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Construction Specification Manual

Salt River Project

Technical Specification Index – March 2022

Division 28

Division	Title	Updated
DIVISION 28: ELECTRONIC SAFETY AND SECURITY		
284613	Fire-Alarm Systems	Revised 03/22
284623	Voice Evacuation Fire Detection and Alarm System	Revised 03/22

SECTION 28 46 13
FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Fire-alarm control unit.
 2. Manual fire-alarm boxes.
 3. System smoke detectors.
 4. Heat detectors.
 5. Notification appliances.
 6. Remote annunciator.
 7. Addressable interface device.
 8. Digital alarm communicator transmitter.

1.2 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.3 SYSTEM DESCRIPTION

- A. Non-coded addressable evacuation system, with automatic sensitivity control of smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only for the remodel and new addition areas.
- B. Fire-alarm wiring shall be in conduit.
- C. Make allowances for necessary headend upgrades, required notification and initiating devices. System shall be designed and provided per latest adopted edition of applicable codes (IFC, IBC, IMC, NEC) in effect for the code enforcement department having jurisdiction.
1. Fire-alarm system shall meet Owner's and Engineer's requirements that may require a system exceeding code requirements.
 2. Systems are to be ADA compliant.
 3. Contract Documents (including mechanical, electrical, control, and fire-alarm Drawings and Specifications) provide engineer's intent of the fire-alarm system; however final number and type of devices, interconnections, circuitry, control relays, etc. shall be determined by the system designer and included in the contract sum.

1.4 PERFORMANCE GUIDELINES

- A. Provide fire-alarm devices, control functions, and associated control power per Contract Documents.
- B. System device locations shall be coordinated with Architect. When adding devices, they shall be added and then the locations approved by the Architect for aesthetic appearance in the space. Some inefficiency may occur adding devices instead of re-arranging devices shown on the Drawings. Also providing devices shown on the Drawings in addition to other devices or system components required for a code compliant system may exceed standard code requirements by a significant number of devices. Bidding Contractor shall anticipate this and include it in their bid.
- C. A complete, code compliant, fire-alarm system along with fire-alarm devices/interconnection/wiring shall be provided by the Fire-alarm System Contractor. Provide devices including smoke detectors for smoke fire dampers with required circuitry, duct detectors, and other similar fire-alarm devices that on other projects may have been provided by another division. The Work includes the following:
 - 1. Installation of a complete operational point addressable fire-alarm system.
 - 2. Core drilling and fire stopping.
 - 3. Cutting, patching and fire caulking.
 - 4. Detailed Shop Drawings.
 - 5. Coordinate the work with other trades for this project.
 - 6. Provide on-site project supervision by a person licensed by the State Fire Marshall while installation is being performed.
 - 7. Provide record documents as required by code, AHJ and Specifications.
 - 8. Provide operating and maintenance instructions.
 - 9. Provide training of Owner's personnel.
 - 10. Provide design and as built drawings in ACAD 2000 or later, DWG and/or Revit 2018 or later, as appropriate for project and required by Architect.
 - 11. Provide 1-year job site warranty of materials and labor furnished under this section. The 1-year warranty shall begin upon Authority Having Jurisdiction, Owner and Engineer acceptance.
 - 12. Provide final approved printed set of fire-alarm drawing in main electric room. Put in 4" PVC labeled tube and secure to wall.
- D. Devices required but not limited to the following areas:
 - 1. Voice Evac
 - a. Voice Evacuation Systems are required to be installed in new assembly occupancies with occupant loads of more than 1,000 people, educational occupancies with an occupant load of more than 100, assembly halls capable of supporting more than 300 people, and "high-rise" occupancies.
 - b. Audio/Visual devices in multi-person offices, open offices, cafeterias, breakrooms, and other spaces as required by applicable code.
 - c. Visual devices in rooms except single offices, janitor's room, and small mechanical rooms.

- d. Pull stations within 5'0" of every door to exterior of building and maximum 200 ft. between pull stations.
 - e. Visual devices in every single fixture restroom and Audio/Visual devices in group toilets.
 - f. Install Audio/Visuals in corridors spaced to be clearly audible above ambient noise (Maximum 100' o.c. and not more than 15' from the end of a corridor) and as required by local Fire Marshal or authority having jurisdiction.
 - g. Install ceiling mounted smoke detectors, maximum of 30 feet on center and 15 feet from the end, in egress corridors.
 - h. Install wall-mounted speakers in corridors at spacing required for intelligibility.
 - i. Install heat detectors in kitchen cooking area and smoke detectors in rest of kitchen area.
2. Traditional Systems:
- a. Visual devices in rooms except single offices, janitor's room and small mechanical rooms.
 - b. Pull stations within 5'- 0" of every door to exterior of building and maximum 200 ft. between pull stations.
 - c. Visual devices in restrooms.
 - d. Install ceiling mounted smoke detectors, maximum of 30 feet on center and 15 feet from the end, in egress corridors.
 - e. Install wall-mounted speakers in corridors at spacing required for intelligibility.
 - f. Install heat detectors in kitchen cooking area and smoke detectors in rest of kitchen area.
3. Connection to kitchen hood extinguishing system and connect to kitchen hood fan systems. Hood exhaust fans to run and hood supply fans to not operate on fire-alarm suppression system activation.
4. Provide rough-in junction boxes for devices and conduit to above ceiling or accessible area.
5. Smoke detectors in storerooms, Technology/Data rooms, and room housing power supplies.
6. Heat detector in electric/IDF/MDF rooms.
7. Provide magnet hold opens and door releases for fire doors and coiling doors. Reference architectural door schedule and hardware Specification for quantity, location, and type. Make required connections.
8. Install smoke or heat detectors at each elevator landing per code and authority having jurisdiction.
9. Install exterior device as required by code and plans.
- E. Related Work:
1. Related work existing or specified in other sections:
 - a. Electrical.
 - b. Demolition and removal of existing system.

2. Existing equipment or equipment furnished and installed by others under another section of the Specification to be wired, and connected to the fire-alarm system by the fire-alarm contractor as required:
 - a. Fire Smoke dampers are furnished and installed by mechanical contractor. The Fire-alarm contractor to provide an alarm relay (contacts rated minimum 10 amp) for control.
 - b. AHU shutdown control. Fire-alarm Contractor to provide an accessible control relay for AHU control. Fire-alarm contractor to provide necessary wire conductors from control relay to AHU connection point. Fire-Alarm Contractor to provide duct smoke detectors, Mechanical Contractor to install and Fire-Alarm Contractor to provide connection.
 - c. Provide electrical power connections to fire-alarm panels.

F. Unit Prices:

1. The Contractor shall provide with his bid, unit price during construction for the items in the following list. The unit prices for the devices shall include the device, installation, 20 feet of conduit, wire, programming, and other required installation.
 - a. Addressable rate of rise heat detector.
 - b. Addressable photoelectric smoke detector.
 - c. Addressable duct smoke detector with relay.
 - d. Addressable manual pull station.
 - e. Point addressable monitor module.
 - f. Point addressable control/relay module.
 - g. 24 VDC Relay SP/DT, with 10 amp rated contacts.
 - h. Fire Alarm Speaker.
 - i. Speaker/Strobe Wall Mount. 15/75, 30, 75, and 110 candela rating.
 - j. Speaker/Strobe Ceiling Mount. 15/75, 30, 75, and 110 candela rating.

