [NAC]. [Smoke detectors [shall] [shall not] have combined alarm initiating and power circuits.]
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. Provide a trouble alarm silence switch which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. Over-ride this switch upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.

- h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at [20] [_____] seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Program fire alarm devices other than smoke detectors without confirmation or verification.
- i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. Do not provide an override at the HVAC panel.
- j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.
- l. The fire alarm control panel shall monitor [and control] the fire sprinkler system, or other fire protection extinguishing system.
- m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.
- n. Zones for [IDC] [and] [NAC] shall be [arranged as indicated on the contract drawings] [as follows: [_____]].

1.10.3 Alarm Functions

NOTE: Check with the local fire department to determine which signal or signals are to be transmitted. For zoned fire alarm reporting, the transmitter should be zoned as required by the Authority Having Jurisdiction (AHJ).

The designer will list zones and indicate the exact wording of the descriptive zone labeling.

Functions e., g., and h. below are optional depending on the job conditions.

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of [a signal] [signals] over the station [telephonic] [telegraphic] [radio] fire reporting system. [The signal shall be common for any device] [The signals shall be as follows: [_____]].
- b. Visual indications of the alarmed devices on the fire alarm control

panel display [and on the remote audible/visual display].

- c. Continuous sounding or operation of alarm notification appliances [only in designated areas] [throughout the building] as required by **ASA S3.41**.
- d. Closure of doors held open by electromagnetic devices.
- e. Operation of the smoke control system.
- f. Deactivation of the air handling units [serving the alarmed area] [throughout the building].
- g. Shutdown of power to the data processing equipment in the alarmed area.
- h. Automatic discharge of the designated fire suppression systems.
Provide a [_____] [15] second maximum delay for the deluge system, a [_____] [30] second delay for the wet pipe system.

1.10.4 Primary Power

Provide operating power as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.10.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.10.6 Interface With Existing Fire Alarm Equipment

NOTE: If an addition to an existing system is required, provide the make, model number, and other pertinent information on existing components that are to operate with the new equipment. Since new interfaces will have to be compatible with the existing system or to the central fire alarm reporting system, it may be necessary to edit major items out of this specification. If a new fire alarm panel is required, it has to be compatible with the existing central fire alarm reporting system.

The existing Fire Alarm equipment must be clearly identified by the fire alarm system designer in the specification and on the drawings.

Operate the **equipment** specified herein as an extension to an existing configuration. Connect the new equipment to [an existing control panel in the existing part of the building] [existing monitoring equipment at the Supervising Station (Building [_____])]. Existing [control] [monitoring] equipment shall be expanded, modified, or supplemented as necessary to extend the existing [control] [monitoring] functions to the new points or zones. New components shall be capable of merging with the existing

configuration without degrading the performance of either system. The scope of the acceptance tests of paragraph Testing shall include aspects of operation that involve combined use of both new and existing portions of the final configuration.

1.10.7 Interface With other Equipment

Furnish interfacing components as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

1.11 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

PART 2 PRODUCTS

[2.1 EXISTING FIRE ALARM EQUIPMENT

Existing fire alarm equipment shall be maintained fully operational until the new equipment has been tested and accepted by the Contracting Officer. As new equipment is installed, label it "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the Government, place it in service and connected to the station fire alarm system. New equipment shall have tags removed and tag the existing equipment "NOT IN SERVICE" until removed from the building.

[2.1.1 Equipment Removal

NOTE: Contact the Contracting Officer, Base Fire Prevention Office, and/or Base Maintenance Personnel to determine what action is appropriate for the salvaging of existing fire alarm equipment.

After acceptance of the new system by the Contracting Officer, remove existing equipment not connected to the new system, remove unused exposed conduit, and restore damaged surfaces. The material shall be removed from the site and disposed of by the Contractor.

]2.1.2 Repair Service/Replacement Parts

Repair services and replacement parts for the system furnished under this contract shall be available for a period of 10 years after the date of final acceptance of this work by the Contracting Officer. Provide on-site service during the guarantee period within 24 hours after notification. Complete all repairs within 48 hours after notification.

]2.1.3 Other Divisions To Be Coordinated With

Refer to the following sections for related work and coordination:

[Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION]
[Section 21 30 00 FIRE PUMPS] [Section 21 23 00.00 20 WET CHEMICAL FIRE EXTINGUISHING FOR KITCHEN CABINET] [Section 21 13 16.00 20 DRY-PIPE FIRE SPRINKLER SYSTEMS] [Section 21 13 19.00 20 [DELUGE][PREACTION] FIRE

SPRINKLER SYSTEM] [Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS].

[Section 08 71 00 DOOR HARDWARE for [door release] [door unlocking] and additional work related to finish hardware.]

[Section[s] [14 21 00.00 20 ELECTRIC TRACTION ELEVATORS][14 21 13 ELECTRIC TRACTION FREIGHT ELEVATORS][14 21 23 ELECTRIC TRACTION PASSENGER ELEVATORS] [14 24 00 HYDRAULIC ELEVATORS] for additional work related to elevators.]

[Section 07 84 00 FIRESTOPPING for additional work related to firestopping.]

2.1.4 Manufacturer Qualifications

Components shall be of current design and in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

]2.2 INTERIOR FIRE ALARM SYSTEM DESIGN

2.2.1 Definitions

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

- a. Analog/Addressable System: A system in which multiple signals are transmitted via the same conduction path to a remote fire alarm control unit and fire alarm control panel, decoded and separated so that each signal will initiate the specified response.
- b. Hard Wired System: A system in which alarm and supervisory initiating devices are directly connected, through individual dedicated conductors, to a central control panel without the use of analog/addressable circuits or devices.
- c. Interface Device: An addressable device which interconnects hard wired systems or devices to an analog/addressable system.
- d. Fire Alarm Control Unit: A control panel, remote from the fire alarm control panel, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm control panel.
- e. Fire Alarm Control Panel (FACP): A master control panel having the features of a fire alarm control unit and to which fire alarm control units are interconnected. The panel has central processing, memory, input and output terminals, [video display units (VDUs),] [and] [printers].
- f. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door in which terminal strips are securely mounted.

2.2.2 System Operation

NOTE: The supply and return portions of the Style 6 loop shall not be located in the same room or shaft to ensure system reliability. Separate them by a sufficient distance so that a single fire will not involve both the supply and return portions of the loop.

The system shall be a complete, supervised, noncoded, analog/addressable fire alarm system conforming to NFPA 72. The system shall have an interconnected riser loop or network having Style [6] [_____] supervision that shall not be located in the same room or shaft. The return portion of the loop shall be remote from the supply portion of the loop. [Where the building has two stairs for egress from floors above grade, a single impairment cannot adversely affect more than one floor. Where three or more stairs are provided for egress from floors above grade, a single impairment cannot adversely affect more than 1/2 of any floor.] [Any single impairment of the system shall not affect the system on more than [one] [one-half] of any floor.] Operate the system in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The system shall provide the following functions and operating features:

- a. The FACP and fire alarm control units, if used, shall provide power, annunciation, supervision, and control for the system.
- b. Provide Style [B] [_____] initiating device circuits [for conductor lengths of 3050 mm 10 feet or less].
- c. Provide Style [4] [_____] signaling line circuits for each floor.
- d. Provide Style [6] [_____] signaling line circuits for the network.
- e. Provide Style [Z] [_____] notification appliance circuits. The visual alarm notification appliances shall have the flash rates synchronized.
- f. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
- g. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature which shall silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke sensor in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.
- h. Provide a notification appliance silencing switch which, when activated, will silence the audible signal appliance, but will not affect the visual alarm indicator, the liquid crystal display, or the automatic notification of the [fire department] [central station service]. Override this switch upon activation of a subsequent alarm.
- i. Provide alarm verification capability for smoke sensors. Alarm

verification shall initially be set for [30] [_____] seconds.

- j. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, [fire reporting system] [air handler shutdown] [smoke control operation] [elevator recall] [door release] [door unlocking] features. Operation of this programming shall indicate this action on the FACP display and printer output.
- k. Automatically transmit alarm, supervisory, and/or trouble signals to the [fire department] [a UL listed central station].
- l. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- m. The system shall be capable of being programmed from the panel's keyboard. Store programmed information in non-volatile memory.
- n. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.
- o. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.
- p. Where the fire alarm system is responsible for initiating an action in another emergency control device or system, such as [an HVAC system] [an atrium exhaust system] [a smoke control system] [an elevator system], the addressable fire alarm relay shall be within 915 mm 3 feet of the emergency control device.

