****

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-28 31 00.00 98 (August 2023)

Preparing Activity: NASA

Superseding
NASA/KSC-28 31 00.01 98 (September 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

****

SECTION 28 31 00.00 98

FIRE DETECTION AND ALARM
08/23

****

NOTE: This specification covers the requirements for fire-alarm and detection equipment.

Indicate on drawings:

a. Location and mounting height of manual alarm stations, control unit, remote annunciator, transmitter, detectors, notification appliances, and other interfacing controllers.

b.Automatic fire detectors coverage (heat detector, flame detectors, etc.).

c. Fire alarm Notification Appliances coverage, candela, and wattage ratings.

d. Boundaries and classifications of hazardous locations.

e. Fire alarm input/output matrix. Show sequence of operations of input devices on one axis and output functions on the other.

f. Show single riser diagram of the fire-alarm system including interlocking circuits to air-handling-unit and ventilating-fans and other auxiliary equipment. Each device on the riser should be identified by type. Indicate connection of equipment.

g. Interfaces with fire-protection systems

Utilize KSC STD-F-0004 as a design standard for the fire detection and alarm system, including any additional direction and guidance provided by the KSC AHJ, as applicable.

Point-to-point wiring is defined as wiring from field device with integral terminal strip to next device with integral terminal strip, wiring between

modules internal to fire alarm control panels (FACP), circuit terminations on terminal strips in fire alarm control panels and terminal boxes are equipment specific and will be provided by the fire alarm contractor as a Shop Drawing submittal.

Add to Section 01 11 00 SUMMARY OF WORK a description of the scope of the fire alarm work particular to this project.

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

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

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.

****

PART 1 GENERAL

1.1 REFERENCES

****

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

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

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

****

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44	(2019) Safety Code for Elevators and Escalators

COMPRESSED GAS ASSOCIATION (CGA)

KSC-STD-F-0004	(2016, Rev G) Standard for Fire Protection Design

FM GLOBAL (FM)

FM 3260	(2021) Radiant Energy-Sensing Fire Detectors For Automatic Fire Alarm Signaling
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD 8719.11	(2020; Rev B) Safety Standard for Fire Protection

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 75	(2020) Standard for the Protection of Information Technology Equipment
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 13	(2015) Power-Limited Circuit Cables
UL 38	(2008; Reprint Nov 2013) Manual Signaling Boxes for Fire Alarm Systems
UL 268	(2023) UL Standard for Safety Smoke Detectors for Fire Alarm Systems
UL 268A	(2008; Reprint Oct 2014) Smoke Detectors for Duct Application
UL 346	(2005; Reprint Sep 2019) UL Standard for Waterflow Indicators for Fire Protective Signaling Systems
UL 444	(2017; Reprint Jun 2021) UL Standard for Safety Communications Cables
UL 464	(2023) UL Standard for Safety Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 497B	(2004; Reprint Feb 2022) UL Standard for Safety Protectors for Data Communications and Fire Alarm Circuits
UL 521	(1999; Reprint Feb 2023) UL Standard for Safety Heat Detectors for Fire Protective Signaling Systems
UL 864	(2014; Reprint May 2020) UL Standard for Safety Control Units and Accessories for Fire Alarm Systems
UL 1424	(2015) Cables for Power-Limited Fire-Alarm Circuits
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL 1480	(2023) UL Standard for Safety Speakers for Fire Alarm and Signaling Systems, Including Accessories
UL 1711	(2006) UL Standard for Amplifiers for Fire Protective Signaling Systems, 4th Edition
UL 1638	(2023) UL Standard for Safety Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 2196	(2008) UL Standard for Tests for Fire Resistive Cables, 1st Edition
UL 1971	(2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

UL Fire Resistance (2014) Fire Resistance Directory

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project.

A "G" following a submittal item indicates that the submittal requires Government approval. Specification Editor is responsible for selecting items that require Government approval due to their complexity or criticality. 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.

An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING.

SD-02 Shop Drawings, SD-03 Product Data and Design Data (SD-05)are to be combined and submitted as one complete package. A Qualified Engineer provided by the Fire Alarm Contractor and independent of the design Architect & Engineer, reviews the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. Partial submittals and submittals not reviewed by the Qualified Engineer will be returned by the Government disapproved without review.

Submit the following in accordance with 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor's Certifications[; G] Submit to the Contracting Officer

for approval, prior to any work being started on the Fire Alarm System, in accordance with paragraph entitled "Qualifications".

SD-02 Shop Drawings

Connection Drawings[; G]

Site-Specific Software Programs[; G]

Fire Service Floor Plans[; G]

Floor Plan Drawings[; G]

Module Schematics[; G]

SD-03 Product Data

Where multiple types of the same item are required (Example: indoor, weatherproof, and explosion-proof types) provide separate Catalog Data for each type of device. Submit Manufacturer's Catalog Data for the following items:

Fire Alarm Control Panel[; G]

CRMS Reporting Equipment[; G]

Addressable Modules/Devices[; G]

Annunciator Panels[; G]

Heat-Actuated Detectors[; G]

[Flame Detectors][; G]

Smoke Detectors[; G]

Duct Smoke Detectors[; G]

Manual Alarm Stations[; G]

Horn/Strobe Combination Units[; G]

Strobe Units[; G]

Speakers[; G]

Fire Resistive Cables[; G]

Water Flow Alarm Devices[; G]

Valve Tamper Switches[; G]

Remote Auxiliary Control Relays[; G]

Power Source[; G]

Batteries[; G]

Line Voltage Surge Suppressors[; G]

Low Voltage Surge Suppressors[; G]

Wiring (Wire and Multi-Conductor Cable)[; G]

SD-05 Design Data

Voice Evacuation System[; G]

[Flame Detectors FOV][; G]

SD-06 Test Reports

Fire Alarm System Acceptance Test Procedures[; G]

CRMS Antenna Performance Test[; G]

Continuity Test Report[; G]

Insulation Resistance Test Report[; G]

SD-07 Certificates

NFPA 72 Record Of Completion[; G]

Verification of Compliant Installation[; G]

[Certificate of Training][; G]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals[; G]

Recommended Critical Spares List[; G]

[Special Tools][; G]

[Instruction of Government Employees][; G]

SD-11 Closeout Submittals

Record Drawings[; G] (As-builts after completion of the final acceptance test)

Fire Alarm System Acceptance Test Procedures[; G](with signatures)

Site-Specific Software Programs[; G](Record copy)

NFPA 72 Record of Completion Form[; G](with signatures)

1.3 GENERAL REQUIREMENTS

Related Specification Sections that apply to work specified in this section:

Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL
[Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS]
[Section 28 31 33.00 98 AIR SAMPLING DETECTION SYSTEMS (ASDS)]
[Section 21 13 00.00 98 FIRE SUPPRESSION SPRINKLER SYSTEMS]

[Section 21 13 26.00 98 DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS]
[Section 21 23 00.00 98 WET-CHEMICAL FIRE-EXTINGUISHING SYSTEMS]

1.3.1 Submittals Sequence

Submit submittals for approval in the following sequence with each approved prior to the next submittal.

1.3.1.1 Preconstruction Submittals

Submit the following submittals no later than [30] [_____] days after notice to proceed:

a. Contractor's Certifications

b. Product Data (Catalog Data)

c. Shop Drawings

d. Design Data

Combine and submit (b.), (c.) and (d.) above as one complete package.

1.3.1.2 Acceptance Test Procedures

Submit the following no later than [60] [_____] days prior to performing system tests:

a. Fire Alarm System Acceptance Test Procedures

1.3.1.3 Site-Specific Software Programs

Provide Fire Alarm Control Panel (FACP) [and network] Site-specific Software Programs and provide a copy to the Contracting Officer in accordance with owner's Representative (i.e., O&M System Engineer) instruction document titled Software Modifications Process for review, approval, and upload to the panel no later than [30] [ ] days prior to the scheduled preliminary test.

1.3.1.4 Preliminary Test Submittals

Submit the following submittals no later than 14 [_____] days prior to the scheduled preliminary acceptance test:

a. Fire Alarm System Preliminary Acceptance Test Procedures (Approved copy. Re-submit if approved test procedure was revised)

b. Site-Specific Software Programs (Approved copy. Re-submit if approved site-specific software was revised)

c. NFPA 72 Record of Completion (Draft form)

d. Verification of Compliant Installation

e. CRMS Antenna Performance Test(results)

Provide two completed sets minimum of the shop drawings and documentation above and make available for reference at the preliminary test.

1.3.1.5 Final Test Submittals

Submit the following submittals no later than [14] [_____] days prior to the scheduled final test:

a. Fire Alarm System Final Acceptance Test Procedures

b. NFPA 72 Record of Completion Form

Provide two completed sets minimum of the Shop Drawings and documentation above, completed Preliminary Test Documentation results and make available for reference at the final test.

1.3.1.6 Closeout Submittals

Submit the following submittals no later than [21] [_____] days after approved completion of Final Acceptance Test:

a. Operation and Maintenance Manuals

b. Recommended Critical Spares List

c. Record Drawings

d. Site-Specific Software Programs (Record copy)

e. Fire Service Floor Plans

f. Completed Fire Alarm System Acceptance Test Procedures (with signatures)

g. Completed NFPA 72 Record of Completion (with signatures)

h. [Special Tools]

i. [Instruction for Government Employees]

Include in this submittal .DWG or .DGN electronic computer format file of all the Record Drawings (As-builts)and Fire Service Floor Plans. Prepare and submit all drawings generated by computer aided design (CAD). Provide a complete copy of the Record Drawings (As-builts) and Fire Service Floor Plans in PDF format. Submit these items electronically or using a government approved method.

1.3.2 Documentation Requirements

Provide Installation shop drawings, record drawings, connection drawings, signed and sealed by a Qualified Engineer as defined in section 1.6 titled "QUALIFICATIONS".

Prepare all drawings generated by computer aided design (CAD) .DWG or .DGN electronic computer format file.

1.3.2.1 Shop Drawings

Include in Shop Drawings: Connection Drawings, Floor Plan Drawings, Module Schematics, Fire Alarm Control Panel (FACP), Sequence of Operations, Battery Calculations, Voltage Drop Calculations, and all other wiring

details required to fully document the completed system. After final testing is complete, submit Record Drawings including digital media and hard copies of all new and revised software, drawings, and analysis/calculations incorporating approved comments and any changes.

1.3.2.2 Connection and Floor Plan Drawings

Provide Connection Drawings consisting of point-to-point wiring diagrams and color-coding of internal and external wiring including, but not limited to, all fire alarm field devices, panel wiring, and interconnection between other building systems and components and the fire alarm system. Indicate wire label designations matching the field installation on these drawings.

Include in Floor Plan Drawings, device legend, equipment locations, device locations with address designation, heat detector spacing, notification appliances with signal circuit, with speaker wattage tap and candela rating, and conduit/wiring routing from the FACP(s) to all field devices. Also include typical mounting requirements for each type of initiation, signaling, notification appliance, and control device,[spaces/areas requiring voice intelligibility], floor plans drawn to scale, and ceiling heights. [Show validation and replication of actual Flame Detectors FOV (field of views), consisting of left and right horizontal axis and vertical axis on drawing for each detector. Map and use FOV drawn to scale. Indicate detector's sensitivity setting, fuel type selection, size of flame, and distance range on drawing. Show detector's location, angle alignment, mounting height, and aiming point/mark with clear dimensions from fixed and readily identifiable structural references on drawing.] Include riser diagram and sequence of operations in an input/output matrix format that clearly shows interaction of system components.

1.3.2.3 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings. Include in Record Drawings all data required to fully document the completed system. Prepare and submit all drawings generated by computer aided design (CAD) .dwg or .dgn. Provide a complete copy of the Record Drawings in PDF format. Submit the record drawing in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

Document final system configuration in Record Drawings including, but not limited to, geographic monitor zone boundaries, location of the FACP, all initiating and auxiliary control devices, signaling line devices, notification appliances, additional cabinets, water-based system riser, releasing control panel, smoke and fire dampers, magnetic door holders, and all other equipment associated with the fire alarm system(s). Also, annotate the location and address setting for each multiplexed addressable device (when used), deviations from and amendments to the record drawings, and field installation changes, concealed and visible.