1.5 ACTION SUBMITTALS

A. General Submittal Requirements

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Submit code compliant fire-alarm system Shop Drawings, equipment cut sheets, and other necessary information to Authorities Having Jurisdiction (AHJ) for review as may be requested or otherwise required to secure approval and to arrange pertinent field observations by AHJ during construction. Architect/Engineer shall be copied for review of device locations and general system conformance with Specifications. A/E will not review submittals for code compliancy as the docents were sealed or certified by others.
3. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. System design drawings shall be stamped by an independent, registered engineer not associated with the vendor or design team. Or the system design drawings shall be certified by a level 3 NICET designer. System Planner's Name and License Number are to appear on Shop Drawings.

- c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include floor plans to indicate final locations of each addressable device. Show size and route of cable and conduits.
 - 7. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 8. Device locations and quantities shown on the Drawings show minimum required, however, bidding Contractor shall review and add additional devices to meet code (without moving or deleting Audio/Visual devices already shown on the Drawings). Audio/Visual devices shall remain where shown and previously coordinated with Architect. When adding devices, they shall be added and then the locations approved by the Architect for appearance in the space. Some inefficiencies may occur adding devices instead of re-arranging devices shown on the Drawings. Also providing devices shown on the Drawings in addition to other devices or system components required for a code compliant system may exceed standard code requirements. Bidding Contractor shall anticipate this in their bid.
 - 9. Confirm final room names / numbers with the Owner prior to providing final programming for names and locations shown on the alarm panel or transmitted to the remote monitoring.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
 5. Manufacturer's required maintenance related to system warranty requirements.
 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 7. Copy of NFPA 25.
- B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application.
 5. As-built Shop Drawings / system.
- C. Printed and scanned close out materials listed above shall be contained on a CD containing device listing and as-built drawings located in a lockable box located next to the fire-alarm control panel. Provide lockable box sized as required.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be supervised by personnel certified by NICET as fire-alarm Level II technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.

- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Smoke Detectors, Heat Detectors and Flame Detectors: Quantity equal to five percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 2. Detector Bases: Quantity equal to five percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 3. Keys and Tools: One extra set for access to locked and tamper proofed components.
 - 4. Audible and Visual Notification Appliances: Five percent of each type installed.

1.10 WARRANTY

- A. The contractor shall warranty materials, installation, and workmanship for one year from date of acceptance, unless otherwise specified. A copy of the manufacturer's warranty shall be provided with close-out documentation and included with the operation and installation manuals.
- B. System supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Defects that render the system inoperative shall be repaired within 24 hours of the Owner notifying the contractor.
- C. Warranty shall not be affected if the Owner chooses not to enter into a maintenance / monitoring contract with the installing vendor/contractor. There shall be no cap on liability if the Owner chooses not to enter into a maintenance contract with the installing vendor/contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. System provided shall be non-proprietary.
 - 1. Notifier.
 - 2. EST-3.
 - 3. Gamewell.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
1. Manual stations.
 2. Heat detectors.
 3. Flame detectors.
 4. Smoke detectors.
 5. Duct smoke detectors.
 6. Verified automatic alarm operation of smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciator.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Activate voice/alarm communication system.
 6. Release fire and smoke doors held open by magnetic door holders.
 7. Close smoke dampers in air ducts of designated air conditioning duct systems.
 8. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
- D. Valve supervisory switch.
- E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of switch at fire-alarm control unit or annunciator.
- F. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:

1. Provide a field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - c. Addressable control circuits for operation of mechanical equipment.
 - d. Batteries shall be located only in conditioned spaces. If the fire-alarm panel contains the batteries and the panel is located in an unconditioned space, such as an exterior fire riser room, building cooling shall be provided in the riser room or batteries shall be remotely located within a conditioned space. Owner will approve location of remote batteries to assure easy access to service.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands
- C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Initiating Device Circuits: Style D.
 - b. Notification Appliance Circuits: Style Z.
 - c. Signaling Line Circuits: Style 6.
 - d. Install no more than 80% of capacity of addressable devices on each signaling line circuit.
 2. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
 - a. Initiating Device Circuits: Style B.
 - b. Notification Appliance Circuits: Style Y.
 - c. Signaling Line Circuits: Style 4.
 - d. Install no more than 80% of capacity of addressable devices on each signaling line circuit.
 3. Serial Interfaces: One RS-232 or USB port for printer.

- D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Sound general alarm if the alarm is verified.
 4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Notification Appliance Circuit: Operation shall sound in a Temporal Code.
- F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out the final adjusted values on system printer.
- G. Voice/Alarm Signaling Service (if required): Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "Clear."
 - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

- J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch. System shall operate under secondary power for 24 hours of supervisory current and 5 minutes of alarm condition.
 - 1. Batteries: Sealed, valve-regulated, recombinant lead acid.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.
 - 5. Integral Visual-Indicating Light: LED type indicating detector has operated.
 - 6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.

e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
7. Where duct smoke detectors or smoke detection at smoke/fire dampers is indicated, the detectors shall be furnished by the fire-alarm supplier, installed by the mechanical contractor, and wired (for power and unit shut down) by the electrical contractor. Refer to mechanical/control Contract Documents for control sequences and provide devices and control circuitry as noted.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 92 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- C. Voice/Tone Notification Appliances:
 1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 2. High-Range Units: Rated 2 to 15 W.
 3. Low-Range Units: Rated 1 to 2 W.
 4. Mounting: Flush.
 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.
 6. Mounting Faceplate: Factory finished, white.

2.8 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall or to circuit-breaker shunt trip for power shutdown. See Drawings for connection.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL. Provide this device whether used or not on this project.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 1. Verification that both telephone lines are available.

2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Zone of the supervisory signal.
3. Zone of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.10 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

2.11 DEVICE COLOR

A. Color of fire-alarm devices (red or white) to be determined by Architect during submittal review of fire-alarm floor plans.

B. Horn and/or strobes shall be rectangular in shape.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit with tops of cabinets not more than 72 inches above the finished floor.

C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from part of a lighting fixture.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- F. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install per NFPA 72 requirements
- H. Visible Alarm-Indicating Devices: Install per NFPA 72 requirements.
- I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- J. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- K. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Supervisory connections at valve supervisory switches.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in 28 05 53 - "Identification for Electrical Safety and Security."
- B. Fire Alarm Annunciator plaque at FACP and FAAP: Provide Permanently affixed floor plan(s) map, depicting the initiating devices, (CAD generated, appropriately sized drawing) which are affixed and oriented according to the applicable FAAP and FACP locations. Plaque shall clearly indicate which way is up (i.e. top of floor plan is away from the location and user) (North, East, South, or West).
- C. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Retain first paragraph below to require that field quality-control tests be witnessed. Local ordinance or custom may require that authorities having jurisdiction witness the testing.
- B. Field tests shall be witnessed by authorities having jurisdiction (AHJ).
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- E. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- F. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- G. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.
- I. Maintenance Test and Inspection: Owner or Owner's representative shall perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- J. Annual Test and Inspection: One year after date of Substantial Completion, Owner or Owner's representative shall test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.
- 3.6 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate the fire-alarm system. Allow two sessions on different days of 4 hours for this training.