NOTE: Show the following in matrix format either in
this specification or on the drawings. If a matrix
is provided, omit subparagraphs q, r, and s.

- q. An alarm signal shall automatically initiate the following functions:
 - (1) Transmission of an alarm signal to [the fire department] [a UL listed central station].
 - (2) Visual indication of the device operated on the fire alarm control panel (FACP), [video display unit (VDU),] [and on the graphic annunciator]. [Indication on the graphic annunciator shall be by floor, zone or circuit, and type of device.]

NOTE: Where a high-rise building in which the fire alarm system is being provided is fully sprinkler protected, the fire alarm notification appliances should operate only on the fire floor, (one/two) floor(s) above, and floor below. Where the building has some fire protection or life safety concerns or the building can be evacuated quickly, the fire alarm system should operate all notification appliances in the building upon a fire alarm. In those buildings designed for total evacuation due to fire protection or life safety concerns, design the

system so that it can easily be modified when the fire protection or life safety improvements have been made to the building.

(3) [Continuous actuation of all alarm notification appliances, except those in stairs or in elevator cabs.] [Continuous actuation of alarm notification appliances on the floor of fire alarm origin, the floor above the floor of fire alarm origin, and the floor below the floor of fire alarm origin, except those in stairs or in elevator cabs.]

- [(4) Recording of the event via the system printer.
-][(5) Release of doors held open by electromagnetic devices.
-][(6) Operation of the [smoke control system] [atrium exhaust system].
-][(7) Release of power to electric locks on doors which are part of the means of egress.
-][(8) Operation of a smoke sensor in an elevator lobby or other location associated with the automatic recall of elevators, shall recall the elevators in addition to other requirements of this paragraph.
-][(9) Operation of a duct smoke sensor shall shut down the appropriate air handler in accordance with NFPA 90A in addition to other requirements of this paragraph.

NOTE: Use this paragraph only where a sensor or detection system is to release a special fire extinguishing system.

-][(10) Operation of [_____] shall release the [_____] fire extinguishing system after a [_____] second time delay.
 -][(11) Operation of a sprinkler waterflow switch serving an elevator machinery room shall operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1/CSA B44.
 -][(12) Operation of an interface, which operates vibrating pagers worn by hearing-impaired occupants.
-] r. A supervisory signal shall automatically initiate the following functions:
- (1) Visual indication of the device operated on the FACP, [VDU,] and on the graphic annunciator, and sound the audible alarm at the respective panel.
 - (2) Transmission of a supervisory signal to [the fire department] [a UL listed central station].
- [(3) Recording of the event via the system printer.

-] s. A trouble condition shall automatically initiate the following functions:
 - (1) Visual indication of the system trouble on the FACP, [VDU,] and on the graphic annunciator, and sound the audible alarm at the respective panel.
 - (2) Transmission of a trouble signal to [the fire department] [a UL listed central station].
 - [(3) Recording of the event via the system printer.
-] t. The maximum permissible elapsed time between the actuation of an initiating device and its indication at the FACP shall be 15 seconds.
- u. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP shall not exceed 200 seconds.

2.2.3 System Monitoring

- a. Valves: Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, valves at fire pumps, and valves at backflow preventers, whether supplied under this contract or existing, shall be electrically monitored to ensure its proper position. Provide each tamper switch with a separate address[, unless they are within the same room, then a maximum of [5] [_____] can use the same address.]
- [b. Independent Fire Detection System: Monitor each existing independent smoke detection subsystem, and kitchen fire extinguishing system both for the presence of an alarm condition and for a trouble condition. Provide each monitored condition with a separate address.

]2.2.4 Overvoltage and Surge Protection

- a. Signaling Line Circuit Surge Protection: For systems having circuits located outdoors, communications equipment shall be protected against surges induced on any signaling line circuit and comply with the applicable requirements of [IEEE C62.41](#). Cables and conductors, which serve as communications links, shall have surge protection circuits installed at each end that meet the following waveform[s]:
 - (1) A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
 - [(2) An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Provide protection at the equipment. Install additional triple electrode gas surge protectors, rated for the application, on each wireline circuit within [915 mm 3 feet](#) of the building cable entrance. Do not use fuses for surge protection.
-][b. Sensor Wiring Surge Protection: Protect digital and analog inputs and outputs against surges induced by sensor wiring installed outdoors and as shown. Test the inputs and outputs with the following waveform[s]:
 - (1) A 10 by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

- [(2) An 8 by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Do not use fuses for surge protection.

]]2.2.5 Addressable Interface Devices

The addressable interface (AI) device shall provide an addressable input interface to the FACP for monitoring normally open or normally closed contact devices such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation, etc.

2.2.6 Smoke Sensors

**NOTE: Provide smoke sensors only in spaces where
they are specifically required by MIL-HDBK-1008.**

2.2.6.1 Photoelectric Smoke Sensors

Provide addressable photoelectric smoke sensors as follows:

- a. Provide analog/addressable photoelectric smoke sensors utilizing the photoelectric light scattering principle for operation in accordance with **UL 268**. List smoke sensors for use with the fire alarm control panel.
- b. Provide self-restoring type sensors which do not require any readjustment after actuation at the FACP to restore them to normal operation. Sensors shall be UL listed as smoke-automatic fire sensors.
- c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.
- d. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.
- e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Provide sensors of the low voltage type rated for use on a 24 VDC system.
- f. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.
 - (1) Primary status
 - (2) Device type
 - (3) Present average value

- (4) Present sensitivity selected
- (5) Sensor range (normal, dirty, etc.)

[2.2.6.2 Ionization Type Smoke Sensors

Provide addressable ionization type smoke sensors as follows:

- a. Provide analog smoke sensors which operate on the ionization principle and are actuated by the presence of visible or invisible products of combustion. List smoke sensors for use with the fire alarm control panel.
- b. Provide self-restoring type sensors which do not require any readjustment after actuation at the FACP to restore them to normal operation. Sensors shall be UL listed as smoke-automatic fire sensors.
- c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.
- d. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on the screw terminals. The sensor shall have a visual indicator to show actuation.
- [e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system.
-] f. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.
 - (1) Primary status
 - (2) Device type
 - (3) Present average value
 - (4) Present sensitivity selected
 - (5) Sensor range (normal, dirty, etc.)

]2.2.6.3 Duct Smoke Sensors

Duct smoke sensors shall be analog/addressable photoelectric type as described in paragraph entitled "Photoelectric Smoke Sensors," and shall be provided in ductwork in accordance with NFPA 90A and in accordance with manufacturer's recommendations.

]2.2.6.4 Smoke Sensor Testing

Test smoke sensors in accordance with manufacturer's recommended calibrated test method. Submit smoke sensor testing procedures for approval.

2.2.6.5 Projected Beam Smoke Detectors

Design detectors for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED which is powered upon an alarm condition. Automatically compensate long-term changes to the received signal caused by environmental variations. Detectors shall incorporate features to assure that they are operational; a trouble signal shall be initiated if the beam is obstructed, the limits of the compensation circuit are reached, or the housing cover is removed. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam. In the event of beam interference for more than three seconds, transmit a trouble alarm.

2.2.7 Thermal Sensors

NOTE: Heat detectors provided in elevator machinery rooms are strictly for the warning sign in the elevator cab and shall not be connected to the FACP. Coordinate with Section 14 21 13 ELECTRIC TRACTION FREIGHT ELEVATORS, 14 21 23 ELECTRIC TRACTION PASSENGER ELEVATORS and/or Section 14 24 00.HYDRAULIC ELEVATORS.

- a. Thermal sensors shall be combination rate-of-rise/fixed temperature sensing. Determine the alarm condition by comparing sensor value with the stored values.
- b. A moving average of the sensor's heat sensing value to automatically compensate for conditions that could affect detection operations. System shall automatically maintain a constant heat sensing sensitivity from each sensor by compensating for environmental factors.
- c. Perform automatic self-test routines on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the value being transmitted. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.
- d. An operator at the control panel, having the proper access level, shall have the capability to manually access the following information for each heat sensor:
 - (1) Primary status
 - (2) Device type
 - (3) Present average value
 - (4) Sensor range ([____])
- e. An operator at the control panel, having the proper access level, shall have the capability to manually control the following information for each heat sensor:

- (1) Alarm detection sensitivity values
- (2) Enable or disable the point/device
- (3) Control sensor's relay driver output

2.2.8 Electric Power

2.2.8.1 Primary Power

Provide primary power for the FACP from the normal AC service to the building [where shown on the drawings] [or] [_____]. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of circuits and devices. Make the service connection for the FACP at the [main service switchgear] [emergency distribution panel where shown] [a main distribution panel where shown]. Provide appropriate equipment to protect against power surges. Provide a separate NEMA 1 "general purpose enclosure" for the circuit breaker. The circuit breaker enclosure shall be painted red, marked "FIRE ALARM SYSTEM," provided with a red and white engraved plastic sign permanently affixed to the face of the switch, and provided with a lockable handle or cover.