1.3.2.4 Software Programs

Provide Site-Specific Software Programs, both hard copy in PDF format and compact disc media, for all new and/or existing programmable FACP(s) affected by the project. Provide system software executable file and source file, including all files and data to restore the system on the compact disc media. FACP program documentation to include system point summary, addressable device switch settings, and descriptive check boxes for program functions listed on paragraphs titled "FACP Functions". FACP

site-specific software program documentation to clearly show interaction of system components in accordance with the Fire Alarm Input/Output Matrix and Sequence of Operations included in design. Programming documentation specifically programming check boxes to be reviewed and approved by government prior to Final Acceptance Testing.

1.3.2.5 Fire Alarm System Acceptance Test Procedures

Conduct tests in accordance with approved Fire Alarm System Acceptance Test Procedures, and in accordance with the paragraph entitled "Field Testing" in this specification. Prepare a test procedure and test record form for conducting complete tests on control panels, reporting systems, wiring systems, and field devices installed in accordance with the manufacturer's requirements and these specifications. Identify each device and circuit to be tested in the test procedure, describe the initial condition, each step or function in the test, required test result, and equipment to be employed.

Test procedures are to be written to minimally disrupt facility operations and reduce the time required to receive signals at the Ground Support Fire Alarm (GSFA) console for KSC testing by not routinely transmitting repetitive signals, for example on site inspectors may observe relay operations that cause radio zones to transmit. Test procedure to detail how to minimize activation of evacuation notification appliances, AHU shutdown, etc. in support of testing requirements. Ensure test forms have suitable space for recording test results on all equipment, devices, and wiring to be tested. Provide test record forms with identified spaces for verification signatures of AHJ or designee, Owner's Representative (i.e., O & M System Engineer), and Contracting Officer or Designee.

1.3.2.6 Fire Service Floor Plans

Clearly indicate on Fire Service Floor Plans the location of the FACP, all initiating and auxiliary control devices, signaling line devices, notification appliances, additional cabinets, detection systems, releasing control panels, smoke and fire dampers, magnetic door holders and all other equipment associated with the fire alarm system(s). Show floor plan(s) drawn to scale. Also, annotate the location and address setting for each multiplexed addressable device (when used). Do not place borders or title blocks on the Fire Service Floor Plan. Where applicable, maximize viewing area by showing only a close-up view of all fire alarm devices and eliminating empty floor plan space. Provide uniform font size and line type styles throughout entire space. For multistory building, show all floor levels in single Fire Service Floor Plan to be located in the main floor level. Maximize the floor plan scale, device size, font size, close-up views, as required to obtain best result and generate a clear view of entire Fire Service Floor Plan. Provide a symbol legend, which clearly identifies each device shown on the Fire Service Floor Plan. Install a copy of the Fire Service Floor Plan, minimum size 457 mm by 610 mm 18 by 24 inch in a painted metal frame with a Plexiglas cover. Submit the floor plan and its location for approval, to the Contracting Officer, prior to installation.

1.3.2.7 Battery Calculations and Voltage Drop Calculations

Include Battery Calculations for the Fire Alarm and Detection Systems consisting of the battery capacity and loading calculations, including 20 percent safety margin on the shop drawing.

Include Voltage drop calculations for each notification circuit indicating that sufficient voltage is available for proper operation of the system and all components, at a minimum rated voltage of the system operating on batteries on the shop drawings.

1.3.2.8 Operation And Maintenance Manuals

Submit Operation and Maintenance Manuals. Bind information in manual format and group by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended test equipment, and safety precautions.

1.3.2.9 Recommended Critical Spares List

Submit Recommended Critical Spares List specific to the project. List to include critical spare parts and components recommended by the manufacturer to restore the system to operation in with minimal downtime and to be replaced after 1 year of service. Spare parts furnished must be directly interchangeable with the corresponding components of the installed system[s]. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Contracting Officer at the time of the Government testing and must be accompanied by an inventory list.

****

NOTE: Coordinate inclusion of the following bracketed paragraph with the Flame Detector requirements paragraph in this specification.

****

****

NOTE: Select the bracketed submittal paragraph if the design prepared under this project will be for installation of a new flame detector (make/manufacturer) other than Det-tronics, which is currently installed at KSC premises.

****

[1.3.2.10 Special Tools

Furnish special tools necessary for the maintenance and testing of the equipment to the Contracting Officer after completion of Government Testing. Provide test lamp, approved by manufacturer, for testing of new flame detectors.

]1.4 SYSTEM REQUIREMENTS

[Provide a new, complete fully addressable, modular type, microprocessor based, supervised, non-coded electrical][Modify existing]fire alarm system, as described herein and on the contract drawings, and in accordance with applicable requirements of NFPA 72, NFPA 70, NFPA 75, NFPA 90A, NFPA 101, KSC standards KSC-STD-F-0004 and NASA Standard NASA-STD 8719.11. Provide NFPA 72 Class A initiating device circuits, signaling line circuits, notification appliance circuits, and auxiliary control circuits, NFPA 72 Class B Central Radio Monitoring System (CRMS) circuits, and NFPA 72 Class X network reporting circuits. Ensure all Class A and Class X circuits use diverse routing in accordance with NFPA 72. Do not run the outgoing and return redundant circuit conductors in the same

cable assembly, enclosure, or raceway, except where permitted by NFPA 72.

Provide system complete and ready for operation. Electrically connect the fire alarm system to report alarm, trouble, and supervisory signals to the CRMS; to sound the general alarm continuously (where applicable); and to control auxiliary equipment such as dampers, air handling units, magnetic door latches, elevator recall, etc., upon operation of one or more initiating devices. For initiating, notification, signal, and auxiliary control circuits, use 24 V(DC).

Provide all equipment, cabinets, modules, devices, programming, circuits, conduits, testing and labor to meet the requirements of this specification.

1.5 QUALIFICATIONS

1.5.1 Qualified Engineer

Installations requiring completion of installation shop drawings and record drawings for fire alarm systems require signing and sealing by a qualified engineer. For the purpose of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:

a. A Registered Professional Engineer (P.E.) in fire protection engineering.

b. Registered Professional Engineer with verification of experience and minimum of five years of current experience in the design of fire alarm systems of similar complexity.

1.5.2 Installer

Installation of wire, cable, conduit, control cabinets, fire alarm terminal cabinets, and backbones for fire alarm components must be performed by Fire Alarm Installers. Licensed Electricians are allowed to be Fire Alarm Installers. [Fire Alarm Installer to be assisted by a Fire Alarm Technician.]

1.5.3 Technician

Installation and termination of fire alarm control panels, releasing panels, notification appliances, initiating devices, cabinets and modules must be performed by [NICET Level II certified] Fire Alarm Systems Technicians with a minimum of four years of experience. Fire Alarm SystemsTechnicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.5.4 Supervisor

****
NOTE: Select the Supervisor bracketed item based on complexity level of system installation.
****

Installation of the fire alarm control panels and releasing panels must be supervised by a [NICET Level III certified] Fire Alarm Systems Technician with a minimum of 8 years of experience [who will be on-site to supervise

all activities, from pre-construction to install.]. The Fire Alarm SystemsTechnicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.5.5 Test Personnel

Testing and certification of fire alarm systems must be performed by a [NICET Level III certified] Fire Alarm Systems Technician with a minimum of 8 years of experience. The Fire Alarm Systems Technicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.5.6 Manufacturer's Representative

The fire alarm control panel and releasing panel equipment Manufacturer's Representative must be present for the connection of wiring to the panel. The Manufacturer's Representative must be an employee of the manufacturer with necessary technical training [NICET Level III] on the system being installed or certified by the manufacturer with necessary technical training on the system being installed.

1.5.7 Manufacturer

Components must be of current design and be 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 the most current version of NFPA 72, except as otherwise or additionally specified herein.

[1.5.8 Certified Flame Detector Specialist

Provide on-site services of a manufacturer's certified representative, to supervise installation, adjustments, and tests of the flame detection system. Manufacturer's certified representative involved with designing and installation of flame detection system shall have a minimum of three (3) years experience in the installation of flame detection system, holding a valid Laser Aimer Certificate of Training, by manufacturer as being trained and certified to model, design, install, program, and test the multi-spectrum IR flame detector field of view coverage. Provide evidence of experience and of the equivalent certification and the basis of certification to the Contracting Officer for approval.

]PART 2 PRODUCTS

2.1 FIRE ALARM CONTROL PANEL

Provide fully addressable Fire Alarm Control Panel (FACP), of modular construction with solid state, microprocessor-based electronics. Provide a control panel that complies with the applicable requirements of UL 864 and suitable for use with fire alarm devices specified in this specification. Include non-volatile programmable operating system memory for all operating requirements in the panel. Ensure control unit provides power, supervision, control, and logic for the entire system. Program FACP in accordance with fire alarm input/output matrix and sequence of operations in contract drawings or specified herein. Provide visual annunciation for a LED or LCD visual display as an integral part of the control panel and identify with a word description and ID number each device. Addressable components are to include, but not be limited to, addressable monitor

modules, control modules, signal modules, and addressable input/output relays. Equip modules with transient surge suppression. Provide visual indication of alarm, supervisory, or trouble initiation on the FACP is by LED or LCD. Provide panel with supervisory functions for power failure, internal component placement, and operation. Ensure control unit is suitable for operation on a 60 hz, 120 V (AC) building power supply.

Wiring for fire alarm control panel must meet resistance, capacitance, and length in accordance with the manufacturers circuit type wiring requirements.

[Provide FACP UL listed or FM approved and rated for service as a releasing panel. Ensure FACP includes all components and modules required to electronically activate fire [suppression] [extinguishing] systems.]

[2.1.1 New and Retrofit Facilities FACP

****
NOTE: Select the following paragraph for new FACP installation where a new fire system is being installed to replace the existing Simplex or Siemens fire system (obsolescence, beyond its life expectancy, fails to meet current needs, upgrade that would require the entire existing system to be brought up to current code, etc.)
****

Provide an addressable NOTIFIER FACP, or approved equivalent.

][2.1.2 Existing Facilities FACP

****
NOTE: Select the following paragraph for existing Simplex or Siemens FACP modification where the existing Simplex or Siemens fire system is being reconfigured or expanded (within its life expectancy, no obsolescence).
****

For upgrades or expansion of existing Fire System, equipment and devices must be compatible and operable with the existing building fire alarm system. Equipment must not impair reliability or operational functions of the existing system. The existing FACP is a [make, model number].

Ensure new components are compatible with, and UL listed for use with remaining FACP.

]2.1.3 FACP Functions

2.1.3.1 Indicator Lights and Switches

Ensure (FACP) contains power-on, alarm, supervisory, and trouble indicating lights plainly visible when the cabinet is closed; and also contains the following functions accessible only by unlocking and opening the unit:

a. Alarm Silence - Audible and visual notification appliances will deactivate upon a silence signal from the FACP. When the notification appliances have been silenced, ensure subsequent alarms reactivate

them.

b. Power On-Off (If standard by the manufacturer)

c. Supervisory/Trouble Acknowledge - Ensure that supervisory and trouble acknowledge switches silence the supervisory and trouble audibles in the panel, but not extinguish the visual indicator. This switch must be overridden upon activation of a subsequent supervisory or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated if the supervisory or trouble condition still exists.

d. Auxiliary Devices Maintenance Disable - Include maintenance disable switches for all auxiliary control devices in the FACP. Ensure disable switches are supervised to report supervisory signal when in the maintenance (disable) position. Provide switches used for disable functions which are either toggle or soft key type, and listed for use with the control panel. In addition, provide each switch with a positive visual indication to show the function is ON.

e. System Reset - Provide alarm, supervisory, and trouble reset switches which reset a cleared device in alarm, supervisory, or trouble condition. Ensure alarm signal does not self-restore without activating the switch. Ensure programmable capability to automatically clear a trouble or supervisory condition when the problem causing the trouble or supervisory is corrected.