END OF SECTION

SECTION 28 46 23

VOICE EVACUATION FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 REFERENCES

- A. The publications listed below form a part of this Specification Section to the extent referenced. The publications are referred to within the text by the basic designation only. Use the latest edition, unless noted otherwise.
- B. ACOUSTICAL SOCIETY OF AMERICAN (ASA)
 - 1. ASA S3.2: (2009, R2014) Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85)
- C. AMERICANS WITH DISABILITIES ACT (ADA)
 - 1. ADAAG: Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
- D. ASME INTERNATIONAL (ASME): Safety Code for Elevators and Escalators
 - 1. ASME A17.1: Safety Code for Elevators and Escalators
- E. ASTM INTERNATIONAL (ASTM)
 - 1. ASTM F402-05 Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- F. FM GLOBAL (FM)
 - 1. FM APP GUIDE Approval Guide <http://www.approvalguide.com/>
- G. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
 - 1. IEEE C62.41.1 Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
 - 2. IEEE C62.41.2 Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
- H. INTERNATIONAL CODE COUNCIL
 - 1. IBC (2018) International Building Code
 - 2. IFC (2018) International Fire Code
 - 3. IMC (2018) International Mechanical Code
- I. INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
 - 1. IEC 60268-16 Sound System Equipment-Part 16: Objective rating of speech intelligibility by speech transmission indexes
- J. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

1. ISO 7240-16 Fire Detection and Alarm Systems - Part 16: Sound System Control and Indicating Equipment
2. ISO 7240-19 Fire Detection and Alarm Systems - Part 19: Design, Installation, Commissioning and Service of Sound Systems for Emergency Purposes

K. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. NFPA 70 (2017) National Electrical Code®
2. NFPA 72 (2016) National Fire Alarm and Signaling Code®
3. NFPA 90A (2015) Installation of Air Conditioning and Ventilating Systems
4. NFPA 170 (2015) Standard for Fire Safety and Emergency Symbols

L. SRP Codes

1. UL 1449 Surge Protective Devices
2. [UL 1480 Standard for Speakers for Fire Alarm, Emergency, and Commercial and Professional Use]
3. UL 1638 Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
4. UL 1971 Signaling Devices for the Hearing Impaired
5. UL 2017 General Purpose Signaling Devices and Systems
6. UL 268 Smoke Detectors for Fire Protective Signaling Systems
7. UL 464 Audible Signal Appliances
8. UL 497B Protectors for Data Communications and Fire-Alarm Circuits
9. UL 521 Heat Detectors for Fire Protective Signaling Systems
10. UL 864 Control Units and Accessories for Fire Alarm Systems
11. UL Fire Prot Dir Fire Protection Equipment Directory
12. <http://productspec.ul.com/index.php>

1.2 NOTICE TO BIDDERS

- A. Before submittal of bid, examine all Drawings, Specification, Addenda, alternatives, special conditions, and all other bidding documents of all sections of this Project, verifying all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement to all requirements of the Contract Documents and no consideration will be granted for any claimed misunderstanding thereof.
- B. Submittal of a bid is deemed a representation by the bidder that he is qualified in all respects to properly perform the work for which he is bidding and has experience with similar work. Bidders are deemed to be aware, on the basis of their background and experience, of materials which may be required in the discharge of their responsibilities, even though unspecified.
- C. Any case of error, omission, discrepancy, inconsistency or lack of clarity in the Specification or Drawings shall be promptly identified to Client.

1.3 SYSTEM DESCRIPTION

- A. This work includes providing a new, complete, networked, analog/addressable [voice evacuation] fire-alarm system as described herein and on the contract Drawings for the entire building. Include in the system wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, supervising station fire-alarm system transmitter, and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide system complete and ready for operation.
- B. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with the required provisions of NFPA 72, NFPA 70, NFPA 90A, IMC, IFC, ISO 7240-16, IEC 60268-16, and Client AFC, except as modified herein. The system layout on the Drawings shows the intent of coverage and devices/equipment are shown in suggested locations. Submit plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each conduit, and circuit layouts for all floors. Drawings shall comply with the requirements of NFPA 72 using symbols noted in NFPA 170. Final quantity, system layout and coordination are the responsibility of the contractor.
- C. Technical data and computer software (meaning technical data that relates to computer software) that are specifically identified in this Project, and may be defined/required in other Sections, shall be delivered, strictly in accordance with the CONTRACT CLAUSES. Identify data delivered by reference to the particular Specification Section paragraph against which it is furnished. Data to be submitted shall include complete system, equipment and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:
1. Identification of programmable portions of system equipment and capabilities.
 2. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
 3. Provisions of operational software data on all modes of programmable portions of the fire-alarm and detection system.
 4. Description of fire-alarm control panel equipment operation.
 5. Description of auxiliary and remote equipment operation.
 6. Library of application software.
 7. Operation and maintenance manuals.
- D. Keys and locks for equipment shall be identical. Provide not less than six keys of each type required. Master all keys and locks to a single key.

1.4 SUBMITTALS

- A. Submit six copies of the following, no later than 21 days prior to the start of system installation, in accordance with the General Conditions of the Contract. Drawings, unless noted otherwise, shall be no smaller than the Contract Drawings.

1. Shop Drawings
 - a. System Layout: Detail drawings conforming to the requirements prescribed in NFPA 72 and NFPA 170. Drawings shall include plan views showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each circuit, and circuit and conduit layouts for all floors. All devices shown on plans and riser diagram shall include device addresses.
 - b. Wiring Diagrams: Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams shall show connections from field devices to the FACU and remote fire control units, initiating circuits, switches, relays and terminals. Provide complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment.
 - c. Sequence of operation that describes how the system responds during an alarm, supervisory and trouble condition. The description shall include fire-alarm control unit LEDs, audible and visible indications; initiating devices, notification appliances, and auxiliary functions (such as elevator recall, HVAC fan unit shutdown, and smoke control system operation). The description shall provide sufficient information so that the exact function of each installed device and appliance is known.
 - d. System Operation: A complete list of device addresses and corresponding messages.
 - e. Notification Appliances / Initiating Devices: Data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances and 25 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings.
 - f. [Amplifiers: Data to indicate that amplifiers have sufficient capacity to simultaneously drive all notification speakers plus 25 percent spare capacity. Annotate data for each circuit on the drawings.
2. Contractor shall not order any equipment and shall not begin any work until the submittals have been approved in writing by SRP.
 - a. Contractor shall not perform any installation prior to the receipt of a written authority to proceed from SRP.
 - b. If submittals are found not to conform to all of the requirements of this Specification Section and the applicable referenced Codes, Standards and Regulations, Contractor shall be required to revise and resubmit the package with modifications.
3. Product Data: Annotated catalog data showing manufacturer's name, model, and catalog number for all equipment and components to be considered for the Project, as well as standby and alarm current for all initiation and notification appliances to verify calculations. In addition, a complete equipment list with equipment description, model number, and quantity shall be provided. This shall include the following:
 - a. Fire alarm control unit (FACU)
 - b. Terminal cabinets
 - c. Manual stations