[2.2.8.2 Generator

Where any emergency generator provides a standby power supply for life safety system circuits, provide a connection from one of the circuits for the fire alarm system.

]2.2.9 Emergency Power Supply

Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and not cause transmission of a false alarm.

2.2.9.1 Batteries

Provide sealed, maintenance-free, [lead-calcium] [sealed lead acid] [gel cell] [nickel-cadmium] [lithium] batteries as the source for emergency power to the FACP. Batteries shall contain suspended electrolyte. Maintain the battery system in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.2.9.2 Capacity

**NOTE: Use 48 hours if the building has no generator
 providing standby power to the fire alarm system.
 If such a generator exists, use 4 hours.**

Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for [48] [_____] hours and audible and visual signal devices under alarm conditions for an additional [10] [_____] minutes.

2.2.9.3 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and maintain the batteries at full charge. In the event the batteries are fully discharged, the charger shall recharge the batteries back to 95 percent of full charge within 48 hours. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

2.2.10 System Field Wiring

2.2.10.1 Wiring Within Cabinets, Enclosures, Boxes, Junction Boxes, and Fittings

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, which are securely mounted. The use of wire nuts or similar devices is prohibited.

2.2.10.2 Terminal Cabinets

**NOTE: Provide terminal cabinets on each floor where
the fire alarm system supply riser is located and
where the fire alarm return riser is located.**

Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size shall be appropriate for the size of the wiring to be connected. Label conductor terminations and permanently mount a drawing containing conductors, their labels, their circuits, and their interconnection in the terminal cabinet. Minimum size is 200 mm by 200 mm 8 inches high by 8 inches.

2.2.10.3 Alarm Wiring

Signaling line circuits and initiating device circuit field wiring shall be copper, No. [16] [18] [_____] AWG size conductors at a minimum. Notification appliance circuit conductors, that contain audible alarm devices, [other than speakers,] shall be solid copper No. 14 AWG size conductors at a minimum. [Speaker circuits shall be copper No. [16] [_____] AWG size conductors at a minimum.] [Firefighter telephone circuits shall be No. [16] [18] [_____] AWG size conductors as a minimum.] Wire size shall be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage. Power wiring, operating at 120 VAC minimum, shall be No. 12 AWG solid copper having similar insulation. Provide all wiring in rigid metal conduit or intermediate metal conduit. Electrical metallic tubing conduit is acceptable in dry locations not enclosed in concrete or where not subject to mechanical damage. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. Permit the use of flexible conduit not exceeding a 1830 mm [6] [_____] foot length in initiating device circuits. Run conduit or

tubing concealed unless specifically shown otherwise on the drawings. Utilize shielded wiring where recommended by the manufacturer. For shielded wiring, ground the shield at only one point, which shall be in or adjacent to the FACP. T-taps are permitted in Style 4 circuits with interconnections occurring on terminal strips. Color coding is required for circuits and shall be maintained throughout the circuit.

2.2.10.4 Conductor Terminations

Provide labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit, and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.

2.2.10.5 Wiring to Station Telegraphic Fire Alarm Circuit

Wiring from the master fire alarm box to the station telegraphic fire alarm circuit shall be a two-conductor No. [12] [10] [_____] AWG type UF cable [in conduit].

2.2.11 Fire Alarm Control Panel (FACP)

**NOTE: For high-rise buildings, locate the FACP in
an emergency control center having one door opening
to the outside.**

Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. Perform operations required for testing or for normal care and maintenance of the systems from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. [If more than a single unit is required, and is located in the lobby/entrance, notify the [_____] Division] [EFA [_____] Fire Protection Engineer, via the Contracting Officer, prior to installing the equipment.] Each control unit shall provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation. Visual indication of alarm, supervisory, or trouble initiation on the fire alarm control panel shall be by liquid crystal display or similar means with a minimum of 80 characters of which at least 32 are field changeable.

2.2.11.1 Cabinet

Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of panels as well as field wiring. Identify the enclosure by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm Control Panel" and shall not be less than one inch high.

Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. Provide the cabinet in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.2.11.2 Control Modules

Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory, or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage.

2.2.11.3 Silencing Switches

- a. Alarm Silencing Switch: Provide an alarm silencing switch at the FACP which shall silence the audible signal but not affect the visual alarm indicator. Override this switch upon activation of a subsequent alarm.
- b. Supervisory/Trouble Silencing Switch: Provide supervisory and trouble silencing switch which shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. Override this switch upon activation of a subsequent alarm, supervision, or trouble condition.

2.2.11.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually resettable by switch from the FACP after the initiating device or devices have been restored to normal.

[2.2.11.5 Fire Alarm Voice Message

**NOTE: Use the proper bracketed item depending upon
whether the fire alarm system is to cause total
evacuation upon an alarm.**

A fire alarm shall activate notification appliance circuits. Textual audible appliances shall produce a slow whoop tone for three cycles followed by a voice message which is repeated until the control panel is reset or silenced. Broadcast automatic messages through speakers on appropriate floors, but not in stairs or elevator cabs. The visual strobes and audible message shall automatically be broadcast on the floor of fire alarm origin, [the floor] [two floors] immediately above the floor of fire alarm origin, and the floor immediately below the floor of fire alarm origin. A live voice message shall override the automatic audible output through use of a microphone input at the control panel. When using the microphone, broadcast live messages through speakers in stairs, in elevator cabs, and throughout a selected floor or floors. The system shall be capable of operating all speakers at the same time. The digitalized voice message shall consist of a non-volatile (EPROM) microprocessor based input to the amplifiers. The microprocessor shall actively interrogate

circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction which could render the digitalized voice module inoperative shall automatically cause the slow whoop tone to take over all functions assigned to the failed unit. Messages shall utilize a [male] [female] voice and be as follows:

["May I have your attention, please. May I have your attention, please. A fire has been reported which may affect your floor. Please walk to the nearest exit and evacuate the building." (Provide a [2] [_____] second pause.) "May I have your attention, please (repeat the message)."

["May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a [2] [_____] second pause.) "May I have your attention please (repeat the message)."

] [_____]]

] [2.2.11.6 Fire Alarm Signal

A fire alarm shall activate notification appliances throughout the building. Audible devices shall be fire alarm horns which produce a [three-pulse temporal pattern] [continuous slow whoop tone] [_____] . Visual devices shall be strobes operating in accordance with NFPA 72.

] 2.2.11.7 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.2.11.8 Field Programmability

Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and accomplished using personal computer based equipment.

2.2.11.9 Input/Output Modifications

The FACP shall contain features which allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad [and a keyboard]. Any bypass or modification to the system shall indicate a trouble condition on the FACP[, VDU] [and a printed output of the trouble condition].

2.2.11.10 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.2.11.11 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. [Install the instructions on the interior of the FACP.] [Install the frame in a conspicuous location observable from the FACP.] The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the Contracting Officer before being posted.

2.2.11.12 Walk Test

The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.2.11.13 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.2.11.14 RS-232-C Output

Each local control panel shall be capable of operating remote service type cathode ray tubes (CRTs), printers, and/or modems. The output shall be paralleled ASCII from an EIA RS-232-C connection with a baud rate of 1200 or 2400 to allow use of any commonly available CRT, printer, or modem.

2.2.12 Remote Fire Alarm Control Units

Provide complete remote control units fully enclosed in a lockable steel enclosure as specified herein. Operations required for testing or for normal care and maintenance of the control units shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. Each control unit shall provide power, supervision, control, and logic for its portion of the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each unit with supervisory functions for power failure, internal component placement, and operation.

2.2.12.1 Cabinet

Install remote control unit components in cabinets large enough to accommodate components and also to allow ample gutter space for interconnection of units as well as field wiring. Identify the enclosure by an engraved laminated phenolic resin nameplate. Label lettering on the nameplate "Remote Fire Alarm Control Unit" and not less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. Provide the cabinet in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.2.12.2 Control Modules

Provide power and control modules to perform all functions of the remote control unit. Provide audible signals to indicate any alarm or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the remote control unit. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage. Arrange circuits so that there is 25 percent spare capacity for any circuit.