2.1.3.2 Software Requirements

Unless otherwise specified, the following operating parameters will be incorporated in the system configuration software:

a. Time will be displayed in 24-hour format.

b. Time and date must be automatically set.

c. Temperature will be displayed as degrees Fahrenheit.

d. Local mode will not be used.

e. Service reset and combined alarm/hardware reset will be employed.

f. Audible notification will be temporal mode.

g. Ensure there is no alarm cutout or silence/reset inhibit used.

h. Ensure no active signal reminders are used.

i. All operator actions except "silence", "system reset", "acknowledge", and "display time" must require passcode for access.

j. Default passcodes can be used and are acceptable

k. Ensure all ceiling smoke detectors to operate as "verified" smoke detectors.

l. After all active troubles are acknowledged, additional troubles must retransmit a trouble signal to CRMS where software permits.

m. AC power failure and card failure troubles must transmit a separate trouble signal when possible.

n. Remote annunciators panels will only display alarm, priority 2, and supervisory signals. Trouble signals will be displayed only at the main control unit.

o. Visual notification appliance must be silenced at the same time as the audible notification devices.

p. Automatic self-test routines must be performed on heat detector that will functionally check detector sensitivity electronics and ensure the accuracy of the value being transmitted. Any detector that fails this test must indicate a trouble condition with the detector location at the control unit.

q. Automatically adjust/set analog type smoke detector's sensitivity to compensate environmental changes meeting UL listed calibrated sensitivity requirements per NFPA 72. When the limits of this compensation are reached, a "trouble" signal must be initiated.

2.1.3.3 Alarm

Ensure FACP contains all components necessary to monitor and supervise all initiating device circuits, and when any detector, manual alarm station (pull box), water flow switch, pressure switch, etc., connected to the fire alarm control panel is activated, the control panel's visual alarm, alarm indicator and audible signal are activated. This causes all notification appliances to be activated, where applicable, including all associated auxiliary control functions. Verify that the control panel visually indicates the addressable device or zone in alarm and transmits an alarm condition to the remote Central Radio Monitoring System.

2.1.3.4 Supervisory

Ensure that the FACP contains all components necessary to monitor and supervise all supervisory device circuits. Verify that when any valve tamper switch, low air pressure switch, water level indicator, panel maintenance disable functions, or other supervisory device connected to the control panel is activated, the control panel supervisory visual indication and supervisory audible device is activated; and that control panel visually indicates the addressable device or zone in supervisory alarm and transmit a supervisory condition to the remote Central Radio Monitoring System.

2.1.3.5 Auxiliary Devices

Provide FACP with all components necessary to operate and supervise the circuits for annunciator panels indicated, auxiliary power supplies indicated, and auxiliary devices controlling equipment such as ventilating fans, air handling units, fan coil units, damper motors, solenoids, magnetic door holders, and elevator recall. Ensure circuits for auxiliary control relays are supervised to within 0.91 m 3 feet of the device to be controlled in accordance with NFPA 72.

2.1.3.6 Trouble

Provide panel which monitors and reports any trouble open supervised circuits, ground faulted supervised circuits, removal of detector or

device, removal or failure of control panel module, maintenance disable switch activated, loss of primary power, power supply trouble, low battery voltage, loss of battery voltage, and activation of the alarm silence switch. Ensure all trouble signals are identified by initiating, notification appliance, auxiliary control, or signaling line circuit; and that trouble signals activate the control panel trouble visual indication and trouble audible devices, and send a trouble signal to the remote Central Radio Monitoring System.

[2.1.3.7 Voice Evacuation

Include in FACP a voice evacuation system with all components and modules required for a [single] [multiple] channel audio signaling system distributed over [8] [_____] audio signaling device circuits, capable of accurately reproducing horn, bell, chimes, or slow whoop tones and pre-programmed voice messages for [staged] building evacuation. Include audio amplifier input with a dedicated power supply, with a primary power input of 120 V(AC) and a battery backup input of 24 V(DC). Ensure audio amplifier output is a minimum 100 watts at [25][75] VRMS. Locate a microphone and 102 mm 4 inch speaker at the control panel for fire fighter paging and monitoring. Include in audio system controls switching with visual indication for localized facility-wide paging announcements. [Provide voice messages in English language, followed by temporal threetones in accordance with NFPA 72. Intelligibility testing of the System must be accomplished in accordance with NFPA 72 and KSC-STD-F-0004 for Voice Evacuation Systems. Use commercially available test instrumentation to measure intelligibility as specified by NFPA 72 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.]

]2.1.4 FACP Contacts

Provide FACP with an individual set of Form C dry contacts which activate for alarm, trouble and supervisory conditions for connection to the Central Radio Monitoring System (CRMS). Provide additional other fire monitoring or special function relay contacts as indicated.

Ensure all relays are continuous duty and have self-cleaning contacts of silver or an alloy of equivalent performance and are suitably protected against dust by individual covers. Provide all relays with external functions, control device activation, and notification appliance activation, with at least one set of spare contacts. Permanently mark relays with the coil resistance, operating-current range, and internal pin connections using standard pin numbers.

2.1.5 FACP Cabinets

Install a separate terminal cabinet adjacent to the FACP for interfacing device field wiring to the control panel. Install addressable module cabinets to house multiple modules. Install terminal strips for all field wiring circuits plus 25 percent spare. Where a terminal cabinet is installed, install terminal strips to accommodate remote reporting circuits and associated surge suppressors. Provide copper ground bus within this terminal cabinet for termination of equipment ground conductors. Ground/bond enclosures and surge suppressors in accordance with NFPA 70 and manufacturer's instructions.

Provide steel FACP, terminal cabinets, addressable module cabinets, surge suppression cabinets and battery cabinets (when used), with a hinged cover

and an integral pin-tumbler cylinder lock (mortise or standard rim cylinder from Best Access Systems) with removable core that accepts the key presently in use with other control units existing in the area. Lock core will be provided by the government. Cabinet must be large enough to accommodate all components and also to allow ample gutter space for interconnection of control units as well as field wiring, factory painted with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat unless otherwise indicated.

2.1.6 FACP Power and Batteries

Ensure primary power to the local fire alarm systems for all purposes, including separately powered notification appliances and initiating devices, is 120 V (AC), 60 hertz. Ensure fire alarm system operates satisfactorily between 85 and 110 percent of normal voltage. Provide fire-alarm-system disconnect/protective device as a fused switch with factory painted red finish coat. Mount this disconnect fused switch adjacent to the main FACP and, where applicable, to auxiliary/supplemental fire alarm system panel(s). Mark as FIRE-ALARM DISCONNECT FED FROM (indicate supply circuit) with 1/2-inch high letters in white paint or engraved phenolic identification plates fastened with sheet metal screws. Ensure switch is capable of being locked in the "on" or "off" position, a feature which can not interfere with the circuit protection capability of the device. Equip switch with surge suppression for all phase and neutral conductors. Install current limiting Class RK1 fuses properly sized to protect the fire alarm equipment.

Provide all FACPs and auxiliary power supplies units with a DC power input and with a DC disconnect switch integral with the equipment provided (1P switch), or provide a separate safety switch. If supplied within the cabinet, ensure the power on-off switch disconnects all power sources to the control panel. Provide the on-off switch with DC rated contacts.

Provide the means of automatically supplying the entire fire alarm system with backup power with batteries, charger, and power transfer equipment alarm system with battery backup power in event of a primary power system failure. Ensure system switches to battery power in event of AC power failure, and switches back to AC power upon return of primary power. Transmission of loss of AC power trouble signal to be delayed by a minimum of [60] minutes. Ensure control panel(s) and auxiliary power supplies are able to operate when the backup batteries are disconnected for any reason. Also ensure system controls charging currents and floating voltage levels to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Fuse wiring to protect against battery over-current and polarity reversal. Confirm primary power, battery, or charging equipment failure results in a FACP trouble signal and visual indication.

Provide lead-acid, sealed batteries to prevent any corrosive fumes. Provide batteries listed for fire alarm service and suitable for high discharge currents required under alarm conditions. Size batteries to operate the fire alarm and detection system (including voice evacuation system and flame detectors, where installed), in normal supervisory condition for [24] [48] [72] hours, minimum, then operate the system in the alarm mode for [5] 10 [15] [_____] minutes, minimum in accordance with NFPA 72.

2.2 CRMS REPORTING EQUIPMENT

[2.2.1 Radio Based FACP Reporting

[Provide a new, complete][Modify existing] Keltron Corporation UL 864 Listed Radio Fire transceiver [Model 778F] with minimum eight 8 supervised zones and a Keltron Corporation UL Listed DataTap FACP Interface [Model 95K3222], with removable BEST core that accepts the key presently in use with other control units existing in the area. Lock core will be provided by the government.

Point-specific event information captured by FACP is required for reporting, install a Keltron Corporation UL Listed DataTap FACP Interface [Model 95K3222] and coordinate programming with Owner's Representative (i.e., O & M System Engineer). Provide a panel RS-232 Interface Module and configure serial data port connections as indicated per manufacturer's instructions and recommendations. Provide UL listed, copper, twisted pair RS-232 wiring size of not less than 0.8mm2 No. 18 AWG diameter with an insulation rating of not less than 300 volts. Use shielded, twisted pair cable where recommended by the manufacturer. Ensure cable is listed as Type [CMP][FPLP][for fire alarm applications]

Power transmitters by a combination of locally available 60 hz 120 V AC, and sealed lead-acid type batteries. Provide dedicated electrical circuit for CRMS with surge protection, circuit may be shared with the FACP. The battery package shall be capable of supplying all the power requirements for a given transmitter. Radio fire alarm transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of [24][60] hours and shall be capable of transmitting alarms during that period. Submit substantiating battery calculations for supervisory and alarm power requirements.

Provide separate enclosure(s) as required for 60 hz 120 V(AC) power supply components (receptacle and plug-in step-down power transformer). Provide AES Corporation [Model 1640-ENCL] radio transformer enclosure and secure [Model 1640] transformer to receptacle with the screw provided. Provide factory painted with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat on all enclosures unless otherwise indicated.

The radio frequency (RF) power output of each transmitter shall be sufficient for reliable alarm reporting. The antenna system and cabling shall be furnished to provide adequate system gain. Each transmitter shall transmit a distinct identity code number as part of all signals emanating from the transmitter.

Provide a Metz antenna [Model 217] omnidirectional with a driving point impedance to match transceiver output (SWR 1.5:1 or less). Provide at least two RF pathways across the mesh radio network to the Central monitoring station to comply with NFPA 72. Antenna lightning protection, surge protection, and grounding requirements shall comply with NFPA 70, NFPA 780, and as described on the contract drawings.

]2.3 ADDRESSABLE MODULES/DEVICES

****
NOTE: Select and edit paragraphs as necessary for the multiplex system designs only.
****

Provide solid-state addressable modules compatible with the FACP. Provide modules which are suitable for individual outlet box mounting or group mounting within a control enclosure.

Provide field addressable modules to individually communicate with the FACP using multiplexed communication techniques. Provide communication circuit wiring connections suitable for supervised Class A operation. Derive module power from the communication circuit or 24 V(DC) power supply supervised by the FACP. Ensure invalid address setting, component failure, or power failure initiates a trouble signal at the FACP.

Provide supervised addressable modules for initiation circuits, Class A type, unless otherwise indicated. Two-wire Class B modules are acceptable when installed in the same box or enclosure as the connected initiating device.

Provide supervised addressable modules for notification appliance circuits with parallel wired Class A type unless otherwise indicated. Ensure module is suitable for use with all notification devices types and relays.