- d. Batteries
 - e. Battery chargers
 - f. Smoke detectors
 - g. Heat detectors
 - h. Wiring and cable
 - i. Notification appliances
 - j. Addressable interface devices
 - k. DACT
 - l. LCD annunciator Transmitters (including housing) – If applicable
 - m. Amplifiers– If applicable
 - n. Tone generators – If applicable
 - o. Digitalized voice generators– If applicable
 - p. Electromagnetic door hold-open devices– If applicable
 - q. Line voltage surge protective devices
 - r. Auxiliary power (Booster) panels – If applicable
 - s. Fire-stopping
4. Calculations: Battery calculations as required in paragraph Battery Power Calculations. Submit a voltage drop calculation to indicate 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.
 5. Installers Qualifications: Data approved, prior to submittal of any other data or drawings, to substantiate that the proposed installer is regularly engaged in the installation of the type and complexity of the fire protection system included in this Project. Data shall identify the location of three systems recently installed by the proposed installer which are comparable to the system specified. Contractor shall certify that each system has performed satisfactorily, in the manner intended, for a period of not less than 6 months. Submit copy of license to perform work in the local jurisdiction and submit certification for the personnel working on the Project as detailed in 1.5 Quality Assurance.
 6. Field Report: A unique identifier for each device, including the control panel and initiating and indicating devices, with an indication of test results, and signature of the factory-trained technician. Include the NFPA 72 Record of Completion and Inspection and Testing forms with the appropriate test reports.
 7. As-Built Drawings: In addition to six hard copies, furnish one set of CD or DVD discs containing software back-up and CAD based drawings in the latest version of AutoCAD and DXF format and pdf copy of as-built drawings and schematics. The drawings shall include complete wiring diagrams showing connections between devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built locations of devices and equipment. The drawings shall show the system as installed, including deviations from both the Project Drawings and the approved Shop Drawings. These drawings shall be submitted within 14 calendar days after the final acceptance test of the system. At least two sets of as-built (marked-up) drawings shall be provided to Client at the time of, or prior to the final acceptance test.
 8. Operation and Maintenance (O&M) Manual: Four printed copies and one pdf copy for the Project-specific operation and maintenance manual. The operation

and maintenance manual shall be a single volume indexed and in booklet form. Manuals shall be submitted and approved prior to on-site training. In addition to items specified in Division 01 Section 01 78 23 "Operation and Maintenance Data", the Manuals shall include the following documents and information at a minimum:

- a. A general description of the design and operation of the system.
 - b. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - c. A copy of the as-built drawings in 11 x 17-inch format, folded neatly within the binder.
 - d. All applicable product installation sheets annotated as necessary.
 - e. Step-by-step procedures required for system startup, operation, and shutdown.
 - f. The manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.
 - g. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guide, and system warranty information.
 - h. Complete procedures for system revision and expansion, detailing both equipment and software requirements.
 - i. Software delivered for this Project shall be original software from the manufacturer provided on electronic media; no copies.
 - j. Printouts of configuration settings for all devices.
 - k. Routine maintenance checklist. The routine maintenance checklist shall be arranged in columnar format. The first column shall list all installed devices, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.
9. Impairment Plan: In the event the scope of work may remove from service or interfere with a fire suppression or alarm system, the design engineer shall consult and communicate with the Client
10. Fire Marshal to develop an Impairment Plan. The Impairment Plan developed by the design engineer shall be submitted at the same time as the design drawings for review and approval. The final plan shall be written on the drawings.
11. Training Documentation: Provide in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training shall familiarize Client's designated personnel with proper operation of the installed system.
- a. The maintenance training course shall provide SRP's designated personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.
12. Schedule: Provide a schedule indicating the delivery dates of the equipment to be supplied; installation sequence; time frame and the total amount of on-site technical assistance time (in man-hours per phase) that the supplier of the equipment has included in their bid to comply with the requirements of this

Specification Section and SRP's requirements; and final acceptance test dates to meet SRP's scheduled Project completion dates.

13. Preliminary Equipment List: Provide a preliminary equipment list identifying the type, quantity, make, and model number of each piece of equipment to be provided under this submittal. Types and quantities of equipment submitted shall coincide with the types and quantities of equipment used in the battery calculations and those shown on the Shop Drawings. A final equipment list shall be submitted with the Operating and Maintenance (O&M) manual.
14. In the event that the Contractor's submittal package is required to be revised and resubmitted due to nonconformance with this Specification, illegibility of the submittal, incomplete submittals, noncompliance with the referenced local, state and national Codes, Standards and Regulations or nonconformance with pertinent documentation relative to the Project, the contractor shall pay all fees associated with the additional submittal review. Payment of the fee shall be solely the contractor's responsibility.

1.5 QUALITY ASSURANCE

- A. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.
- B. Qualifications - Contractor: The contractor shall be an Arizona licensed contractor in possession of a valid fire-alarm system contractor's license. Design and installation must be performed by a fire-alarm contractor whose business is located within a 75-mile radius of the Project site. The contractor shall have a minimum of 3 years of experience in the installation of [voice evacuation] fire-alarm systems in similar facilities.
- C. Qualifications - Design Services: Shop (working) Drawings and calculations shall be prepared under the direction of and signed by a qualified registered Professional Engineer or a NICET Level III in Fire Alarm Systems. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:
 1. A registered professional engineer having passed the NCEES examination in fire protection engineering.
 2. Registered professional engineer with verification of experience and at least 5 years of current experience in the design of the fire protection and detection systems.
- D. Qualifications - Supervisor: A NICET Level III (minimum) fire-alarm technician shall supervise the installation of the fire-alarm system. The fire-alarm technician shall be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the Drawings.
- E. Qualifications - Technician: Fire alarm technicians with a minimum of 4 years of experience shall be utilized to assist in the installation and termination of fire-alarm devices, cabinets and panels. The fire-alarm technicians installing the equipment shall be factory-trained in the installation and adjustment of the equipment specified herein and on the Drawings.

- F. Qualifications - Installer: Fire alarm installer with a minimum of 2 years of experience shall be permitted to assist in the installation of fire-alarm devices, cabinets and panels. An electrician shall be permitted to install wire, cable, conduit and backboxes for the fire-alarm system.
- G. Qualifications - Test Personnel: Fire alarm technicians with a minimum of 8 years of experience shall be utilized to test and certify the installation of the fire-alarm devices, cabinets, and panels. The fire-alarm technicians testing the equipment shall be factory-trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the Drawings.