2.2.12.3 Silencing Switches

Provide an alarm silencing switch at the remote control unit which will silence the audible signal but not affect the visual alarm indicator. Override this switch upon activation of a subsequent alarm. Provide trouble and supervisory silencing switch which will silence the audible trouble and supervisory signal, but not extinguish the visual indicator. Override this switch upon activation of a subsequent trouble or supervisory signal.

2.2.12.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually resettable by switch from the remote control unit after the initiating device or devices have been restored to normal.

2.2.12.5 Memory

Provide each control unit with non-volatile memory and logic for all functions. Do not consider the use of long life batteries, capacitors, or other age-dependent devices as equal to non-volatile processors, PROMS, or EPROMS.

2.2.12.6 Field Programmability

Provide control units that are fully field programmable for control, initiating, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and accomplished using personal computer based equipment.

2.2.12.7 Input/Output Modifications

Each remote control unit shall contain features which allow the elimination of input devices from the system or the modification of system outputs. Any such modifications shall indicate a trouble condition on the remote control unit, the FACP, and a printed output of the trouble condition.

2.2.12.8 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory, or trouble condition on the system still exists.

2.2.12.9 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the remote fire alarm control unit. [Install the frame in a conspicuous location observable from the remote fire alarm control unit.] The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the Contracting Officer before being posted.

2.2.12.10 Walk Test

Each remote control unit shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.2.12.11 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

[2.2.13 Amplifiers, Preamplifiers, Tone Generators

Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 shall be housed in a fire alarm control unit, terminal cabinet, or in the fire alarm control panel. The system shall automatically operate and control all building fire alarm speakers except those installed in the stairs and within elevator cabs. Operate the speakers in the stairs and elevator cabs only when the microphone is used to deliver live messages. Each amplifier shall have two channels; one to broadcast a message and the other for paging.

[2.2.13.1 Construction

Amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

][2.2.13.2 Inputs

Equip each system with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.

][2.2.13.3 Tone Generator

The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a

slow whoop tone, which shall slowly ascend from low (500 hertz) to high (1200 hertz), and constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. Each slow whoop cycle shall last approximately 4 seconds. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay.

][2.2.13.4 Protection Circuits

Constantly supervise each amplifier for any condition which could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator on the control panel, appropriate logging of the condition on the system printer, and other actions for trouble conditions as specified.

]][2.2.14 Video Display Unit (VDU)

**NOTE: Contact the EFD or Engineering Field Activity
(EFA) Fire Protection Engineer to determine if a VDU
is to be provided.**

- a. The VDU shall be the secondary operator-to-system interface for data retrieval, alarm annunciation, commands, and programming functions. The desk mounted VDU shall consist of a CRT monitor and a keyboard. The VDU shall have a [300] [430] [_____] mm [12] [17] [_____] inch minimum [touch] screen, capable of displaying 25 lines of 80 characters each. Supervise communications with the FACP. Record faults on the printer. Power required shall be 120 VAC, 60 Hz from the same source as the fire alarm control panel.
- b. To eliminate confusion during an alarm situation, the screen shall have dedicated areas for the following functions:
 - (1) Alarm and returns to normal
 - (2) Commands, reports, and programming
 - (3) Time, day, and date
- c. Use Full English language throughout to describe system activity and instructions. Full English language descriptors defining system points shall be 100 percent field programmable by factory trained personnel, alterable and user definable to accurately describe building areas.
- d. Display alarms and other changes of status in the screen area reserved for this information. Provide the follow information in English:
 - (1) Condition of device (alarm, trouble, or supervisory).
 - (2) Type of device (manual pull, waterflow, etc.)
 - (3) Location of device plus numerical system address.

Upon receipt of alarm, an audible alarm shall sound and the

condition and point type shall flash until acknowledged by the operator. Returns to normal shall also be annunciated and require operator acknowledgment.

- e. The system shall have multiple levels of priority for displaying alarms to conform with [UL 864](#). Priority levels shall be as follows:

- (1) Level 1 - Fire Alarms
- (2) Level 2 - Supervisory Alarms
- (3) Level 3 - Trouble Signals

- f. Provide the system with memory so that no alarm shall be lost. A highlighted message shall advise the operator when unacknowledged alarms are in the system.

- g. Provide multiple levels of access for operators and supervisors via user-defined passwords. The following functions shall be provided for each level:

- (1) Operator level access functions
 - (a) Display system directory, definable by device.
 - (b) Display status of an individual device.
 - (c) Manual command (alarm device with an associated command shall use the same system address for both functions).
 - (d) Report generation, definable by device, output on either the VDU or printer, as desired by the operator.
 - (e) Activate building notification appliances.
- (2) Supervisory level access functions
 - (a) Reset time and date.
 - (b) Enable or disable event initiated programs, printouts, and initiators.
 - (c) Enable or disable individual devices and system components.

- h. The above supervisory level functions shall not require computer programming skills. Record changes to system programs on the printer and maintained in the control panel as a trouble condition.

][2.2.15 [Graphic Annunciator](#)

NOTE: Provide the graphic annunciator at a location convenient for fire department. It should be near the door through which they will enter the building as indicated in their pre-fire plan.

[2.2.15.1 Annunciator Panel

Provide a graphic annunciator which indicates the building floor plan, including the locations of stairs and elevators. Identify stairs and elevators by [letter] [number]. Clearly mark alarm circuit boundaries on the floor plan. Annunciator shall include a north arrow, [location of the fire alarm control panel,] and a "you are here" indicator. The graphic annunciator shall be [a minimum size of 915 by 915 mm 3 by 3 feet] [as indicated on the contract drawings].

][2.2.15.2 Indicating Lights

Provide the graphic annunciator with individual light emitting diode (LED) indicating lights for each type of alarm and supervisory device. Provide an amber LED for indicating a system trouble condition and a separate amber LED for indicating a supervisory condition. Provide a green LED to indicate presence of power and a red LED to indicate an alarm condition. The actuation of any alarm signal shall cause the illumination of a boundary LED, a floor LED, and a device LED. System supervisory or trouble shall cause the illumination of a trouble LED. In addition to all of these LED indicators, provide normal power and emergency power indicating LEDs. Provide a push button LED test switch. The test switch shall not require key operation. Annunciator LEDs shall only be extinguished by operation of the system reset switch on the FACP.

][2.2.15.3 Material

Construct the graphic annunciator face plate of [smoked Plexiglas] [bronze]. The LEDs shall be backlit. House control equipment and wiring in a [recessed] [semi-recessed] [surface mounted] back box. The exposed portions of the back box shall be [chrome plated] [bronze plated] with knockouts.

][2.2.15.4 Programming

Where programming for the operation of the proper LEDs is accomplished by a separate software program than the software for the FACP, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.

]][2.2.16 System Printers

- a. Provide a system printer to record alarm, supervisory, and trouble conditions without loss of any signal or signals. Printout shall be by circuit, device, and function as provided in the FACP. Printer shall operate on a 120 VAC, 60 Hz power supply.
 - (1) The printer shall have at least 80 characters per line and have a 96 ASCII character set. The printer shall have a microprocessor-controlled, bi-directional, logic seeking head capable of printing 120 characters per second utilizing a 9 by 7 dot matrix print head. Printer shall not contain internal software which is essential for proper operation.
- b. When the FACP receives a signal, the alarm, supervisory, and trouble condition shall be printed. The printout shall include the type of signal, the circuit or device reporting, the date, and the time of the occurrence. The printer shall differentiate alarm signals from other printed indications. When the system is reset, this condition shall

also be printed including the same information concerning device, location, date, and time. Provide a means to automatically print a list of existing alarm, supervisory, and trouble conditions in the system. If a printer is off-line when an alarm is received, the system shall have a buffer to retain the data and print it when the printer is restored to service. The printer shall have an indicator to alert the operator that the paper has run out.