Provide addressable relay modules for control and/or remote reporting circuits (addressable relays), including 2 separate fused Form-C contacts rated at 2 Amperes for 28 V(DC) or 120 V(AC).

[Provide addressable modules for [suppression] [extinguishing] system releasing service which are UL listed for use with the fire alarm control panel and the releasing device [valve] [_____]. Include in module all necessary circuitry to supervise the system release device coil.]

2.3.1 Addressable Module Boxes and Enclosures

Install outdoor modules in NEMA 250 [Type 4X] [Type 3R] [stainless steel] rated enclosures.

Provide manufacturer's standard outlet box for enclosure housing a single isolated module (not grouped with other modules or no other modules nearby).

Provide enclosures housing more than one addressable module with hinged door type with back panel for module mounting. Provide hinged cover(s) with an integral pin-tumbler cylinder lock (Mortise or Standard Rim Cylinder from Best Access Systems) with removable core that accepts the key presently in use with other fire alarm control units at KSC; lock core will be provided by the government. Provide adequately sized enclosure to allow a minimum of50.8mm 2-inch wiring space for all module termination points. Provide additional spare space for [2] [_____] future modules. Provide terminal strips for interfacing all module connections to field wiring. Provide factory painted enclosures with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat unless otherwise indicated. Provide enclosures with an engraved phenolic nameplate which reflects the cabinet designation as shown on the contract drawings.

2.4 ANNUNCIATOR PANELS

Provide LCD alphanumeric type annunciator compatible with and supervised from the FACP, with an operating power supply of 24 V(DC). Provide yellow lamp color for trouble/supervisory and red for alarm; also provide a test

switch for testing all lamps. Provide each lamp with a nameplate, with zone and function identified for all lamps.

The display must indicate the device in alarm or supervisory and show the device name, address, and building location. Program annunciator to annunciate only alarm and supervisory signals; annunciate trouble signals only at the main FACP.

Provide LED type graphic annunciator panels where indicated. Include laminated area display to indicate location and condition (trouble and alarm) of devices connected with annunciator panels.

Provide terminal strips suitable for 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors for all annunciator panel wiring connections.

Mount annunciator panels in manufacturer required enclosures. Provide hinged cover with an integral pin-tumbler cylinder lock (Mortise or Standard Rim Cylinder from Best Access Systems) with removable core that accepts the key presently in use with other fire alarm control units at KSC; lock core will be provided by the government.

2.5 HEAT-ACTUATED DETECTORS

Provide alarm-initiating heat-actuated detectors, listed for use with the FACP in accordance with UL 521.

[Provide heat detectors which are individually addressable by connection to addressable modules. Provide addressable modules in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.]

[Provide analog addressable heat detector with base including circuitry and user selectable switching required for assigning each detector a unique address on the FACP communication bus. Verify invalid address switch settings or component failure initiates a trouble signal at the FACP. Provide detector head which plugs into a separate receptacle type base wired to the FACP signaling line circuit which powers and monitors the detector. Provide supervised base which initiates a trouble signal at the FACP if the detector is removed.]

Provide detectors with a set of normally open contacts that close to initiate an alarm, with wiring connections which are for supervised Class A operation, and made with terminal blocks capable of accepting 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors. Provide detectors with a LED indicator light which gives a visual indication when the detector initiates an alarm. Ensure all components of the detectors are rust and corrosion resistant.

Ensure activation of detector causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

In areas subject to moisture or exterior atmospheric conditions, provide only detectors that are UL listed or FM approved for use in those locations.

Ensure enclosures and detectors mounted in hazardous locations conform to the requirements of Underwriter's Laboratory (UL) or Factory Mutual (FM) for the hazardous location classification indicated. Provide conduit

seal-off fittings suitable for the hazardous location classification at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.5.1 Combination Fixed-Temperature and Rate-of-Rise Detector

Detectors must be self-resetting. Detector must operate at [57.2][68][88] degrees C [135][155][190] degrees F. Detector must feature rate of rise operation between 8.33 and 13.88 degrees C 15 and 25 degrees F.

2.5.2 Fixed Temperature Detector

Detectors must be self-resetting. Detector must have a specific temperature setting of [57.2][68][88] degrees C [135][155][190] degrees F.

Provide heat-actuated detectors in elevator shafts and machine rooms in accordance with ASME A17.1/CSA B44 and NFPA 72.

2.5.3 Line-Type Fixed Temperature Heat Detector

Provide [thermostatic] or [thermistor] line-type heat detection cable where indicated, with cable nominally rated for a temperature of 138 degrees C 280 degrees F and operational on a fixed temperature principle only.

Ensure Linear Heat Detector can distinguish when a physical damage condition and an alarm condition are present.

2.5.4 Rate Compensating Heat Detector

Provide hermetically sealed, automatically resetting type detectors which operate when ambient air temperature reaches detector setting, regardless of rate of temperature rise or subject to thermal lag.

2.6 FLAME DETECTORS FOV

****
NOTE: Edit paragraphs as necessary for flame detection characteristics.
****

2.6.1 Multi-spectrum Infrared (IR) Flame Detectors

Provide FM approved multi-spectrum IR flame detectors, incorporating all sensory, signal processing, and alarm system interfacing components, sensitive to the IR radiation range best suited for their intended use. Ensure detector logic requires IR signal from three (3) sensors present in the proper spectral signature, as emitted by a [hydrogen] [hydrocarbon] flame and retains alarm-initiating capability in the presence of modulated false alarm sources. Ensure detector is not activated by single sources of UV and IR radiation including sunlight (direct, intermittent, or reflected), quartz halogen lighting, electric discharge lighting, arc welding, lightning, radiant heat, hot engine exhaust, heating coils, etc., as well as being immune from radio frequency interference and electromagnetic frequency interference. Detectors using guard band technology are not acceptable.

Ensure detector has a minimum field of view of 90 degrees along the horizontal axis and 75 degrees along the vertical axis, and is capable of

detecting a [_____] fuel type and minimum [____] size at a specific [_____] distance from its axis in accordance with its design FM 3260 approval performance criteria. Ensure detector response time is selectable to 500 msec with typical response under 5 seconds for initiating fire signal, and includes self-diagnostic features to monitor its sensors, power source, and internal circuitry.

Detectors must operate over electrically supervised wiring circuits and the loss of power to the detector must result in a trouble signal. Provide a detector which incorporates separate single pole, double throw (SPDT) alarm and trouble contacts rated 5 amperes minimum at 30 V(DC), with alarm contacts which activate upon fire detection and are programmable for latching or non-latching operation; program for non-latching operation unless otherwise indicated. Ensure cycling detector power or momentarily (10ms) activating the manual test line resets latching alarm contacts. Provide non-latching trouble contacts which activate upon loss of unit power or internal diagnostic failure. Provide wiring connections for all contacts suitable for Class A wiring and made on screw terminals capable of accepting 0.8 mm through 3.0 mm2 No. 18 through No. 12 AWG solid copper conductors. Ensure detectors are individually addressable for alarm and trouble conditions by connection to addressable modules. Provide addressable modules in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Ensure activation of detector causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Power detector from a 24 V(DC) source. Where a power source other than the FACP is used, ensure the power source is UL 864 listed, and incorporates power supply, battery backup, and power transfer equipment in accordance with the paragraph entitled, "Fire Alarm Control Panel," of this section. Ensure detector power wiring connections are made on screw terminals suitable for No. 16 through 5.0 mm2 No. 10 AWG diameter solid copper conductors.

Ensure enclosures and detectors mounted in hazardous locations conform to the requirements of Underwriter's Laboratory or Factory Mutual for the hazardous location classification indicated. Install conduit seal-off fittings suitable for the hazardous location classification at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70. Provide stainless steel, rated NEMA 4X enclosures, and include threaded conduit connection. Mount enclosure on a stainless steel swivel base, which allows 180 degree horizontal and vertical rotation from the pivot point.

[A self-test feature must be provided for each detector to be individually tested. Provide detector with an automatic calibrated integral optical integrity test feature, automatically performs a test, at minimum once per minute, and generate a fault condition when 50 percent of the detection range is lost (optical contamination, etc.) and do not generate an alarm when more than 50 percent of the detection range is retained.]

Provide a manual remote test capability for each flame detector from the addressable FACP. Ensure the test is activated, manually or when the addressable control module is activated from the FACP. Ensure activation of the control circuit via the addressable control module causes all the associated flame detectors to go into an alarm condition. Also ensure that when the test switch is restored to its normal position all the affected

flame detectors self-restore. Ensure flame detector can be tested by use of an external IR test lamp and by use of placing a magnet at the detector.

2.7 SMOKE DETECTORS

Provide analog addressable photoelectric alarm initiating smoke detectors designed for use with automatic/manual fire alarm systems in accordance with UL 268.

Provide [2.5] [_____] percent per foot nominal obscuration (photo-electric) type smoke detectors, listed for use with FACP installed, including all required accessories, rust and corrosion resistant. Ensure detector head is a plug-in unit, that detector contains no moving parts, nor requires readjustment or removal to resume normal operation after an alarm. Provide all detector openings with screen to prevent the entry of insects and debris.

Provide detector head that plugs into a separate receptacle type base wired to the FACP signaling line circuit which powers and monitors the detector. Provide detectors with a set of normally open contacts that close to initiate an alarm, wiring connections which are for supervised Class A operation, and base screw terminals suitable for 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors for all wiring connections required. Ensure base is supervised to initiate a trouble signal at the fire alarm control panel if the detector is removed, and a light emitting diode indicator to provide a visual indication when the detector initiates an alarm.

Ensure activation of detector causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Provide detectors in areas subject to moisture or exterior atmospheric conditions that are UL listed or FM approved for such locations.

2.7.1 Duct Smoke Detectors

Provide analog addressable alarm-initiating duct-mounted smoke detector designed for use with automatic/manual fire alarm systems in accordance with UL 268A.

Provide addressable type duct smoke detectors connected to an addressable FACP, unless otherwise indicated, with the ability to perform sensitivity testing from the FACP in accordance with NFPA 72.

Detectors must be listed for operation over the complete range of air velocities, temperature and humidity expected at the detector when the air-handling system is operating. Provide photoelectric type duct smoke detectors listed by UL Fire Prot Dir or FM APP GUIDEFM Approval Guide, including duct housings, mounted exterior to the duct, and perforated sampling tubes extending across the width of the duct. Ensure activation of duct smoke detectors causes shutdown of the associated air-handling unit in accordance with NFPA 90A, annunciation at the FACP, and transmits a silent alarm to the Central Radio Monitoring Station but does not activate the building evacuation notification appliances. Provide a single maintenance by-pass switch to isolate each air handling unit's duct smoke detectors.

Ensure activation of any maintenance by-pass switch inhibits reporting and

causes a supervisory condition at the FACP, and when the maintenance by-pass switch is restored to its normal configuration, the supervisory signal at the FACP self-restores. Where duct smoke detectors are installed outdoors, in unconditioned mechanical or electrical rooms, or in areas with high ambient temperatures and humidity, or in high ambient temperature areas, install the detector housing in an additional PVC enclosure with an additional set of supply and exhaust sampling tubes to prevent condensation from forming within the detector housing.

Provide duct smoke detectors with terminals suitable for Class A wiring powered from the panel alarm initiation or communication bus circuit; separate power sources are not acceptable.

Install a separate remote indicator for each duct smoke detector. Indicator must consist of LED lamp with a key test switch type. Where multiple duct smoke detectors are installed, group the remote indicators together at a common location.

2.8 MANUAL ALARM STATIONS

Provide non-coded, single action, addressable manual alarm stations designed for use with automatic/manual fire alarm systems in accordance withUL 38.