1.6 REGULATORY REQUIREMENTS

- A. All system components shall be listed or approved for their intended use and shall be compatible with the system and its components. Where the terms "listed" or "approved" appear in this Specification Section, they shall mean UL-listed (UL Fire Prot Dir), FM-approved (FM App Guide), or listed by a nationally recognized testing laboratory (NRTL). The omission of these terms under the description of any item of equipment described shall not be construed as waiving the requirement for listing or approval. All listings or approvals shall be based on an existing ANSI or UL published standard.
- B. Compliance with NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this Specification Section and applicable standards, this Specification Section shall govern.
- C. Install all work in full conformance with the requirements of all local and governmental authorities having jurisdiction over these matters, utility company requirements, and requirements of the latest issues of all applicable Codes, including the IBC, IFC and SRP AFC. The building permit will be secured by SRP, any additional permits, inspections, close out shall be the responsibility of the contractor.
- D. The fire protection installation and the installing contractor shall comply fully with all city, county and state laws, ordinances and regulations applicable to fire protection installations.
- E. Should any change in Drawings or Specification be required to comply with governmental regulations, the contractor shall notify the Engineer at the time of submitting his bid.
- F. Secure and pay for necessary approvals, permits, inspections, etc., and deliver the official records of the granting of permits to the SRP Representative without additional cost to SRP.
- G. A Work Authorization is required for all [voice evacuation] fire-alarm system work. The SRP Project Manager (PM) shall apply for and receive the Work Authorization. The fire protection contractor will receive the Work Authorization from the SRP PM. The Work Authorization must be prominently displayed at the jobsite before any work, to

include demolition, can begin. Upon completion of the work, a final inspection by the SRP Fire Marshal, and the satisfactory resolution of all issues identified by the Final Inspection, the SRP Fire Marshal shall sign and close out the Work Authorization which indicates acceptance of the permitted work.

1.7 VERIFYING ACTUAL FIELD CONDITIONS

- A. Before commencing work, examine all adjoining work on which the contractor's work is in any way dependent for perfect workmanship according to the intent of this Specification section, and report to the SRP Representative any condition which prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.
- B. The contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the SRP Representative of any discrepancy before performing the work.

1.8 COORDINATION OF TRADES

- A. The Contract Documents are not intended to serve as coordinated construction drawings showing all minor adjustments in locations required for a fully coordinated installation that respects the work of all trades.
- B. Conduit, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction.
- C. Wherever the contractor's work interconnects with work of other contractors, the contractor shall coordinate his work with other contractors to ensure that all contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers, etc.) concealed above hung ceilings by permanent colored pins/tabs in the ceiling directly below the item.
- D. Provide required supports and hangers for conduit and equipment, so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.
- E. Field drilling and cutting of holes in structural decks, roofs, walls, etc., required for work under this section shall be coordinated through various trades in their respective materials and approved by the SRP Representative. All such drilling, cutting, and reinforcing costs shall be borne by the contractor.
- F. Due to the type of installation, a fixed sequence of construction is required to properly install the complete systems. It shall be the responsibility of the contractor to coordinate, protect, and schedule his work with other trades in accordance with the construction sequence.

- G. Cooperate with all other contractors and subcontractors to facilitate the completion of the work as a whole, subject to the direction of the SRP Representative.

1.9 SCHEDULING

- A. Provide a schedule to SRP indicating the installation sequence and time frame prior to beginning work. Provide weekly updates to SRP. All wiring, circuit testing and device installation shall be completed in time for the equipment supplier to make all final connections and conduct all tests as outlined in this Specification section.
- B. Coordinate the Acceptance Test for each fire-alarm system with SRP and other necessary parties identified by SRP.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants in accordance with manufacturer's instructions.
- B. Coordinate the storage arrangement and location with SRP.
- C. Deliver and store products in shipping containers/boxes, with labeling in place.

1.11 WASTE REMOVAL

- A. At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash, which may have accumulated during the day as a result of work by the contractor and of his presence on the job.
- B. Sidewalks and street adjoining the property shall be kept broom clean and free of waste, debris, trash and obstructions of any kind caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities and property.

1.12 EXTRA MATERIALS

- A. Repair Service/Replacement Parts: During warranty period, the service technician shall be on-site within 24 hours after notification. All repairs shall be completed within 24 hours of arrival on-site.
- B. Interchangeable Parts: Spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to SRP at the time of the final acceptance testing.
- C. Spare Parts: Furnish the following spare parts and accessories:
 - 1. Fuses: Four of each for each type, rating, and size of fuse used in the system.
 - 2. Ten percent of each initiating device and notification appliance installed, but no less than two of each.

3. Surge protective devices: Two low voltage, one [telephone][ethernet], and one 120 VAC surge protective devices.
 4. Addressable control and monitor modules: Ten percent of the installed quantity of each type, but no less than two devices of each type.
 5. Light bulbs: Four of each for each type of lamp used in the system.
 6. Keys: A minimum of three sets of keys shall be provided and appropriately identified.
- D. Special Tools: Software, connecting cables, and proprietary equipment, necessary for the maintenance, testing and reprogramming of the equipment shall be furnished to SRP.
- E. Spare Parts Cabinet: A wall-mounted, metal, locking cabinet no less than 22 gage steel in black baked-on enamel shall be provided and installed by the contractor adjacent to the system control unit or another approved location as directed by the SRP Representative. The cabinet shall be sized to hold all spare parts and one copy of the O&M manual and training manual. An inventory list shall be made of all items to be kept inside cabinet. Include on the list the number of all spare parts and keys to be provided. Give inventory list to the SRP Representative during acceptance of the fire-alarm system for verification of items in the cabinet. The SRP Representative will sign off on list when all items on list appear in the cabinet. The cabinet shall be provided with a permanent label stating "FIRE ALARM SPARE PARTS".
- F. Documentation Cabinet: A wall-mounted, metal, locking cabinet, no less than 22 gage steel, shall be provided and installed adjacent to the system control unit or another approved location as directed by the SRP Representative. Cabinet shall be sized to fit all system record documentation. The cabinet shall be prominently and permanently labeled "SYSTEM RECORD DOCUMENTS". The spare parts cabinet and document cabinet can be combined into one unit.

1.13 EXISTING FIRE ALARM SYSTEM

- A. The existing fire-alarm system shall remain operational until the new fire-alarm system has been installed, partially tested, and preliminarily accepted by the SRP Representative. Upon partial acceptance of the new fire-alarm system, the contractor shall remove the existing fire-alarm system, including all devices, wire/cable and the fire-alarm control unit. All unused raceways shall be demolished unless directed otherwise. All areas where portions of the existing fire-alarm system are removed shall be repaired to match the surrounding areas. All repairs shall be subject to approval by the SRP Representative.
- B. All parts of the existing fire-alarm system including the devices and control unit, raceway, wire and wiring related materials shall be properly disposed of off-site by the contractor.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. **Standard Products:** Material and equipment shall be the standard products of a manufacturer, where possible, and not a combination of manufacturers for any particular classification of materials. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. All materials and equipment supplied shall be new, first quality and the manufacturer's best type and latest model capable of complying with all requirements of this Specification section and shall have been in continuous production and in continuous service in commercial applications for at least one year. Obsolete equipment shall not be used.
- B. **Nameplates:** Major components of equipment shall have the manufacturer's name, model or serial number, and date of installation provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to FACUs, DACT, or terminal cabinets. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.
- C. **Acceptable Manufacturers:** Notifier (NFS3030, NFS640, NFS320).
- D. **Expansion/Spare Capacity:** Spare capacity shall pertain to quantities of devices, circuits, amplifiers, raceway, conductors, ampacities (size) and lengths. The system shall have spare installed capacity enabling it to support a 25 percent increase in the number of initiating devices and monitor and control points (addressable devices), notification appliance circuits, and power supplies. Spare circuit capacity to accommodate installation of the required device increases shall be evenly distributed throughout the system.