]]2.2.17 **Firefighter Telephone** Communication System

NOTE: Provide a master control station at the FACP with remote telephone stations in each stair at each floor landing, in each elevator lobby on each floor, and in elevator cabs. In addition, provide them at specific locations containing essential fire protection equipment, such as the fire pump room and outside the emergency generator room.

a. Provide a firefighter telephone system as follows:

- (1) Provide a firefighter telephone communication system with complete, common talk, closed circuits. The system shall include, but not be limited to, a master control station mounted in the fire alarm control panel, a power supply and standby battery system, and remote telephone stations.
- (2) Provide a master control station which shall provide power, supervision, and control for wiring, components, and circuits. The act of lifting any remote telephone hand set from its cradle shall cause both a visual and audible signal to annunciate at the master control station. Removing the hand set at the master control station and depressing a button at the remote telephone hand set shall cause the automatic silencing of the audible signal. Communication between the master control station hand set and any/or all remote hand sets shall require the depressing of a push-to-talk switch located on any/all remote hand sets. During the time that the master control hand set is removed from its cradle it shall be possible to communicate between five remote hand sets and the master control station. Hand sets shall be able to monitor any conversation in progress and join the conversation by pressing the push-to-talk button. It shall not be possible to communicate between two or more remote hand sets with the master control station hand set in its cradle. The master control station hand set shall be red in color and equipped with a 5-foot long strain-relieved coiled cord. Make wiring connections to terminal strips. The master control station shall monitor wire and connections for any opens, shorts, or grounds which would render the system inoperable or unintelligible. Equip the master control station with a silencing switch and ring-back feature such that any audible trouble signal can be silenced and shall be so indicated by the lighting of an amber LED. Once any trouble condition has been corrected, the amber LED shall be extinguished and the silencing switch shall sound again until the switch is restored to its original position. Equip the master control station with a separate, LED annunciated switch for each telephone circuit. In addition, LEDs shall provide for the annunciation of operating and supervisory power. The loss of operating or

supervisory power shall cause an audible and visual indication at the master control station and shall also cause the fire alarm trouble signal to sound on the FACP. Switches, LEDs, and controls shall be fully labeled.

- (3) Provide [surface] [flush] mounted remote telephone stations. Equip each station with a hinged door that is magnetically locked. Permanently wire each hand set in place with a coiled cord. Each hand set shall be red high-impact cyclac and equipped with a push-to-talk switch which, when operated, shall signal the master control station and a switch-equipped, storage cradle.
- (4) Provide operating and supervising power from the same supply circuit(s) utilized for the fire alarm control panel.

]2.2.18 Manual Stations

Provide metal or plastic, semi-flush mounted, double action, addressable manual stations, which are not subject to operation by jarring or vibration. Equip stations with screw terminals for each conductor. Stations which require the replacement of any portion of the device after activation are not permitted. Finish stations in fire-engine red with molded raised lettering operating instructions of contrasting color. The use of a key or wrench shall be required to reset the station.

2.2.19 Notification Appliances

[2.2.19.1 Fire Alarm Speakers

NOTE: Locate speakers throughout the building with a maximum spacing of 92.9 square meters 1000 square feet per speaker. Where sound has to pass through more than one partition or wall to be heard in a space, provide an additional speaker.

- a. Provide fire alarm speakers conforming to UL 464 having a minimum of three tap settings and separate terminations for each in and out connection. Tap settings shall include taps of 1/4, 1/2 and 1 watt. Speakers shall utilize the 1/2 watt tap in the system. Speakers shall have an output rating of 84 dBA at 3050 mm 10 feet as determined by the reverberant room test; data on peak output as determined in an anechoic chamber is not suitable. Speakers shall be capable of installation on standard 100 mm 4 inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall mounted unit.
- b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gage and equipped with mounting holes and other openings as needed for a complete installation. Grind and finish fabrication marks and holes to provide a smooth and neat appearance for each plate. Prime and paint each plate.

]2.2.19.2 Visual Alarm Signals

NOTE: Locate strobes wall mounted in corridors no more than 4570 mm 15 feet from the end of a corridor

with 30.48 m 100 feet maximum distance between strobes. Where there is an obstruction to the viewing path in the corridors, such as a cross-corridor door or ceiling elevation change, consider the obstruction as defining a new corridor. Provide wall mounted strobes in rooms accessible to the public, such as conference rooms, restrooms, courtrooms, cafeterias, and auditoriums in accordance with NFPA 72.

Provide strobe light visual alarm signals which operate on a supervised 24 volt DC circuit. The strobe lens shall comply with UL 1971 and conform to the Americans With Disabilities Act. Disburse the light pattern so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. The strobe flash output shall be a minimum of [15] [_____] candela based on the UL 1971 test. The strobe shall have a xenon flash tube. Visible appliances may be part of an audio-visual assembly. [Where more than two appliances are located in the same room or corridor, provide synchronized operation.]

[2.2.19.3 Fire Alarm Horns

NOTE: Where horns or bells are used for fire alarm notification, calculate the proper locations for these devices as detailed in "Designing Fire Alarm Audibility," which is contained in the Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering. Submit the calculations at the 35 percent design review.

Provide [surface] [semi-flush] mounted electronic multi-tone horns that produce a minimum of four distinct sounds, suitable for use in an electrically supervised circuit. Horns shall have a rating of 90 dBA at 3050 mm 10 feet when tested in accordance with UL 464 while emitting a slow whoop tone. Output from the horn shall be [three-pulse temporal pattern] [the slow whoop tone] [_____] . Where horns and strobes are provided in the same location, they may be combined into a single unit.

]2.2.19.4 Fire Alarm Bells

NOTE: Where horns or bells are used for fire alarm notification, calculate the proper locations for these devices as detailed in "Designing Fire Alarm Audibility," which is contained in the Society of Fire Protection Engineers (SFPE) Handbook of Fire Protection Engineering. Submit the calculations at the 35 percent design review.

Provide [surface] [flush] mounted bells suitable for use in an electrically supervised circuit. Bells shall be 255 mm 10 inch vibrating type with a sound output rating of at least 90 dBA at 3050 mm 10 feet when tested in accordance with UL 464.

2.2.19.5 Connections

Provide screw terminals for each notification appliance. Design terminals to accept the size conductors used in this project without modification.

2.2.19.6 Chimes

NOTE: Chimes are normally only used in hospitals to alert the staff about a fire emergency without arousing the patients. Sound output is low and prevents them from being used in areas having even moderately low noise levels.

Chimes shall be electrically operated, supervised, electronic type, with an adjustable frequency of 800 to 1200 Hertz. Chimes shall have a minimum sound rating of [80] [_____] dBA at 3.05 m 10 feet. [Chimes shall ring the bell codes, as indicated.]

2.2.19.7 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Factory assemble units. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.2.19.8 Voice Evacuation System

The voice evacuation system shall provide for [one-way] [two-way] voice communications, routing and pre-amplification of digital alarm tones and voice (digital and analog) messages. Zone the system for messages (Custom and prerecorded) and tones as indicated on the drawings. The following electronic tones shall be available from the amplifier: Slow Whoop, High/Low, Horn, Chime, Beep, Stutter, Wail and Bell. The system shall have a microphone and allow for general paging within the space. Operation shall be either manually from a control switch or automatically from the fire alarm control panel. Reset shall be accomplished by the fire alarm control panel during panel reset.

[2.2.20 Valve Monitor Switches (Tamper Switches)]

Provide a tamper switch for each fire protection system control valve. Tamper switches shall be UL listed as "Extinguishing System Attachment" for the location and type of valve supervised. The device shall contain double pole, double throw contacts. Operation of the switch shall cause a supervisory signal to be transmitted to the FACP upon not more than two complete turns of the valve wheel or a closure of 10 percent, whichever is less. Equip tamper switches with screw terminals for each conductor.

[[2.2.21 Waterflow Detectors]

- [a. Provide vane type waterflow detectors for wet pipe sprinkler systems. The device shall contain double pole, double throw contacts. Equip the detector with a pneumatic time delay, field adjustable from 0 to 90 seconds. The time delay shall be set initially to [30] [45] [_____] seconds. The device shall be a UL listed extinguishing system attachment rated for the particular pressure and location at which it

is installed. Equip flow switches with screw terminals for each conductor.]

- b. Provide pressure type waterflow detectors for dry pipe sprinkler systems. The device shall contain double pole, double throw contacts. The device shall be a UL listed extinguishing system attachment rated for the particular pressure and location at which it is installed. Equip switch with screw terminals for each conductor.

] [2.2.22 Electromagnetic Door Holders

NOTE: Provide electromagnetic door holders only for cross-corridor doors and for doors likely to be propped open once construction is complete.

Where indicated on the drawings, provide magnetic fire door hold open devices. Design the electromagnetic holding devices to operate on 120 VAC, and require not more than 3 watts of power to develop 172.4 kPa 25 psi of holding force. The initiation of any fire alarm shall cause the release of the electromagnetic door holding device permitting the door to be closed by the door closer. The device shall be UL listed based on UL 228 tests.