Ensure wiring terminals are suitable for Class A wiring and capable of accepting 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors. Make manual alarm stations individually addressable by connection to addressable modules, provided in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Ensure activation of manual pull station causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Ensure manual alarm station door has a protected, pull-down operating lever with recessed finger grip. When operated, ensure the station mechanically latches, closes single pole contacts, and locks the contacts in the operated position until reset. Provide manual pull stations that are toggle switch type with terminal board. Stations with a pushbutton which depends upon a spring-loaded device to close the contacts when the handle is pulled are not acceptable, nor are stations which are resettable without the use of a key or tool.

Provide factory painted red finish coat pull station made of impact resistant, durable polycarbonate or cast metal construction. Provide identification and directions for operating fire-alarm stations on the cover in raised or depressed white-enameled letters.

Furnish surface-mounted stations with matching factory painted red finish coat durable polycarbonate or cast-iron back boxes with top and bottom threaded-conduit connections. For stations mounted outdoors, provide weatherproof type, with a neoprene gasket, and protect against corrosion.

For hazardous locations, provide manual pull stations that are UL listed, FM approved, or approved by a recognized testing laboratory for the hazardous location classification indicated. Ensure unit consists of a complete manufactured explosion-proof manual pull station assembly. Provide conduit seal-off fittings suitable for the hazard classification at each conduit connection to the explosion-proof enclosure in accordance

with NFPA 70.

2.9 HORN/STROBE COMBINATION UNITS

Audible appliances must conform to the applicable requirements of UL 464. Appliances must be connected into notification appliance circuits. Horns must be [semi-flush mounted][surface-mounted, with the matching mounting backbox surface mounted vibrating type suitable for use in an electrically supervised circuit]. [Multitone]horns must produce a sound rating of at least 85 dBA at3.1 meters 10 feet.[Horns used in exterior locations must be specifically listed [weatherproof] or approved for outdoor use and be provided with metal housing and protective grilles.][Horns must be explosion proof].

Where horns and strobes are provided in the same location, they may be combined into a single unit.

2.10 STROBE UNITS

Provide strobe units designed for use with automatic/manual fire alarm systems, in accordance with UL 1971, UL 1638, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA).

Provide UL listed or FM approved strobe units including factory painted red finish coat housing made of impact resistant polycarbonate or cast metal, clear high intensity optic lens with white "FIRE" lettering on two sides, and a xenon flash tube or light emitting diode (LED) with solid state circuitry. Ensure unit brightness candela rating is set in accordance with NFPA 72, producing a minimum flashing frequency of 1 Hz and a maximum of 2 Hz. Provide a [multiple-candela][fixed candela (as described on the contract drawing)] type strobe. Synchronize strobes in accordance with NFPA 72.

Addressable strobes are not acceptable.

Ensure visual notification appliance circuits have sufficient capacity to operate all devices connected.

Provide units which operate from polarized 24 V(DC), Class A, parallel wired supervised notification appliance circuits, and capability of operating over a 20 percent variation in nominal input voltage. Ensure wiring connection screw terminal blocks are suitable for 1.0 through 3.0 mm2 No. 16 through No. 12 AWG diameter solid copper conductors.

Provide [semi-flush mounted][surface-mounted, with the matching mounting backbox surface mounted type] units. Provide weatherproof units with a neoprene gasket, protected from corrosion, in exterior or wet locations.

If mounted in hazardous locations, provide strobes UL listed or FM approved for the hazardous location classification indicated. When the unit is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.11 SPEAKERS

Provide speakers UL listed or FM approved for audible signal use, designed for use with automatic/manual fire alarm systems in accordance with UL 1480 and UL 1711, capable of clearly reproducing voice messages and horn,

bell, chime, or slow whoop tone sin a three-pulse temporal pattern over a 400 to 4000 Hz range. Ensure speaker output at 1000 Hz for 1-watt input power is no less than 87 dB at 3.04 m 10 feet.

Provide Notification Appliance mechanism consisting of sealed speaker and multiple-tap impedance matching transformer suitable for 24 V(DC), Class A parallel-wired, supervised audio signaling systems. Include with transformer settings 0.25, 0.5, 1.0, and 2.0 watt taps unless otherwise indicated. Ensure Wiring connections for 4 wire operation are screw terminals suitable for 1.0 through 3.0 mm2 No. 16 through No. 12 AWG diameter conductors.

Provide factory painted red finish coat speaker housings made of impact resistant polycarbonate or cast metal construction. Mount flush mounted interior speakers using standard electrical back boxes. Mount surface mounted speakers using factory painted red finish coat cast iron or cast aluminum boxes with threaded conduit hubs. If mounted in exterior or wet locations, provide weather-proof type with a neoprene gasket, protected from corrosion.

Ensure strobe portion of a combination audible/visual notification appliance is in accordance with the applicable provisions of the paragraph entitled, "Strobe Units," of this section.

If mounted in hazardous locations, provide speakers UL listed or FM approved for the hazardous location classification indicated. When the unit is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.12 WATER FLOW ALARM DEVICES

Provide alarm-initiating water flow devices designed for use with automatic/manual fire alarm systems, in accordance with UL 346, conforming to UL or FM requirements for the particular type of sprinkler system being specified.

Ensure contact have a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC). Make water flow devices individually addressable by connection to addressable modules, and provide in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Ensure activation of device causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Operation of a sprinkler waterflow switch serving an elevator machinery room or elevator shaft must operate shunt trip circuit breaker(s) to shut down power to the elevator(s) in accordance with ASME A17.1/CSA B44/CSA B44.

Provide weatherproof and corrosion protected flow devices for outdoor installations. If installed in hazardous locations, provide water flow devices UL listed or FM approved for the hazardous location classification indicated. When the switch is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.12.1 Pressure Switch

Wire alarm pressure switch to make or break an alarm circuit depending on rise or fall of water pressure.

2.12.2 Vane-Type Flow Switch

Provide vane-type alarm flow switch which makes or breaks an alarm circuit upon deflection by a volume of flowing water that equals or exceeds the capacity of a single sprinkler. Ensure alarm flow switch has an instant-recycle pneumatic-retard, or electronic adjustable setting time delay, settable from 45 to 90 seconds. During Preliminary Testing, verify switch is set to 50 to 70 seconds.

2.13 VALVE TAMPER SWITCHES

Provide supervisory initiating valve tamper switches designed for use with automatic/manual fire alarm systems, in accordance with UL 346, conforming to UL or FM requirements of use on the specified valve.

Provide contacts with a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC). Ensure valve tamper switches are individually addressable by connection to addressable modules, in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Provide weatherproof, corrosion-protected switches for outdoor installations. In hazardous locations, provide valve tamper switches UL listed or FM approved for the hazardous location classification indicated. If the tamper switch is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated, at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

Where close-valve supervision is required for system configuration/programming capabilities, do not use devices designed to monitor open valves. Use device Designed for this special type application, such as potter plug type supervisory switch or equal. Otherwise use nonelectrical methods, such as chains.

2.14 REMOTE AUXILIARY CONTROL RELAYS

Provide remote control relays with continuous duty coils rated 24 V(DC). Where relays are used on Class A parallel wired supervised circuits, ensure coils incorporate supervisory current blocking diode. Provide relays with a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC). Where auxiliary control circuits connected to the relay are protected at a higher ampacity than the relay contacts are rated, provide fusing rated to protect the relay contacts in the relay enclosure.

Provide addressable type relays, where indicated, in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Mount remote auxiliary control relays in enclosures indicated, or if not indicated, in manufacturer's finished red painted required enclosure. Install outdoor relays in a weatherproof enclosure with a neoprene gasket and protection against corrosion.

In hazardous locations, install relays with enclosures UL listed or FM approved for the hazardous location classification indicated. Provide seal-off conduit fittings at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

Label enclosure with an engraved phenolic nameplate stating, "F/A RELAY."

The auxiliary contacts must be supplied by the fire alarm system manufacturer to ensure complete system compatibility. Mount remote auxiliary control relays and supervise within 0.91 m 3 feet of the controlled device in accordance with NFPA 72.

2.15 POWER SOURCE

Ensure primary power to the local systems for all purposes, including separately powered notification appliances and initiating devices, is 60 hertz 120 V. Ensure system operates satisfactorily between 85 and 110 percent of normal voltage. Provide fire-alarm-system disconnect/protective device as a fused switch with factory painted red finish coat. Mount this disconnect fused switch adjacent to the main FACP and, where applicable, to auxiliary/supplemental fire alarm system panel(s). Mark as FIRE-ALARM DISCONNECT FED FROM (indicate supply circuit) with 0.5 13mm 1/2-inch high letters in white paint or engraved phenolic identification plates fastened with sheetmetal screws. Ensure switch is capable of being locked in the "on" or "off" position, a feature which can not interfere with the circuit protection capability of the device. Equip switch with surge suppression for all phase and neutral conductors. Install current limiting Class RK1 fuses properly sized to protect the fire alarm equipment.

When power is supplied from a single 20-amp circuit breaker, provide a factory finished red adjustable set screw type clamping device over the circuit breaker handle to prevent handle operation.

2.16 WIRING

Provide copper conductor wiring in accordance with NFPA 70 and NFPA 72. Connect all devices per NFPA 72, with the wire types specified in this section, unless specifically noted otherwise in the paragraph entitled, "Wiring (Wire and Multi Conductor Cable). For 120 V(AC) circuits, use 3.0 mm2 No. 12 AWG minimum stranded copper with an insulation rating of not less than 600 V(AC).

Ensure all conductors installed on fire alarm systems are solid copper with an insulation rating of not less than 300 volts, permanently marked with the size, voltage rating and manufacturer's name on the conductor jacket at no less than 610 mm 2 feet intervals. Conductor sizes are listed below.

Where modifications are made to existing systems, match the new or added conductors to the size and color-coding of the existing system. Conductor AWG diameter and Insulation Type are listed below. Required wire colors are listed in the paragraph entitled, "Wiring (Wire and Multi-Conductor Cable)," of this section.

Provide solid copper meeting UL 497B requirements, for conductors in Signaling Line Circuits (SLC). Use shielded, twisted pair cable where recommended by the manufacturer. For shielded wiring, ground the shield at

only one point, which is in or adjacent to the FACP. Unshielded, twisted pair cable is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable. Ensure cable is listed as Type FPL, Power-Limited Fire Protective Signaling Cable, as appropriate with red colored covering. Select a wire size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than1.0 mm2 No. 16 AWG.

Provide solid copper, shielded, twisted pair, meeting UL 497B requirements, for conductors in Speaker audio circuits and remote reporting circuits. Ensure cable is listed as Type FPL, Power-Limited Fire Protective Signaling Cable, as appropriate with red colored covering. Select a wire size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 1.0 mm2 No. 18 AWG diameter for remote reporting circuits and 2.0 mm2 No. 14 AWG diameter for Speaker audio circuits.

Air sampling detection units are permitted to use 0.8 mm2 No. 18 AWG for connection to addressable modules with maximum conductor length not to exceed 7.62m 25 ft.

Provide direct current initiating device circuit copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 1.0 mm2 No. 16 AWG diameter, with insulation Type TFN or not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN.

Size power leads from the control panel for product-of-combustion detectors accordingly, but not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN for 2.0 mm2 No. 14 AWG diameter and larger.

Provide direct current notification appliance circuit (strobes, horns) copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN.

Provide direct current auxiliary control device (AHU shut down relay) circuit copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 2.0 mm2No. 14 AWG diameter, with insulation Type THHN/THWN.

Provide solenoid valve control circuit copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 2.0 mm2 No. 14 AWG diameter, with insulation type THHN/THWN.

[Ensure all underground circuit wiring meets UL 444, UL 13, UL 1424 and TIA 455-82B water infiltration tests.]

[2.16.1 Fire Resistive Cables

Provide fire resistive cables for notification appliance circuits designed for use with automatic/manual fire alarm systems in accordance with UL 2196.