2.2 SYSTEM OPERATION

- A. The fire-alarm and voice evacuation system shall be a complete, supervised, non-coded, networked, analog/addressable fire-alarm system conforming to NFPA 72, UL 864, and UL 2017. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in alarm mode until the initiating device is reset and the control panel is reset and restored to normal.
- B. **Functions and Operating Features:** The system shall provide the following functions and operating features:
 - 1. The FACU shall provide power, annunciation, supervision, and control for the system. Addressable systems shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits with sufficient memory to perform as specified.
 - 2. Provide Class A initiating device circuits.
 - 3. Provide Class A for each floor].
 - 4. Provide Class A signaling line circuits for the network.
 - 5. Provide Class A notification appliance circuits.

6. Alarm, supervisory, and/or trouble signals shall be automatically transmitted to the remote supervising station.
7. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
8. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.
9. There shall be no limit, other than maximum system capacity, as to the number of addressable devices that may be in alarm simultaneously.
10. Where the fire-alarm system is responsible for initiating an action in another emergency control device or system, such as an HVAC system or an elevator system, the addressable fire-alarm relay shall be within 3 feet of the control device.
11. An alarm signal shall automatically initiate the following functions:
 - a. Transmission of an alarm signal to the remote supervising station.
 - b. Visual indication of the device operated on the fire-alarm control unit, and on the annunciator panel, and visual display unit (VDU)].
 - c. Continuous actuation of all alarm notification appliances.
 - d. Recording of the event electronically in the history log of the FACU.
 - e. Operation of a heat detector or waterflow switch serving an elevator machine room, top of shaft, or elevator shall operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1.
12. A supervisory signal shall automatically initiate the following functions:
 - a. Visual indication of the device operated on the FACU, on the annunciator panel, [and VDU,] and sound an audible signal at the respective panel.
 - b. Transmission of a supervisory signal to the remote supervising station.
 - c. Recording of the event electronically in the history log of the FACU.
 - d. Operation of a duct smoke detector shall shut down the appropriate air handler in accordance with [NFPA 90A][IMC] in addition to other requirements of this paragraph and as allowed by NFPA 72.
13. A trouble condition shall automatically initiate the following functions:
 - a. Visual indication of the system trouble on the FACU, on the annunciator panel and sound an audible signal at the respective panel.
 - b. Transmission of a trouble signal to the remote supervising station.
 - c. Recording of the event electronically in the history log of the FACU.
14. The maximum permissible elapsed time between the actuation of an initiating device and its indication at the FACU is 10 seconds.
15. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACU is 200 seconds.

2.3 SYSTEM MONITORING

- A. Valves: Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, and valves at backflow preventers shall be electrically monitored to ensure its

proper position. Provide each tamper switch with a separate address; unless they are within the same room, then a maximum of five can use the same address.

- B. Electric Fire Pump: The fire pump system shall be monitored by the fire-alarm system for the following conditions: fire pump running, loss of primary power, and phase reversal. Each condition shall be provided with a separate address.
- C. Diesel Fire Pump: The fire pump system shall be monitored by the fire-alarm system for the following conditions: fire pump running, controller main switch not in auto, and main switch mis-set.
- D. Fire Suppression Releasing System: The fire suppression releasing control panel shall be monitored by the fire-alarm system for the following conditions: system activation, supervisory and trouble. Each condition shall be provided with a separate address.

2.4 FIRE ALARM CONTROL UNIT (FACU)

- A. Provide a complete control unit fully enclosed in a lockable steel cabinet as specified herein. Operations required for testing or for normal care and maintenance of the system shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control unit, the cabinets shall match.
 - 1. Each control unit shall provide power, supervision, control and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 VAC, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation.
 - 2. Visual indication of alarm, supervisory, or trouble initiation on the fire-alarm control panel shall be by liquid crystal display or similar means with a minimum of 80 characters.
 - 3. Provide secure operator console for initiating recorded messages, strobes, and displays; and for delivering live voice messages. Provide capacity for at least eight prerecorded messages. Provide the ability to automatically repeat prerecorded messages. Provide a secure microphone for delivering live messages. Provide adequate discrete outputs to temporarily deactivate fire-alarm audible notification and initiate/synchronize strobes. Provide a complete set of self-diagnostics for controller and appliance network. Provide local diagnostic information display and local diagnostic information and system event log file.
 - 4. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
 - 5. Provide an audible and visible trouble signal to activate upon a single break or open condition, or ground fault. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature that shall silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke

- detector in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.
6. Provide program capability via switches in a locked portion of the FACU to bypass the automatic notification appliance circuits, air handler shutdown, and door hold-open release. Operation of this programming shall indicate this action on the FACU display.
 7. Provide alarm verification capability for smoke detectors. Alarm verification shall initially be set for 0 seconds.
 8. The system shall be capable of being programmed from the panel's keyboard. Programmed information shall be stored in non-volatile memory.
- B. Cabinet: Install control unit components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of units as well as field wiring. The enclosure shall be identified by an etched metal or plastic nameplate. Lettering on the nameplate shall say "Fire Alarm Control Unit" and shall not be less than 1-inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with backbox, hinged steel door with cylinder lock, and surface mounting provisions.
- C. Wiring: Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and resistors, if any, on screw terminals in the FACU. Circuits operating at 24 VDC shall not operate at less than the UL-listed voltage at the detector or appliance connected. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of normal voltage.
- D. Silencing Switches:
1. Alarm Silencing Switch: Provide an alarm silencing switch at the FACU that shall silence the audible and visual signal but not affect the visual alarm indicator and shall not silence a waterflow alarm. This switch shall be overridden upon activation of a subsequent alarm.
 2. Supervisory/Trouble Silencing Switch: Provide supervisory and trouble silencing switch that shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm, supervisory, or trouble condition. Audible trouble indication must resound automatically every 24 hours after silencing feature has been operated.
- E. Non-Interfering: Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually reset by switch from the FACU after the initiating device or devices have been restored to normal.
- F. Audible Notification System: The audible notification system shall comply with the requirements of NFPA 72 for emergency voice/alarm communications, except as specified herein. The system shall be a one-way multi-channel voice notification system incorporating user selection of a minimum of eight distinct sounds for tone signaling, and the incorporation of a voice module for delivery of prerecorded

messages. Audible appliances shall produce a temporal 3 tone for three cycles following a voice message that is repeated until the control panel is reset or silenced. Automatic messages shall be broadcast through speakers throughout the building/facility. A live voice message shall override the automatic audible output through use of a microphone input at the control unit.