] 2.2.23 Automatic Transmitters

] [2.2.23.1 Telegraphic Transmitter

Provide transmitter of the electric motor-driven or pre-wound spring mechanism type which shall transmit not less than four rounds of code. When motor-driven transmitters are provided, connect the motor to a supervised circuit in a control panel. Provide metallic or rigid plastic code number plates on the exterior face of transmitters. Design transmitters to provide the same features as the fire alarm boxes for electrically supervised, coded positive noninterfering type and have the ability to transmit signals on grounded or open circuits. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection. Transmitter shall have a local energy type auxiliary tripping device. Code wheel shall be metallic and box code shall be as directed by the Contracting Officer.

] [2.2.23.2 Radio Transmitter and Interface Panels

Provide radio transmitter with antenna that is compatible with the existing supervising station fire alarm system. Transmitter shall have a means to transmit alarm, supervisory, and trouble conditions via a single transmitter. Provide transmitters in accordance with applicable portions of [NFPA 72,] Federal Communications Commission (FCC) 47 CFR 90. Protect the antenna from physical damage. Transmitter shall have a source of power for operation which conforms to NFPA 72. Transmitter shall be capable of initiating a test signal daily at any selected time.

] [2.2.23.3 Digital Alarm Communicator Transmitter (DACT)

Provide DACT that is compatible with the existing supervising station fire alarm system. Transmitter shall have a means to transmit alarm, supervisory, and trouble conditions via a single transmitter. Transmitter

shall have a source of power for operation which conforms to NFPA 72. Transmitter shall be capable of initiating a test signal daily at any selected time. Arrange transmitter to seize telephone circuits in accordance with NFPA 72.

]]2.2.23.4 Signals To Be Transmitted to the Base Receiving Station

Send the following signals to the base receiving station:

- [a. Sprinkler water flow
-]]b. Manual pull stations
-]]c. Smoke detectors
-]]d. Duct smoke detectors
-]]e. Sleeping room smoke detectors
-]]f. Heat detectors
-]]g. Sprinkler valve supervision
-]]h. Fire pump running
-]]i. Fire pump loss of power/phase reversal
-]]j. [_____]

]]2.3 NAMEPLATES

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

- a. FACPs
- b. Automatic transmitter
- c. Printer

Furnish to obtain approval by the Contracting Officer before installation. Obtain approval by the Contracting Officer for installation locations. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.4 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

2.5 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a [flush] [surface] [semi-flush] mounted steel cabinet with hinged door and cylinder lock. Control panel

shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Locate the LED/LCD displays on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. Provide a suitable means (single operation) for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Provide signals and LEDs/LCDs to indicate by zone any alarm, supervisory or trouble condition on the system. [Power and supervise each IDC so that a signal on one zone does not prevent the receipt of signals from other devices.] Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Provide visual annunciation for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Provide cabinets with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, install the units in a single cabinet large enough to accommodate units. Paint cabinets [red] [beige].

2.5.1 Remote System Audible/Visual Display

**NOTE: Provide a remote audible/visual display when
the control panel is located in an area where the
control panel integral signaling normally cannot be
heard or seen.**

Audible appliance shall have a minimum sound level output rating of [85] [_____] dBA at 3.05 m 10 feet and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible device shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

2.5.2 Circuit Connections

Connect circuit conductors entering or leaving the panel to screw-type terminals with each conductor and terminal marked for identification.

2.5.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.5.4 Addressable Control Module

NOTE: Remove this paragraph when not required.

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. Detect the supervision a short on the supervised circuit and prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled. [Connect existing fire alarm system notification appliance circuits to a single module to power and supervise the circuit.]

2.5.5 Addressable Initiating Device Circuits Module

NOTE: Remove this paragraph when not required.

Configure the initiating device being monitored as a [Style D] [Style B] initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED. [Connect existing fire alarm system initiating device circuits to a single module to power and supervise the circuit.]

2.6 STORAGE BATTERIES

NOTE: The fire alarm system may interface with auxiliary systems or subsystems; ensure that adequate battery backup is available, if the fire alarm system provides the power.

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Locate batteries [at the bottom of the panel] [in a separate battery cabinet]. Provide batteries with overcurrent protection in accordance with NFPA 72. Separate

battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. Key the lock the same as the fire alarm control panel. Paint cabinets to match the fire alarm control panel.

2.7 ADDRESSABLE MANUAL FIRE ALARM STATIONS

NOTE: American Disabilities Act (ADA) requires that manual alarm stations be mounted at a maximum of 1.2 m 48 inches above finished floor (AFF) for forward reach and 1.4 m 54 inches AFF for side reach.

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Connect manual stations into signal line circuits. Install stations on [surface] [semi-flush] [flush] mounted outlet boxes. Mount manual stations at [1220] [1370] [_____] mm [48] [54] [_____] inches. Stations shall be [single] [double] action type. Finish stations in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods [are] [are not] acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Rate switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Match and paint surface mounted boxes the same color as the [fire alarm manual stations] [mounting surface].

2.8 FIRE DETECTING DEVICES

NOTE: Remove last sentence when not applicable.

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. Provide the detectors as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. Installed devices shall conform to NFPA 70 hazard classification of the area where devices are to be installed.

2.8.1 Heat Detectors

Design heat detectors for detection of fire by [fixed temperature] [combination fixed temperature and rate-of-rise principle] [rate-compensating principle]. Rate heat detector spacing in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations [as defined by NFPA 70] [and] [as shown on drawings], shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

2.8.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Design detectors for [surface] [semi-flush] outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be [[57.2] [_____] degrees C [135] [_____] degrees F] [as shown]. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 15 by 15 m 50 by 50 ft.

2.8.1.2 Rate Compensating Detectors

Detectors shall be [surface] [flush] mounted [vertical] [horizontal] type, with outlet box supported independently of wiring connections. Detectors shall be hermetically sealed and automatically resetting. Rate Compensated detectors shall be rated for 15 by 15 m 50 by 50 ft.

2.8.1.3 Fixed Temperature Detectors

Design detectors for [surface] [semi-flush] outlet box mounting and supported independently of wiring connections. Design detectors to detect high heat. The detectors shall have a specific temperature setting of [57.2] [_____] degrees C [135] [_____] degrees F] [as shown]. The UL 521 test rating for the fixed temperature detectors shall be rated for 4.57 by 4.57 m 15 by 15 ft.

2.8.2 Combination Smoke and Heat Detectors

Combination smoke and heat detectors shall have an audible device (self-contained) and be designed for detection of abnormal smoke densities by the photoelectric principle and abnormal heat by a fixed temperature sensor. Provide smoke detectors with an LED light source. Failure of the LED shall not cause an alarm condition and the sensitivity shall be factory set at a nominal [3] [_____] percent and require no field adjustments of any kind. Heat detector portion shall be fixed temperature sensor rated at 57 degrees C 135 degrees F. The audible appliances shall have a minimum sound output of at least [85] [_____] dBA at 3.05 m 10 feet. Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Heat detectors shall connect to a control panel [SLC] [IDC] and shall be [non-restorable] [self restorable].

2.8.3 Flame Detectors

NOTE: Modify these paragraphs as necessary to indicate that detectors placed in an explosive environment will be approved for use in the appropriate class, division, and group environment as defined in NFPA 70 and as shown on drawings.

The detectors shall comply with FM APP GUIDE. The detectors shall be sensitive to the micron range best suited for their intended use. The detectors shall operate over electrically supervised wiring circuits and

the loss of power to the detector shall result in a trouble signal.
Provide a self-test feature for each detector to be individually tested.

2.8.3.1 Infrared (IR) Single Frequency Flame Detector

NOTE: The single frequency IR flame detector has the advantage of a fast response and is moderately sensitive. Its disadvantages are being affected by temperature extremes and being subject to false alarms from a myriad of IR sources.

The detector shall be sensitive in the range of [_____] to [_____] micrometers only.

2.8.3.2 Infrared (IR) Dual Frequency Flame Detector

NOTE: The IR dual frequency flame detector has the advantages of a moderately fast response, moderate sensitivity, and a lower false alarm rate. Its disadvantage is being affected by temperature extremes.

The IR detector shall consist of two or more IR sensors, each selected for a different IR frequency. The primary sensor shall be sensitive in the range of [_____] to [_____] micrometers only. Secondary sensors are tuned to different IR wavelengths to null out the effect of black body radiation to the primary sensor.