Provide UL Fire Prot Dir listed Type FPL-CI fire alarm cable for use with power limited fire alarm notification appliance circuits. Ensure the CI cable has a minimum 2-hour fire resistance rating by having passed the applicable testing requirements of UL 2196. Install this cable in locations required to meet NFPA 72 survivability requirements.

]2.17 SURGE SUPPRESSORS

Provide line voltage and low voltage surge suppression devices to suppress all voltage transients which might damage the control panel components.

Install surge suppression in accordance with UL 497B on each conductor of fire alarm circuits which extend beyond a building. Locate protection as close as practical to the point where the circuits leave the building. Install protectors in factory painted with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat surge suppression cabinets of adequate size with terminal strips for all wiring connections. Where installed outdoors, provide stainless steel NEMA 4X rated cabinets. Provide a copper ground bus inside the cabinet and connect protectors to an earth ground electrode system in accordance with the manufacturer's requirements and NFPA 70. Ensure an etched metal or engraved laminated plastic identification plate labeled, "TSTC," is affixed to the cabinet door of the alarm control unit to identify the cabinet as a fire alarm transient surge terminal cabinet. For cabinets not painted red, the identification plate has white letters on a red background.

2.17.1 Line Voltage Surge Suppressors

Provide suppressor UL 1449 listed with a maximum 330-volt clamping level and a maximum response time of 5 nanoseconds, and also meets IEEE C62.41, category B tests for surge capacity. Ensure suppressor is a multi-stage construction type which includes inductors and silicon avalanche zener diodes. Provide suppressor which has a long-life indicating lamp (light emitting diode or neon lamp) which extinguishes upon failure of protection components, with externally accessible fuses. Wire in series with the incoming power source to the protected equipment using screw terminations.

2.17.2 Low Voltage Surge Suppressors

Provide for all circuits which leave the building shell and as shown on the contract drawings. When circuits interconnect two or more buildings, provide suppressors at the circuit entrance to each building. Ensure suppressor is UL 497B listed, with a maximum 30-volt clamping level and a maximum response time of five nanoseconds, with multi-stage construction and both differential/common mode protection.

[2.18 SOLENOID VALVES AND SAFING KEY SWITCH

Provide solenoid valves at [suppression] [extinguishing] system valves indicated, UL listed or FM approved for operation with the respective releasing control panel. Provide solenoid valves with all fittings, hardware meeting the specified in Division 21 DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS, and solenoid fire alarm interface modules as required specified herein.

Incorporate a safing key switch in solenoid valve, with safing key switches which accepts a Best Access Systems 7-Pin core (Mortise or Standard Rim Cylinder). Design switch and operator for mounting on the front of a sheet metal electrical enclosure cabinet. Ensure that each key switch disconnects all conductors connected to the releasing solenoid valve, and that switch contacts are rated 5 amps minimum at 28V DC. Ensure activation of safing key switch causes annunciation at the FACP, transmits a trouble to the Central Radio Monitoring Station.

When installed in hazardous locations, provide solenoid valves UL listed or FM approved for the hazardous location classification indicated. When the solenoid valve is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

]2.19 MANUAL ACTIVATION STATIONS

Provide manual activation stations that meet the requirements specified in Division 21 DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATION

3.1.1 Normal Operation

Ensure all switches are in the normal position; available power indicator light is on, the trouble and detector indication lights are off, and all circuits are electrically supervised.

3.1.2 Supervisory Condition

Per system conditions identified in the paragraph entitled, "Fire Alarm Control Panel," of this section, ensure that a supervisory signal is transmitted to the Central Radio Monitoring System, device indication is provided, a supervisory signal is activated in the FACP, and input is provided to remote annunciators (when used). Ensure supervisory signal in the alarm control unit is comprised of visual and audible indications and is self-restoring.

3.1.3 Trouble Condition

Per system conditions identified in the paragraph entitled, "Fire Alarm Control Panel," of this section, ensure that a trouble signal is transmitted to the remote reporting device of the Central Radio Monitoring System, providing zone indication, activating a trouble signal in the FACP, and providing input to remote annunciators (when used). Ensure trouble signal in the alarm-control unit provides visual and audible indications.

3.1.4 Alarm Condition

Ensure activation of any detectors, manual alarm stations, water flow switches, or other initiating devices closes a contact that activates the appropriate FACP. FACP transmits a signal to the remote reporting device of the Central Radio Monitor System, activates the facility indicating appliances (where applicable), provides zone identification, controls air handling and ventilating units, provides an input to remote annunciators (when used), and provides indication or control to devices or other systems.

3.2 INSTALLATION

****

NOTE: If the installation of the specified fire alarm system is on a new facility, then delete the first paragraph under the paragraph entitled, "Installation," of this section.

****

Prior to performing any installation or modification work to existing Fire Alarm system(s), secure a Transfer of Responsibility Form completed by the COR and signed by the Contractor and Owner's Representative (i.e., O & M System Engineer). The completed form will be turned over to the Contracting Officer by the COR. Permanently affix a copy of the completed "Transfer of Responsibility" Form to the affected FACP throughout the construction period.

For modifications, additions, or expansion to an existing fire alarm system, the Contractor is not responsible for existing troubles and ground faults that are not in contract scope. Before commencing work, clearly convey the existing troubles, ground faults, or other present faults that are not in contract to the Contracting Officer. Contracting Officer shall be notified to request and schedule support from Owner's Representative (i.e., O & M System Engineer) to resolve the identified FACP fault indications.

Install all equipment in accordance with manufacturer's installation instructions and requirements of this Section. Use new components in the installation that are not more than one (1) year old.

3.2.1 Fire Alarm Control Panel(s)[and Battery Cabinets] and Reporting Equipment

Install equipment in each protected building, located where indicated on contract drawing, and complete with all indicated accessories and devices. Install equipment in accessible locations. Surface mount the enclosure with the top of the cabinet 2 m 6 feet above the finished floor or center the cabinet at 1.5 m5 feet, whichever is lower, unless otherwise indicated. Equipment requires a minimum of 0.91 m 3 feet clearance directly in front of the panel for maintenance per NFPA 70. With multiple equipment, the 0.91 m3 feet clearance is required directly in front of the complete configuration. In addition, provide a 711 mm 28-inch clear aisle way for access to the equipment.

Ensure wiring within FACP(s) is in accordance with the paragraph entitled, "Installation in Cabinets and Boxes," of this section.

When FACP(s) are installed flush or semi-flush, provide three spare 25 mm 1-inch conduits in accordance with the paragraph entitled, "Conduit and Raceways," of this section, from the FACP wiring termination cabinet to an accessible location.

3.2.1.1 Battery Cabinets

When batteries will not fit in the FACP, locate battery cabinets below or adjacent to the FACP. Battery cabinets must be installed at an accessible location when standing at floor level. Battery cabinets must not be installed lower than 300 mm 12 inches above finished floor, measured to the bottom of the cabinet, nor higher than 900 mm 36 inches above the floor, measured to the top of the cabinet. Battery cabinets must be large enough to accommodate batteries. The cabinet must be provided in a sturdy steel housing, hinged steel door with cylinder lock, and surface mounting provisions. The cabinet must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must indicate the control unit(s)the batteries power and must not be less than 25 mm 1-inch high.

3.2.2 CRMS Reporting Equipment

Install equipment in each protected building, located where indicated on contract drawing, and complete with all indicated accessories and devices. Install equipment in accessible locations. Surface mount the enclosure with the top of the cabinet 1.5m 5 feet above the finished floor, unless otherwise indicated.

Perform test in accordance with approved Fire Alarm System Acceptance Test Procedures and the paragraph entitled "Field Testing" in this specification to confirm expected CRMS Transceiver signals and messages (alarms and fault conditions) are properly transmitted and received at the CRMS Station.

3.2.2.1 CRMS Antenna

CRMS antenna mounting location must be validated and coordinated with the Owner's Representative (i.e., O & M System Engineer) prior to installation. Contractor must Validate Antenna placement produces a minimum of 2 mesh network radio frequency (RF) signal paths in accordance with NFPA 72 and entire RF transmission line must be tuned to achieve a 1.5:1 Standing Wave Ration (SWR) reading or lower.

The radiating element of the antenna must be at least .457m 18 inches above the highest point on the facility roofline providing 360 degree "visibility", in a straight up and level position. Place the antenna where it is not subject to damage and obstructions to connectivity or service. Use mounting offset bracket to space the antenna body a minimum of 18-inches from any metal (metal building, conduit, piping, gutter, etc.). Where structures exist above the facility roofline (e.g. fixed ladders, rooftop HVAC systems, building wall, etc.) the antenna must be mounted a minimum of .254 10 inches away from such obstructions.

Trim the antenna to a length of .7874m 31-inches measured from the top of the coil body. Use LMR-400 coaxial cable and approved Type-N and UHF PL-259 male connectors to connect the antenna to the suppression module, and from the suppression module to the radio Type-N bulkhead and BNC coaxial AES cable assembly Model 13-0346. Route the coaxial cable in as direct a route as possible, avoiding tight radius bends and the coiling of excess cable. PL-259 connectors must be designed to accept the soldering of the center conductor, and all PL-259 connectors must have the center pin soldered. Outdoor antenna coaxial connections must be weatherproofed. RF Surge suppression module must be the approved [Polyphaser model][Keltron Lightning Suppressor [Model 10R7230]] as indicated on contract drawings. For UL listed compliance, all antenna system wiring must be installed in minimum 25.4mm 1-inch rigid galvanized conduit. Use only long radius sweep elbows.

Bond the antenna surge suppression module and the antenna mast/bracket to the facility ground in accordance with NFPA 70. Use an approved grounding mechanical connector or exothermic weld to achieve a proper earth ground connection. Mount the suppressor/enclosure in a location where the path (#8 ground wire) to facility/earth ground is shorter than the path (LMR-400) to the CRMS radio. The surge suppression enclosure must be large enough to eliminate tight radius bending of the LMR-400 cable

3.2.2.2 CRMS Antenna Performance Test

a. Verify and Validate the Network Connectivity (NetCon) value of NetCon

5 using the hand-held AES Network Connectivity Tool. A NetCon 5 reading indicates 2 good paths to the network.

b. Verify and Validate the Standing Wave Ratio (SWR) reading of 1.5:1 or lower using a SWR meter. The SWR reading indicates the efficiency of transceiver power level, cable integrity, and antenna placement for optimum RF (mesh network) performance.

c. Identify final antenna location/details.

Notify the Contracting Officer [30] [___] days before the antenna performance test is to be conducted and submit the test procedure, in booklet form showing field tests above are being performed to prove compliance with the specified system performance criteria, upon completion of the installed system. Perform the test in the presence of the Contracting Officer and the Owner's Representative (i.e., O&M System Engineer). Secure the signatures and date on the summarized set of test procedure from the required witnesses. Test report shall document all readings, test results, and indicate the final position of the antenna. Furnish all instruments and personnel required for the tests.

3.2.3 Addressable Modules/Devices

Install addressable modules at accessible locations indicated. Configure module address switches to settings indicated on approved shop submittals. Individually identify modules adjacent to their mounting.

Mount control zone addressable modules used for smoke control, AHU shutdown, etc. in accessible locations or within 0.91 m 3 feet of the device to be controlled. Do not install control modules connected to separately energized control wiring from auxiliary systems in the same enclosure with initiation and signal zone addressable modules.

Where addressable modules are grouped within an enclosure, wire in accordance with the paragraph entitled, "Installation in Cabinets and Boxes," of this section.

3.2.4 Annunciator Panels

Install [surface mount] [semi-recessed][flush] annunciator in accessible locations make for first responders, such as near main entrance door in accordance with NFPA 72.

Locate the LCD annunciator as shown on the drawings. Mount the annunciator, with the top 1.5m 5 feet above the finished floor.

Provide wiring within annunciator panels in accordance with the paragraph entitled, "Installation in Cabinets and Boxes," of this section.

3.2.5 Heat-Actuated Detectors

Ceiling mount detectors unless otherwise indicated. Location, number, and general arrangement to be as indicated. Provide field installation locations complying with NFPA 72.