1. Where audible appliances are installed in sleeping areas they shall produce a low frequency alarm signal of 520 Hz.
 2. When using the microphone, live messages shall be broadcast throughout a selected floor or floors or all call. The system shall be capable of operating all speakers at the same time. The microprocessor shall actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction that could render the digitalized voice module inoperative shall automatically cause the code 3 temporal tone to take over all functions assigned to the failed unit in the event an alarm is activated.
- G. Visual Notification System: Notification appliance circuits (NAC) shall be provided for the activation of strobe appliances. The activation of the visual NAC circuits shall follow the operation of the audible NAC circuits. The strobe NAC circuits shall provide at least 2 amps of 24 VDC power to operate strobes and have the ability to synchronize all strobes.
- H. Outputs and Operational Modules: All outputs and operational modules shall be fully supervised with on-board diagnostics and trouble reporting circuits. Provide form C contacts for system alarm and trouble conditions. Provide circuits for operation of auxiliary appliance during trouble conditions.
- I. Memory: Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.
- J. Field Programmability: Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and shall be accomplished using personal computer-based equipment.
- K. Input/output Modifications: The FACU shall contain features that allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad. Any bypass or modification to the system shall indicate a trouble condition on the FACU.
- L. Resetting: Provide the necessary controls to prevent the resetting of any alarm supervisory, or trouble signal while the alarm, supervisory, or trouble condition on the system still exists.
- M. Walk Test: The FACU shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the

notification appliances operate for only a few seconds[and the event is indicated on the system printer,] but no other outputs occur.

- N. History Logging: The control unit shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control unit shall not clear the memory.
- O. Access: Access and control of the operating program shall be restricted to proper personnel designated by SRP.
 - 1. The control unit shall have a minimum of two (2) security levels. Each level shall have individual passwords. Illegal access attempts shall be rejected by the system and shall be displayed and recorded in the history file with time and date.
 - 2. The "First" security level shall be the lowest security level and shall only allow access to the system status levels and lists and shall not impair system operation.

2.5 AMPLIFIERS, PRE-AMPLIFIERS, TONE GENERATORS

- A. Any amplifiers, pre-amplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 shall be housed in a remote FACU, terminal cabinet, or in the FACU.
- B. Operation: The system shall automatically operate and control all building speakers except those installed in stairs and within elevator cabs. Speakers in stairs and elevator cabs shall operate only when the microphone is used to deliver live messages.
- C. Construction: Amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient surges up to 10 times the highest rated voltage in the system.
- D. Inputs: Equip each system with separate inputs for the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance balance line type. Both microphone and tone generator input shall be operational on any amplifier.
- E. Tone Generator: The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a code 3 temporal tone and shall be constantly repeated until interrupted by the digitalized voice message, the microphone input, or the alarm silence mode as specified. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay.
- F. Protection Circuits: Each amplifier shall be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator at the control unit, and appropriate logging of the condition electronically.

2.6 ANNUNCIATOR

- A. Annunciator Panel: Provide an annunciator that includes an LCD display. The display shall indicate the device in trouble/alarm or any supervisory device. Display the device name, address, and actual building location.
- B. Programming: Where programming for the operation of the annunciator is accomplished by a separate software program than the software for the FACU, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.

2.7 VISUAL DISPLAY UNIT

- A. Provide visual display unit in locations as shown on the Drawings. The units shall be intelligent and shall be capable of displaying and responding to all fire-alarm network events and points via video display. The units shall be capable of importing and displaying floor plan drawings, and be fully customizable by the user with respect to text, icons, and colors.

2.8 COMBINATION FIXED TEMPERATURE AND RATE-OF-RISE HEAT DETECTORS

- A. Provide heat detectors for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors shall be supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F. The UL 521 test rating for the rate-of-rise detectors shall be rated for 50 by 50 feet.

2.9 SMOKE DETECTORS

- A. Photoelectric Smoke Detectors: Provide addressable photoelectric smoke detectors as follows:
 - 1. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors shall be listed for use with the fire-alarm control unit.
 - 2. Provide self-restoring type detectors that do not require any re-adjustment after actuation at the FACU to restore them to normal operation.
 - 3. Components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 - 4. Provide twist lock bases constructed of white, high impact polycarbonate designed for mounting on a standard 3 1/2-inch or 4-inch octagonal or 4-inch square outlet box for detectors. The detectors shall maintain contact with their bases without the use of springs.
 - a. Provide companion mounting base with screw terminals for each conductor. Terminate field wiring on screw terminals. The detector shall

have a visual indicator to show actuation. Insertion of an incorrect detector type into the base shall cause a "Wrong Device" trouble condition at the FACU until the proper type of detector is installed, or the system is re-programmed.

- b. The system program shall recognize the insertion of a wrong device and shall automatically default to the set point values corresponding to the inserted device and shall monitor alarm and trouble conditions according to the default parameters.
5. Sounder bases shall produce a minimum of 90 dBA at 10 feet.
 6. The detector address shall identify the particular unit, its location within the system, and its sensitivity setting. Detectors shall be of the low voltage type rated for use on a 24 VDC system.
 7. An operator at the control unit, having the proper access level, shall have the capability to manually access the following information for each initiating device.
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Detector range (normal, dirty, etc.)
- B. Duct Smoke Detectors: Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Smoke Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire-alarm control unit.
1. Sampling tubes shall run the full width of the duct. The control functions, operation, reset, and bypass shall be controlled from the fire-alarm control unit.
 2. Lights to indicate the operation and alarm condition, and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Remote indicators shall be provided where required by NFPA 72 and these shall be provided with key-operated test and reset switches.
 3. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall provide for control of auxiliary contacts for shutdown. Auxiliary contacts provided for this function shall be located within 3 feet of the controlled circuit or appliance.
 4. The detectors shall be compatible with the FACU to ensure complete system compatibility.

2.10 AIR SAMPLING SMOKE DETECTORS

- A. Addressable Air Sampling Smoke Detectors: The addressable air sampling smoke system shall consist of a detector assembly housing an integral aspiration fan, filter, laser-based detection chamber and control, output and supervision circuitry. Each sampling point shall be capable of being independently addressable. The system shall consist of a piping or tubing distribution network that runs from the detector

assembly(s) to the protected area(s) and is supported by calculations from a computer-based design modeling tool. The system shall include configurable alarm and trouble relay outputs for interface to other systems where required.

1. System shall be complete in all ways. It shall include all engineering, and electrical installation, all detection and control equipment, auxiliary devices and controls, alarm interface, functional checkout and testing, training and all other operations necessary for a functional system.
2. System base detectors and modules shall each accommodate up to 40 addressable micro-bore sampling tubes where each tube has a sampling point at the end. Additional modules may be used to provide up to 20 addressable sampling holes per system.
3. The system shall provide four alarm outputs along with outputs for trouble and supervisory signals. The four alarm outputs shall be designated as ALERT, PRE-ALARM, FIRE 1, and FIRE 2, and each of the alarms shall be field adjustable based on obscuration levels at the detector. Each alarm is to be transmitted to the FACU. The detector is to interface with the factory approved software which will provide the address location of the alarm initiating point.
4. All air sampling smoke detection devices and associated components shall be new, standard products or the manufacturer's latest design and suitable to perform the functions intended.
5. The laser detection chamber shall be of the mass light scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method shall be employed for the purposes of:
 - a. Preventing large particles from affecting the true smoke reading.
 - b. Monitoring contamination of the filter (dust and dirt, etc.) to automatically notify when maintenance is required. The particle counting method shall not be used for the purpose of smoke density measurement.
6. Detector(s) shall be self-monitoring for filter contamination and provide indication through system fault when replacement is necessary. Detectors which allow automatic reset of filter status upon removal and re-insertion are not permitted.
7. Detector(s) shall contain relays for alarm and fault conditions. The relays shall be software programmable to the required functions.
8. Detector(s) shall permit configuration by programmers that are either integral to the system, portable, or PC based.
9. Detector(s) shall allow programming of:
 - a. Smoke threshold alarm levels.
 - b. Time delays.
 - c. Faults, including airflow, detector, power, filter and network, as well as an indication of the urgency of the fault.
 - d. Configuration of relay outputs for remote indication of alarm and fault conditions.
 - e. General purpose input functionality.]