2.8.3.3 Ultraviolet (UV) Flame Detectors

NOTE: Ultraviolet (UV) flame detectors can be set to respond accurately to UV wavelength light produced by flame from both indoors and outdoors. UV flame detectors operate on the Geiger-Muller principle. These gas-filled vacuum tubes respond in the UV portion of the spectrum but can ignore UV radiation from the sun because the upper response range of the detector falls below the range of UV radiation that reaches the earth.

Solid-state UV detectors are available, but their spectral response extends into the sun's UV range and are not recommended for external use.

UV detectors have an 80 to 90 degree cone of vision. The UV detector has a fast response time and usually is not affected by rain, wind, snow, high humidity, or temperature and pressure extremes. UV units will produce false alarms if they are exposed to arc welding or X-ray and gamma radiation. They can also be blinded by oil film or smoke. UV flame detectors that are used in dirty and dusty environments should be equipped with automatic self-test and self-cleaning devices. The

cleaning device uses a stream of clean air across the lens surface to minimize the build-up of contaminants.

UV flame detector shall be of the narrow band response type which operates on radiated ultraviolet energy and shall be sensitive in the range of [_____] to [_____] micrometers only. The cone of vision shall be 80 degrees or greater. Each detector shall be completely insensitive to light sources in the visible frequency range.

2.8.3.4 Combination UV/IR Flame Detector

NOTE: Combination UV/IR flame detectors have been used both inside and outside to detect fires, but are slower to react than individual units.

The UV/IR detector shall provide discrimination against false alarms by requiring both UV and IR flame detection before an alarm is sent. The UV sensor shall be sensitive in the range of 0.185 to 0.265 micrometers only. The IR sensor shall be sensitive in the range of [_____] to [_____] micrometers only. Detectors shall be completely insensitive to light sources in the visible frequency range.

2.9 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.9.1 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.9.2 Wiring

NOTE: Do not penetrate SCIF perimeters with copper signal line circuits. SCIF penetrations should be either fiber optic cable or IDC. IDC circuits penetrating the SCIF shall be filtered.

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be [fiber optic] [or] [copper] cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. [16] [14] AWG minimum. Do not mix voltages in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Color code conductors. Similarly color code conductors used for the same functions. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.9.3 Special Tools and Spare Parts

NOTE: Remove last sentence when not required.

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Furnish two spare fuses of each type and size required. Furnish two percent of the total number of each different type of detector, but no less than two each. Mount spare fuses in the fire alarm panel.

2.10 TRANSMITTERS

NOTE: State the make and model number of existing proprietary supervising station receiving equipment.

The choice of code transmitter, or radio transmitter depends upon the type of existing fire reporting system at the activity. When telegraphic systems exist, use code transmitter. Determine the type of activity reporting system (i.e., positive non interfering or shunt). In most cases a local energy-tripping device will be required.

The facility Fire Dept. or Engineering office should be contacted to determine the type and amount of data to be supervised (monitored), i.e. -type: separate or common transmission of alarm, supervisory, and trouble type signals; -amount: all points, all zones, or the combined premises. Verify that existing monitoring equipment has sufficient capacity to support the additional premises or that it can be expanded as necessary to accommodate the new fire alarm system. Identify existing components.

2.10.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Provide transmitters in accordance with applicable portions of NFPA 72, NFPA 1221, and 47 CFR 15. Contain transmitter electronics module within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is [_____] and the transceiver shall be fully compatible with this equipment. At the Contractors option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

2.10.1.1 Transmitter Power Supply

Power each radio alarm transmitter by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

- a. Operation: Operate each transmitter from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Accomplish switchover with no interruption of protective service, and automatically transmit a

trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic. Each transmitter shall meet the following requirements: [_____].

- b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.10.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed [identical to the fire alarm system for the building.] [identical to radio alarm transmitter housings on the base.] Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.10.1.3 Antenna

The Contractor shall provide [omnidirectional, coaxial, halfwave dipole antennas] [_____] for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 161 km/h 100 mph. Do not mount antennas to any portion of the building roofing system.

2.10.2 Master Fire Alarm Boxes

Master fire alarm boxes shall be of the coded, [shunt] [positive] noninterfering type with succession features having a [shunt] [local energy] type auxiliary tripping device, and of the rewound, open-door, pull-lever type. House mechanism in a weatherproof cottage shell type of housing with metallic or rigid plastic code number plate mounted on the exterior face of the cottage shell. Operation of the actuating pull lever shall cause the box to transmit four complete rounds of code to gongs, recorders, and other devices on the same circuit. Driving springs shall have the capability to transmit not less than eight complete four-round groups of code before being rewound. Design boxes for operation of 100 milliamperes dc, but with capability of full operation of 70 milliamperes and up to 120 milliamperes. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection. Equip each box with manual signaling key, telephone jack, silent test device, and box shunt device. Box shall be [[wall-] [pole-] [pedestal-] mounted] [as indicated] with center of box 1525 mm 61 inches above grade, and provided with lighting fixture. Mounting bolts, brackets, fastenings, and conduit shall be copper alloy, cadmium, or zinc-coated steel. Code wheel shall be metallic and box code shall be as directed. Electrically powered master fire alarm boxes shall have standby sealed, lead calcium battery capacity for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.10.3 Telephonic Reporting System

Transmitters shall be compatible with existing receiving equipment at the Supervising Station and shall comply with applicable requirements of UL 632. Transmitter shall respond to the actuation of the fire alarm control panel and shall be of the electric motor-driven or rewound spring mechanism type; it shall transmit not less than four rounds of code. When

motor-driven transmitters are provided, connect the motor to a supervised circuit in a control panel. Provide metallic or rigid plastic code number plates on the exterior face of transmitters. Design transmitters to provide the same features as the fire alarm boxes for electrically-supervised, coded [positive] [shunt] noninterfering type and shall have the ability to transmit signals on grounded or open circuits. Activation of box when a single open fault is present on exterior fire alarm circuit shall have box to idle for one complete round only, then immediately transmit four complete code rounds via the box earth ground connection. Transmitter shall have a [shunt] [local energy] type auxiliary tripping device. Code wheel shall be metallic and box code shall be as directed. Extend wiring to the indicated telephone terminating location [for future connection by other] [and connected to specific twisted pair cable identified by the COR in the field]. [One new [____]-pair [shielded] [non-shielded] twisted-pair cable shall be extended to the Supervising Station and connected to existing terminating equipment.]

PART 3 EXECUTION

3.1 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

Install all work as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Do not install smoke detectors until construction is essentially complete and the building has been thoroughly cleaned.

- a. FACP: Locate the FACP [where indicated on the drawings] [____]. [Recess] [Semi-recess] [Surface mount] the enclosure with the top of the cabinet 1830 mm 6 feet above the finished floor or center the cabinet at [1525] [____] mm [5] [____] feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FACP.
- b. Manual Stations: Locate manual stations [as required by NFPA 101 and NFPA 72] [where shown on the drawings] [____]. Mount stations so that their operating handles are 1220 mm 4 feet above the finished floor. Mount stations so they are located no farther than [1525] [____] mm [5] [____] feet from the exit door they serve, measured horizontally.
- c. Notification Appliance Devices: Locate notification appliance devices [as required by NFPA 72] [where shown on the drawings]. Mount assemblies on walls 2030 mm 80 inches above the finished floor or 150 mm 6 inches below the ceiling whichever is lower. [Ceiling mounted speakers shall conform to NFPA 72].
- [d. Smoke and Heat Sensors: Locate sensors [as required by NFPA 72 and their listings] [as shown on the drawings] on a 4 inch mounting box. Install sensors located on the ceiling not less than 100 mm 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor at least 100 mm 4 inches below the ceiling, but not more than 300 mm 12 inches below the ceiling. In raised floor spaces, install the smoke sensors to protect 20.9 square meters 225 square feet per sensor. Install smoke sensors no closer than 1525 mm 5 feet from air handling supply outlets.
-][e. Graphic Annunciator: Locate the graphic annunciator as shown on the drawings. Surface mount the panel, with the top of the panel 1830 mm 6 feet above the finished floor or center the panel at [1525] [____] mm

[5] [_____] feet, whichever is lower.

-]f. Water Flow Detectors and Tamper Switches: Locate water flow detectors and tamper switches [where shown on the drawings] [at each supervised] sprinkler valve station.
-]g. Firefighter Telephones: Locate wall mounted in each stair at each floor landing, in each elevator lobby, and in each elevator cab 1220 mm 4 feet above the finished floor.
-]h. The modification of any fire alarm system and the procedures shall comply with the requirements of NFPA 241.