Configure addressable electronic heat detector address switch settings as approved on shop drawings and submittals. Do not install detectors until work by other trades is completed. Individually identify detectors adjacent to their mounting.

Locate detectors, where in the vicinity of ceiling light fixture/diffuser, as permitted per manufacturer's installation instructions and recommendations.

Make provisions for devices mounted in acoustical, lay-in type ceilings to utilize 'T' bar or corner plate/bracket. Cut ceiling tile as required to accommodate mounting corner plate/bracket and prime and paint to match ceiling grid color.

[3.2.6 [Flame Detectors]

Provide flame detector location and general arrangement for general coverage protection. Ensure field of view (FOV) from detector is free of obstructions. Adjust location as required to prevent obstruction of the detector field of view (FOV) and provide coverage in all protected areas by at least one detector. Aim detectors to accurately cover the areas or target using a laser tool recommended by the detector manufacturer, avoid aiming detector field of view outside the building (open doors) or outside specified protection area perimeter. Mount detector to a solid mounting structure using approved manufacturer's mounting brackets. Provide partial flexible conduit from detector to wall or ceiling for ease of alignment. Determine and identify actual detector mounting height at field to meet all coverage requirements. Ensure field installation are in accordance with manufacturer's installation instructions and NFPA 72. [Provide cross-zoned detection for automatic release of fire suppression systems/extinguishing agents.]

Where detectors are installed outdoors, arrange conduit systems to drain away from the detector.

Aim detectors to accurately cover the field specified using a laser tool recommended by the detector manufacturer. Point the aiming spot on the floor for each detector and include the measurements of this spot from fixed structural elements on the shop drawings and record (as-built) drawings.

]3.2.7 Smoke Detectors

Provide smoke detector location, number, and general arrangement as indicated on the contract drawing. Ensure field installation are in accordance with NFPA 72. Do not install detectors until the work of other trades is complete.

Make provisions for devices mounted in acoustical, lay-in type ceilings to utilize 'T' bar and corner plate/bracket. Cut ceiling tile as required to accommodate mounting corner plate/bracket and prime and paint to match ceiling grid color.

Install duct smoke detectors in accordance with the manufacturer's installation requirements and NFPA 90A. Install remote indicator in the vicinity, corridor/public area, of the detector and identify it with corresponding equipment label. Install a ductwork hinged access panel to each duct smoke detector, for inspection and cleaning in accordance with NFPA 72. Seal all duct penetrations air and watertight. Individually identify detectors adjacent to their mounting.

Configure addressable smoke detector address switch settings as approved on shop drawings and submittals. Individually identify detectors adjacent

to their mounting.

Locate detectors where in the vicinity of ceiling light fixture/diffuser, as permitted per manufacturer's installation instructions and recommendation. Ensure detectors installed in areas subject to moisture or exterior atmospheric conditions are UL listed or FM approved for such locations.

3.2.8 Manual Pull Stations

Mount manual pull stations at locations indicated on the contract drawing within 5-feet of each exit doorway in accordance with NFPA 72. Ensure mounting height is 1219 mm 48-inch above the finished floor measured from the top of the device. Individually identify detectors adjacent to their mounting.

Where manual pull stations are installed outdoors, arrange conduit systems to drain away from the manual pull stations.

3.2.9 Alarm Horns/Speakers

Mount horns and/or audio speaker notification appliances at the approximate locations indicated. Ensure mounting height is 2286 mm 90-inches above the finished floor measured from the top of the horn/speaker, but no less than 152 mm 6 inches below the ceiling. Individually identify speakers along with their respective wattage setting adjacent to their mounting.

Where horns or speakers are installed outdoors, arrange conduit systems to drain away from the bells or speakers.

3.2.10 Strobe Units/Combination Audio Visual

Mount strobe notification appliances at the approximate locations indicated on the contract drawing. Ensure locations are unobstructed and allow viewing by area Occupants, and meet room spacing in accordance with NFPA 72. Ensure mounting height is no less than 2032 mm 80 inches above the finished floor measured from the bottom of the strobe, but no greater than 2440 mm 96 inches above finished floor.

Where strobes are installed outdoors, arrange conduit systems to drain away from strobes.

Ensure visual and audible appliances are capable of operating independently via separate and independent circuits for both the audible and visual portions.

Addressable strobes are not acceptable.

3.2.11 Auxiliary Control Relays

Install and supervise remote control relays in accessible locations within 0.91 m 3 feet of the device to be controlled or power disconnection point as applicable in accordance with NFPA 72. Individually identify relays adjacent to their mounting.

3.2.12 Wiring (Wire and Multi-Conductor Cable)

Provide wiring conforming to the requirements of NFPA 70 and the following

special requirements:

Install fire alarm system circuits in a separate raceway system. Route circuits (Initiating, Notification, Signaling, and Control) through a dedicated separate conduit or raceway system configured to comply with NFPA 72 Class "A" conduit system requirements. Do not allow 60-Hertz power circuits to enter enclosures containing fire alarm circuits except where required to connect to the fire alarm system.

Provide continuous conductors from a terminal point at one device to a terminal point at the next device and from a device to the FACP. Break wires at each terminal; do not loop wires over a terminal. Terminate approved explosion proof devices, provided with pigtail wiring connection leads, on a field installed terminal strip installed in the box on which the device is mounted. Install solderless ring tongue terminal lugs with manufacturer's required tooling on the device wiring connection leads. Use this ring type lug on stranded wire only. Terminate solid wire on compression or screw type terminals. When screw type terminals are used, capture the conductor under 80 percent of the screw head surface. Identify all circuit conductors within each enclosure where a tap, splice, or termination is made. Provide conductor identification by heat-shrink-type sleeves or other approved method. Use point destination type conductor labels to indicate cabinet, circuit board, terminal block and screw terminal location for each individual conductor.

Provide conductor colors as listed below and in accordance with SAE AMS-STD-595A. Where modifications are made to existing systems, match the new or added conductors to the size and color-coding of the existing system.

Mark conductors for Signaling Line Circuits, Speaker audio circuits, and remote reporting circuits with circuit designation, and maintain consistent (twisted pair) color-coding for the positive and negative loops throughout the cable system.

Install direct current initiating device circuits (heat detectors, manual pull station) as Class A, parallel-wired circuits per NFPA 72. Ensure the positive loop conductor is colored blue, Color No. 15102, and the negative loop conductor is colored black, Color No. 17038.

Install power leads from the control panel for product-of-combustion detectors as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is colored White, Color No. 17875, and the negative conductor is colored black, Color No. 17038.

Install direct current notification appliance (horns, strobes) circuits as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is colored red, Color No. 11105, and the negative conductor is colored orange, Color No. 12473.

Install direct current auxiliary device control device circuits (AHU shutdown relay) as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is colored yellow, Color No. 13591, and the negative conductor is colored brown, Color No. 10055.

Install solenoid valve control circuits as Class B circuits per NFPA 72. Ensure the positive conductor is colored yellow, Color No. 13591, and

the negative conductor is colored violet, Color No. 37100.

3.2.13 60-Hertz Power

Provide 60-hertz power to FACP(s) and, where applicable, to auxiliary/supplemental fire alarm system panel(s) or separately powered devices of 120 V(AC). Provide one black phase conductor, one white or gray solidly grounded neutral conductor, and one green equipment grounding conductor. Size conductor as shown on the drawing with the minimum size No. 12 AWG copper. Install surge arrestors in accordance with NFPA 72 and NFPA 70.

Clearly identify Circuit Breakers used to supply AC power to the FACP and, where applicable, auxiliary/supplemental fire alarm system panel(s). Provide a permanent label with white background and red lettering adjacent to the circuit breaker.

3.2.14 Installation in Cabinets and Boxes

Install wiring in control cabinets and boxes in a neat and orderly manner with wire properly grouped, tie-wrapped, or laced parallel and perpendicular to the major axis, supported and identified. Provide continuous control wiring from device to device with no splices unless otherwise indicated. Permanently mark all wires entering or leaving control cabinets, boxes, and devices and terminate on screw terminals. Ensure marking is consistent throughout the fire alarm system and is the same as the identification shown on the connection drawings.

Ensure wire labels correspond to the approved connection drawings and use a method indicating the destination of the other end of the wire. Provide labels in control panel equipment or between fire alarm terminal cabinets which indicate the destination of the other end by cabinet designation-terminal strip designation-terminal number. Provide labels in fire alarm terminal cabinets indicating connection in control panel equipment by fire alarm cabinet designation-module identifier-module terminal strip identifier-terminal number. Provide conductor labels with legible machine-printed black lettering on white background using indelible ink. Ensure labels are heat shrink or wrap around type.

3.2.15 Conduit and Raceways

Minimum size for fire alarm system initiating, notification, signaling line and control circuit conduits and raceways is 12 mm 3/4-inch. Install in accordance with NFPA 70. Ensure all Class A initiating device, signaling line, notification appliance and control circuits use diverse routing in accordance with NFPA 72. Do not run outgoing and return redundant circuit conductors in the same cable assembly, enclosure or raceway except where permitted by NFPA 72.

Install rigid galvanized steel conduit in all hazardous (classified) locations, exterior locations where the conduit is exposed above grade, where subject to physical damage, interior exposed locations from finished floor to 304 mm 1 foot above finished ceiling unless otherwise shown on the drawings. EMT with hexnut expansion gland-type fittings can be installed in all other locations, including above suspended ceiling. Use flexible metal conduit, maximum length 1828 mm 6 feet, as the final connecting raceway to a fire alarm device mounted on vibrating equipment or on a suspended ceiling.

Where devices, junction boxes, and cabinets are installed outdoors, arrange conduit systems to drain away from the box; ensure conduit enters the box side or bottom only and drain type fittings are installed.

Use schedule 80 PVC for conduit direct buried in earth. Ensure that portions of underground raceway systems that penetrate above finished grade are rigid, galvanized, heavy-wall steel conduit with a 40-mil PVC coating or painted with a bitumastic compound.

Conceal all conduit in interior finished areas. In finished areas, paint exposed electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceways, junction boxes, and electrical boxes to match adjacent finishes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. For bends of over 25 mm 1-inch in diameter, provide factory made elbows.

3.2.16 Firestopping

Install tested and listed UL Fire Resistance firestopping systems to maintain the integrity of fire-resistant rated walls, floors or ceilings, including through-penetrations and construction joints and gaps.

3.2.17 Water Flow Alarm and Valve Tamper Switches

Install switches in accordance with the manufacturer's requirements and make final connections using liquid-tight flexible metallic conduit. Adjust time delays on water flow/pressure switches to between 50 and 70 seconds to prevent false alarms due to momentary water movement. Individually identify devices adjacent to their mounting.

3.2.18 Elevators

Ensure activation of fire alarm initiating devices interfaced to elevator control execute the Elevator emergency functions for Elevator Recall [and Elevator Power Shutdown] and initiate the following actions in the elevator controls in accordance with ASME A17.1/CSA B44 and NFPA 72:

a. Primary Fire Fighter Recall.

b. Secondary Fire Fighter Recall.

c. Power Feed Shunt-Trip.

d. Fire-Hat Warning.

e. Shunt-Trip Power Monitoring

3.3 FIELD TESTING

After complete installation of the equipment, conduct tests to demonstrate that the installation requirements of this specification have been met and that the sequential functions of the system comply with the requirements specified herein. Perform the Tests covered in the following paragraphs in three parts:

3.3.1 Contractor Checkout Test

Test includes the testing of fire system conductors, in accordance with

subparagraph to remove all troubles, ground faults, and shorts and to determine the wiring acceptability. Ensure all devices are fully functional and operational. Test the programming to ensure the installation meets the contract drawings and specifications. If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the test.

****
NOTE: Delete the following requirement if the installation is for a new fire alarm system
****

[Refer back to Transfer of Responsibility form, in paragraph entitled, "Installation," of this section, for existing fire system troubles, ground faults, and other present faults that are not in the contract scope.]

3.3.1.1 Existing Fire System Wiring

Perform the following tests on the fire system wiring before connection to the control panel:

a. Continuity 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. Insert temporary jumpers in appropriate sockets of missing detectors and install the end-of line resistor when this test is performed. Verify resistance reading for each circuit is the value of the end-of-line resistor, plus or minus 10 percent. Check continuity of circuits with an ohmmeter. Ensure that the tests are witnessed by the Contracting Officer and that test results are recorded for use at the Final Acceptance Test.

b. Insulation Resistance Tests: Megger test wiring for insulation resistance, grounds, and/or shorts. Test conductors with 300 volt rated insulation at a minimum of 250 V dc. Ensure resistance to ground is not less than 20 megohms. Isolate each wire tested from ground, with all other wires within the same conduit grounded. Verify that the conduit system is grounded prior to insulation resistance testing by verifying a short circuit between the conduit and earth ground. Ensure that the tests are witnessed by the Contracting Officer and that the test results are recorded for use at the Final Acceptance Test.

Submit Continuity Test Report and Insulation Resistance Test Report.

3.3.2 Preliminary Test

After successful completion of Contractor Checkout Test, conduct a Preliminary Test in the presence of the Contracting Officer and Owner's Representative (i.e., O&M System Engineer). Notify the Contracting Officer in writing when the system is ready for a formal Preliminary test. Submit a request for formal Preliminary Test at least [14] [_____] calendar days before the test date.

Submit all completion documentation to the Contracting Officer as required by NFPA 72 including all test reports noted below:

a. Completed and signed Contractor Readiness Affirmation - For Preliminary Fire Alarm Testing

b. Copy of Preliminary Acceptance Test Procedures

c. Draft copy of NFPA 72 Record of Completion Form

d. A signed Verification of Compliant Installation letter by the Qualified Engineer that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the Contractor Checkout test.

[e. Completion of CRMS Antenna Performance Test results in accordance with Part 3 section entitled "CRMS Reporting Equipment."]

Perform this test using the approved Acceptance Test Procedure. Ensure that tests meet the requirements of paragraph entitled "Fire Alarm System Acceptance Test Procedure" and all test requirements in accordance with NFPA 72. Verify fire alarm system drawings against the system installed, annotate all red-lines, and summarize on a single set of drawings. Follow the test procedures as written and annotate all red-lines on a single Test Procedure. Secure the signatures and date on the summarized set of test procedures from the required witnesses. The Preliminary test is not considered complete until all steps in the test procedure have been satisfactorily completed. This includes any additional steps required to complete 100 percent testing of the fire alarm system and its associated functionality. Test must be conducted and repeated if necessary, until the system has been demonstrated to comply with all contract requirements. In the event of malfunctions or excessive nuisance alarms, the Contractor must re-schedule the Preliminary Test, take prompt corrective action, and repeat the 100 percent Preliminary test.

The following must be provided at the job site for formal Preliminary testing:

a. Copy of Acceptance Test Procedures for all witnesses.

b. Marked-up redlines as-built drawings of the system.

c. Copy of site-specific software.

3.3.3 Final Acceptance Test

After the successful completion of the preliminary test, conduct a Final Acceptance test. Ensure the Contracting Officer, Owner's Representative (i.e., O&M System Engineer), and the Authority Having Jurisdiction (AHJ) or their designee(s) witness the final acceptance test for the fire alarm system. The final test must be performed in accordance with the approved acceptance test procedure. Notify the Contracting Officer in writing when the system is ready for Final Acceptance Test. Submit a request for formal Final Acceptance Test at least [14] [_____] calendar days before the test date.

Submit all completion documentation to the Contracting Officer as required by NFPA 72 including all test reports noted below:

a. Completed and signed Contractor Readiness Affirmation - For Final Fire Alarm Testing

b. Copy of Final Acceptance Test Procedures with all marked-up redlines from Preliminary Test incorporated

c. Copy of Marked-up redlines Acceptance Test Procedure from formal Preliminary Test (signed and with all steps annotated as complete)

d. Final copy of NFPA 72 Record of Completion form

Prior to test start, on-site, conduct a line-by-line review that proves all issues found during the preliminary test have been incorporated. At this time, any and all required tests noted in the paragraph entitled "Fire Alarm System Acceptance Test Procedure" or Acceptance Test Procedure must be repeated at the discretion of the AHJ.

The following must be provided at the job site for Final Acceptance Testing:

a. Copy of Final Acceptance Test Procedures for all witnesses.

b. Copy of Final draft/Marked-up redlines as-built drawings of the system.

c. Copy of Final draft site-specific software.

Upon successful completion of the Final Acceptance Test, submit all completion documentation to the Contracting Officer as required by NFPA 72 including all test reports noted below:

a. A signed and completed Final Acceptance Test procedure (with all steps annotated as complete)

b. Complete Record drawings of the system as actually installed.

c. Complete site-specific software.

d. A signed and complete NFPA 72 Record of Completion form.

3.3.4 Fire Alarm System Acceptance Test Procedures

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

With the control panel energized, demonstrate the proper operation of all indicating lights and alarms.

Demonstrate remote annunciator indicator lights to operate when a system alarm / supervisory / trouble condition is present and the correct information is displayed. Verify acknowledge button silences audible sound at both the FACP and annunciator, alarm silence button silences both audible and visual appliances, system reset button restores FACP back to normal, and programmable buttons perform their assigned operations.

Activate each manual pull station to demonstrate proper operation.

Activate each smoke detector, test with smoke in accordance with the manufacturer's instructions, to demonstrate proper operation of both alarm and trouble.

Perform a static pressure differential test on each duct smoke detector to verify the pressure differential between the inlet and outlet tubes is within the manufacturer's specifications for acceptable operation. For air handling units with variable speed drives, test at both the minimum and

maximum operating speeds.

Activate each duct smoke detector, test with smoke in accordance with the manufacturer's instructions, to demonstrate proper operation.

Activate each flame detector in accordance with the manufacturer's recommendation; verify both alarm and trouble indications at the FACP.

Activate each flame detector test switch and verify that each flame detector on this circuit went into alarm and that all the addressable interface modules latched in the alarm condition. Restore the test switch and visually verify the flame detectors returned to normal operation.

Each time an initiating or supervisory circuit is activated, verify that the associated device address, notification appliances circuits, auxiliary control circuits, and alarm reporting to the Central Radio Monitoring System is activated, and the correct information is displayed.

Open circuit test: Introduce an open circuit at each circuit (alarm initiating device circuit, notification appliance circuit, control device circuit and signaling line circuit). Verify indication of trouble signal at FACP.

[Open circuit test: Introduce an open circuit at each fire suppression interface circuit. Verify indication of a supervisory signal at FACP.]

Ground fault test: Introduce a ground fault at each circuit (alarm initiating device circuit, notification appliance circuit, control device circuit and signaling line circuit). Verify indication of ground fault at FACP.

Short circuit test: Introduce a short circuit at each circuit (alarm initiating device circuit, notification appliance circuit, control device circuit and signaling line circuit). Verify indication of short circuit at FACP.

Circuit integrity test: Remove one lead at not less than 10% of the initiating device, notification appliance, and control device on every initiating device circuit, notification appliance circuit, control device circuit, and signaling line circuit. Verify indication of trouble signal at the FACP. For Class A circuits, test the device to verify an alarm/supervisory operation over the trouble condition.

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 must be witnessed by the Contracting Officer and test results recorded for use at the Preliminary and Final tests.

Turn off power to each separately powered panel or device to simulate loss of power and to demonstrate operation of the trouble alarm.

Test the rate-of-rise function on each heat-actuated detector in each zone by application of heat source from a heat lamp or handheld hot air blower to demonstrate proper operation. Ensure detectors initiate an alarm to the system, sustain repeated tests of the rate-of-rise function without damage to the fixed temperature function. Replace heat-actuated detectors (HADS) subject to operation from body temperature.

Open and close water suppression system valves to activate tamper switches, to demonstrate proper operation. Ensure that testing of tamper switches complies with the requirements of NFPA 72.

Activate water flow/pressure switches by opening of the inspector's test valve to demonstrate proper operation. Set water flow time delay between 50 and 70 seconds.

Verify discharge within 60 +/-10 seconds of electrically activated suppression systems. Verify each initiation device that activates the suppression system to activate the solenoid valve. Fully discharge the overall system at least once, via separate test procedure, that may include alternatives such as cylinders filled with breathing air.

Demonstrate each alarm initiating circuit to operate its associated alarm-control and auxiliary control units and remote reporting.

Initiate an alarm to verify all audible and visual notification appliances are functional. Verify audible information to be distinguishable and understandable.[In locations where voice intelligibility is required, verify by one of the NFPA 72 approved methods. Ensure Acceptable Sound pressure level comply with NFPA 72.]

Demonstrate capacity and the operation of the battery backup system to operate as required by these specifications by disconnecting the 120 V(AC), 60 Hz power from the fire alarm (control) panel and operating the system as specified for backup operation.

Test fire alarm circuit to ensure no stray voltages exist between fire alarm circuit conductors and ground, and, where shield cables are installed, between fire alarm circuit conductors, cable shields, and drain wires. The tests will be conducted during the Preliminary Test with results available at the final acceptance test

Measure voltage readings for all circuits to validate voltage drop calculations provided with shop drawings and ensure voltage drop values do not exceed device voltage tolerance. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.

Demonstrate all circuits interconnecting with other systems fire protection, smoke control, HVAC, security and safety, elevators, etc., to operate as specified on alarm from the associated zone or zones.

Verify all maintenance disable functions operate as specified. Independently verify each device or circuit controlled by the disable function.

[Test Class X network wiring configuration and fault tolerance to verify proper operation.]

Demonstrate each alarm control unit to operate in all modes.

3.3.5 Reacceptance System Tests

Perform reacceptance testing after system components are added or deleted; after any modification, repair, or adjustment to system hardware or wiring; or after any change to software. Test all components, circuits, systems operations, or site specific software functions known to be

affected by the change or identified by a means that indicates the system operational changes are 100 percent tested. In addition, also test 10 percent of the initiating devices (maximum of 50 devices) that are not directly affected by the change and verify proper system operation.

Changes to all control units connected or controlled by the system executive software require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify proper system operation.

Upon completion of the modification, functionally test the existing devices that were reinstalled and test the devices that are on both sides of the point of connection of the new devices. Test all newly installed devices in accordance with the paragraph entitled, "Fire Alarm System Acceptance Test Procedures (For Both Preliminary and Final Tests)," of this section.

After final acceptance testing has been successfully completed, submit test data under the terms of the "GENERAL REQUIREMENTS" clause of this contract.

****

NOTE: NOTE: Add the following bracketed option if the design prepared under this project will be for installation of a new fire alarm system (make/manufacturer) other than Simplex or Siemens, which is currently installed on KSC premises.

****

3.4 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.4.1 Instructor

Provide the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the operation, inspection, testing, and maintenance of the system provided. The instructor must train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm system. The instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including the training history.

3.4.2 Required Instruction Time

Provide [8][16][_____] hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.4.3 Technical Training

Equipment manufacturer or a factory representative must provide [1][3][_____] days of on site[and 5 days of technical training to the Government at the manufacturing facility]. Training must allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises.[Factory training must occur

within [6][12][_____] months of system acceptance.]

3.4.4 Technical Training Manual

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

3.5 PAINTING

Bring all manufacturer's standard finish equipment surfaces, damaged during construction, to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replace with new undamaged equipment at no additional cost to the Government.

Paint all fire alarm conduit fittings, junction boxes, and junction box covers red, Color No. 11105 in accordance with SAE AMS-STD-595A. Mark conduit with a minimum 2.54 cm1-inch wide band every 6.1 m20 feet.

-- End of Section --