3.1.1.1 Power Supply for the System

NOTE: It is the responsibility of the designer to ensure that the source of power for the fire alarm system is shown on the drawings.

Provide a single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system. Supply the power as shown on the drawings. Equip the power supply with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Do not install wiring for the fire alarm system in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Make connections and splices using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

Mount the control panel and its assorted components so that no part of the enclosing cabinet is less than 300 mm 12 inches nor more than 2000 mm 78 inches above the finished floor. Manually operable controls shall be between 900 and 1100 mm 36 and 42 inches above the finished floor. Install panel to comply with the requirements of UL 864.

3.1.4 Detectors

Locate and install detectors in accordance with NFPA 72. Connect detectors into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 300 mm 12 inches from any part of any lighting fixture. Locate detectors at least 900 mm 3 feet from diffusers of air handling systems. Each detector shall be provided with

appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Firmly secure conduit drops to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm 3 feet, provide sway bracing. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD [in a finished, visible location] [as indicated] [_____].

3.1.5 Notification Appliances

Mount notification appliances 2003 mm 80 inches above the finished floor or 150 mm 6 inches below the ceiling, whichever is lower.

3.1.6 Annunciator Equipment

Mount annunciator equipment where indicated on the drawings.

3.1.7 Addressable Initiating Device Circuits Module

NOTE: Remove this paragraph when not required.

Use the initiating device circuits module to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in [Section [21 13 13.00 10 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION] [21 13 17.00 10 DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION] [21 13 18.00 10 PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION]] [_____] [NFPA 72], as indicated on the drawings and as specified herein.

3.1.8 Addressable Control Module

NOTE: Remove this paragraph when not required.

Install addressable and control modules in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall be mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. Supervise all interconnecting wires unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification

appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in [Section [21 13 13.00 10 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION] [21 13 17.00 10 DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION] [21 13 18.00 10 PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION]] [_____] [NFPA 72], as indicated on the drawings and as specified herein.

[3.2 DISCONNECTION AND REMOVAL OF EXISTING SYSTEM

Turn over fire alarm control panels and fire alarm devices disconnected and removed to the Contracting Officer.

- a. The existing fire alarm and smoke detection system shall remain in operation at all times during the installation and commissioning of the new system. Once this new system is on-line and accepted by the Government, remove the old system. As new equipment is installed, label it "NOT IN SERVICE." Upon acceptance, remove labels.
- b. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and elsewhere in the specification.
- c. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.

] [3.3 CONNECTION OF NEW SYSTEM

Make the following new system connections during the last phase of construction, at the beginning of the preliminary tests. New system connections shall include:

- [a. Connection of new control modules to existing magnetically held smoke door (hold-open) devices.
-] [b. Connection of new elevator recall smoke sensors to existing wiring and conduit.
-] [c. Connection of new system transmitter to existing base fire reporting system.
-] Once these connections are made, system shall be left energized and new audio/visual devices deactivated. Report immediately to the Contracting Officer, coordination and field problems resulting from the connection of the above components.

] 3.4 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section 07 84 00 FIRESTOPPING.

3.5 PAINTING

Paint exposed electrical, fire alarm conduit, and surface metal raceway to match adjacent finishes in exposed areas. Paint [junction boxes] [conduit] [and] [surface metal raceways] red in unfinished areas. Painting shall

comply with Section 09 90 00 PAINTS AND COATINGS.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

- a. Megger Tests: After wiring has been installed, and prior to making any connections to panels or devices, wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Test conductors with 300 volt rated insulation at a minimum of 250 VDC. Test conductors with 600 volt rated insulation at a minimum of 500 VDC. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.
- b. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer and test results recorded for use at the final acceptance test.
- c. Preliminary Testing: Conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests." After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- d. Request for Formal Inspection and Tests: When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests to the Contraction Officer.
- e. Final Testing: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the operation and maintenance (O&M) manuals are furnished to the Contracting Officer and the following are provided at the job site:
 - (1) The systems manufacturer's technical representative
 - (2) Marked-up red line drawings of the system as actually installed
 - (3) Megger test results
 - (4) Loop resistance test results
 - (5) Complete program printout including input/output addresses

The final tests shall be witnessed by the [[____] Division] [EFA [____]], Naval Facilities Engineering Command, Fire Protection Engineer. At this time, repeat any and all required tests at their discretion. Following acceptance of the system, deliver as-built drawings and O&M Manuals to the Contracting Officer for review and acceptance. In existing buildings, the

transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M manuals are received.

3.6.2 Minimum System Tests

Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

- a. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.
- b. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.
- c. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Test smoke sensors in accordance with manufacturer's recommended calibrated test method. Testing of duct smoke detectors shall comply with the requirements of NFPA 72.
- d. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.
- e. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.
- f. Determine that the system is operable under trouble conditions as specified.
- g. Visually inspect wiring.
- h. Test the battery charger and batteries.
- i. Verify that software control and data files have been entered or programmed into the FACP. Provide hard copy records of the software to the Contracting Officer.
- j. Verify that red-line drawings are accurate.
- k. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.
- l. Measure voltage readings for circuits to ensure that voltage drop is not excessive.
- m. Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke needed to activate the sensor. Conduct testing of smoke sensors using real smoke. The use of canned smoke is prohibited.
- n. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

3.7 INSTRUCTION OF GOVERNMENT EMPLOYEES

Equipment manufacturer shall provide 3 days on site [and 5 days of

technical training to the Government at the manufacturing facility.] Training shall allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises. [Include room and board costs for two Government personnel.] [Factory] training shall occur within [6] [12] [_____] months of system acceptance.

3.7.1 Instructor

Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm [and fire detection] system.

3.7.2 Qualifications

Each instructor shall be thoroughly familiar with all parts of this installation. The instructor shall be trained in operating theory as well as in practical O&M work.

3.7.3 Required Instruction Time

Provide 16 hours of instruction after final acceptance of the system. Give the instruction during regular working hours on such dates and times as are selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.8 OVERVOLTAGE AND SURGE PROTECTION

3.8.1 Power Line Surge Protection

Protect all equipment connected to alternating current circuits from surges per [IEEE C62.41.1/IEEE C62.41.2](#) B3 combination waveform and [NFPA 70](#). Do not use fuses for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

3.8.2 Low Voltage DC Circuits Surge Protection

All [IDC] [IDC, NAC, and communication cables/conductors], except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Protect equipment from surges per [IEEE C62.41.1/IEEE C62.41.2](#) B3 combination waveform and [NFPA 70](#). The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

3.8.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. Protect the circuit from surges per [IEEE C62.41.1/IEEE C62.41.2](#) B3 combination waveform and [NFPA 70](#). The surge protector/isolator shall be rated to protect the equipment.

3.9 GROUNDING

Provide grounding by connecting to building ground system.

3.10 SUPERVISING STATION PROVISIONS

[The proprietary type Supervising Station (PSS) is located [in building [____]] [____]] [The supervising equipment is existing and consists of the following brands and models: [supervising station control panel [____]] [____], [signal reporting components [____]], [annunciator [____]] [____]].

3.10.1 Revisions to Existing Facilities

Modify existing supervising components as indicated on the drawings and update programming if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that operation of existing equipment has not been degraded and that the revised configuration plus interfacing components operates compatibly with the new fire alarm system at the protected premises. Perform work on existing equipment in accordance with the manufacturer's instructions or under supervision of the manufacturer's representative.

3.10.2 Additions to Existing Facilities

Add supplemental components to the existing supervising equipment [as required to accommodate the new fire alarm system to be installed at the protected premises] [as indicated on the drawings]. Extend all present functions, including recording and storage in memory, and update programming if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that operation of existing equipment has not been degraded and that the expanded configuration operates compatibly with the new fire alarm system.

3.11 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. Perform the tests in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

NOTE: If the specified system is identified as critical, configured, or mission essential, use Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS to establish predictive and acceptance testing criteria, above and beyond that listed below.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

3.11.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to

functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. Conduct the megger test prior to the installation of fire alarm equipment. If deficiencies are found, make corrections and retest the system to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.11.2 Acceptance Test

NOTE: Listed tests are minimum required. If additional tests are required, such tests must be added to the list.

Do not perform acceptance testing until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault.
- k. Short circuit faults.
- l. Stray voltage.
- m. Loop resistance.

3.12 TRAINING

Provide training course for the operations and maintenance staff. Conduct the course in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of [1] [_____] training days (8 hours per day) and shall

start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of [2] [_____] training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the [operating and maintenance instructions](#). In addition, provide training on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least [1] [_____] training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

-- End of Section --