2.11 ADDRESSABLE INTERFACE DEVICES

- A. The system shall be capable of defining any module as an alarm module and report alarm, trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open, or loss of polling such as waterflow switches, valve supervisory switches, relays for output function actuation, etc.
 - 1. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code.
 - 2. Monitor module shall contain an integral LED that flashes each time the monitor module is polled and is visible through the device cover plate.
 - 3. Pull stations with a monitor module in a common backbox are not required to have an LED.

2.12 ADDRESSABLE CONTROL MODULE

- A. The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control with other systems, and to control door holders or initiate elevator fire service. The indicating device or the external load being controlled shall be configured as a Class B notification appliance circuit. The system shall be capable of supervising, audible, visual, and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control module shall provide address setting means compatible with the control unit's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled and is visible through the device cover plate. Control modules shall be located in environmental areas that reflect the conditions to which they were listed and shall include a mounting plate for installation in a junction box.

2.13 ISOLATION MODULES

- A. Provide isolation modules to subdivide each signaling line circuit into groups of not more than 20 addressable devices for each floor between adjacent isolation modules.
- B. Isolation modules shall provide short circuit isolation for signaling line circuit wiring.
- C. Power and communications shall be supplied by the SLC and shall report faults to the FACU.
- D. After the wiring fault is repaired, the fault isolation modules shall test the lines and automatically restore the connection.

2.14 MANUAL STATIONS

- A. Provide metal or plastic, surface-mounted, double-action, addressable manual stations, that are not subject to operation by jarring or vibration. Stations shall be equipped with screw terminals for each conductor. Stations that require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire

engine red with molded raised white lettering operating instructions of contrasting color. The stations shall mechanically latch after operation with a key or wrench reset feature. Stations shall have a separate screw terminal for each conductor.

- B. Every manual fire-alarm box shall have an engraved nameplate permanently installed on its face or Brady adhesive markers, or SRP approved equal, attached to them indicating the address of the station. The contractor shall install markers on the outside of the manual fire-alarm box and lettering shall be a minimum of 12-point.

2.15 NOTIFICATION APPLIANCES

- A. Fire Alarm Speakers: Audible appliances shall conform to the applicable requirements of UL 464. Appliances shall be connected into notification appliance circuits. Surface-mounted audible appliances shall be white. Recessed audible appliances shall be installed with a grill that is painted white.
 - 1. Speakers shall conform to the applicable requirements of UL 1480. Speakers shall have six different sound output levels and operate with audio line input levels of 70.7 VRMS and 25 VRMs, by means of selectable tap settings. Tap settings shall include taps of 1/4, 1/2, 1, and 2-watt. Speakers shall incorporate a high efficiency speaker for maximum output at minimum power across a frequency range of 400 Hz to 4,000 Hz, and shall have a sealed back construction. Speakers shall be capable of installation on standard 4-inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single unit. All inputs shall be polarized for compatibility with standard reverse polarity supervision of circuit wiring via the FACU.
 - 2. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16-gage or molded high impact plastic and equipped with mounting holes and other openings as needed for a complete installation. Fabrication marks and holes shall be ground and finished to provide a smooth and neat appearance for each plate. Each plate shall be primed and painted.
 - 3. Speakers shall utilize screw terminals for termination of all field wiring.
- B. Fire Alarm Horns: Horns shall conform to the applicable requirements of UL 464. Horns shall be surface-mounted, with the matching mounting backbox surface-mounted vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles. Horns located in the hangar bay shall be NEMA 4 rated.
- C. Visual Notification Appliances: Visual notification appliances shall conform to the applicable requirements of UL 1971 and conform to ADAAG. Colored lens, such as amber, shall comply with UL 1638. The manufacturer shall have the colored lens tested to the full UL 1971 polar plotting criteria, voltage drop, and temperature rise as stated in UL 1971. Fire alarm notification appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light and be marked "Fire" in red letters. The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90-degree angle on both sides of the strobe. Strobe flash rate shall be 1 flash per second and a minimum of 15 candela based on the UL 1971 test. Strobes shall be

semi-flush-mounted. Where more than two appliances are located in the same room, or corridor, or field of view, provide synchronized operation. Devices shall use screw terminals for all field wiring.

2.16 ELECTROMAGNETIC DOOR HOLD-OPEN DEVICES

- A. Provide where shown on Drawings. The armature portion shall be mounted on the door and shall have an adjusting screw for setting the angle of the contact plate. Mount the electromagnetic release on the wall or in a wall recess behind the door, except where no wall and then mount on floor. Total projection of the door holder release shall not exceed 4 inches. Door holders shall be powered by the fire-alarm system (24 VDC) but not require battery backup power, unless specifically noted on the Drawings.

2.17 PRIMARY ELECTRIC POWER

- A. Power shall be 120 VAC service for the FACU from the normal AC service to the building in accordance with NFPA 72.

2.18 SECONDARY POWER SUPPLY

- A. Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.
- B. Batteries: Provide sealed, maintenance-free, lead-acid batteries as the source for emergency power to the FACU. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid-state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.
 - 1. Capacity, Fire Alarm System: Battery size shall have sufficient capacity to operate the fire-alarm system under supervisory and trouble conditions, including audible trouble signal devices for 24 hours and audible and visual signal devices under alarm conditions for an additional [15][] minutes.
 - 2. Battery Power Calculations: Verify that battery capacity exceeds supervisory and alarm power requirements. Substantiate the battery calculations for alarm, alert, and supervisory power requirements. Include ampere-hour requirements for each system component and each panel component, and compliance with UL 864. Provide complete battery calculations for the alarm, alert, and supervisory power requirements. Include a 1.2 derating factor in all calculations.
 - 3. For battery calculations use the following assumptions: Assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required amp-hours for the specified standby time, and then calculate the required amp-hours for the specified alarm time. Calculate the nominal battery voltage after operation on batteries for the specified time period.

- C. Battery Chargers: Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 120 percent of the connected system load and shall maintain the batteries at full charge.
 - 1. In the event the batteries are fully discharged (20.4 VDC), the charger shall recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph Capacity above.
 - 2. Provide a pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

2.19 LINE VOLTAGE SURGE PROTECTIVE DEVICES

- A. Line voltage surge protective devices shall be provided to suppress all voltage transients which might damage fire-alarm panel components. The surge protective device shall wire in series to the power supply of the protected equipment with screw terminations. Line voltage surge arrestor shall be installed directly adjacent to the power panel where the FACU breaker is located.
- B. Line voltage surge protective devices for nominal 120 VAC shall be UL 1449 listed with a maximum 500 Volt suppression level and have a maximum response time of 5 nanoseconds. The surge protective device shall also meet IEEE C62.41.1 and C62.41.2 category B tests for surge capacity. The surge protective device shall feature multi-stage construction and be provided with a long-life indicator lamp (either light emitting diode or neon) which extinguishes upon failure of protected components. Any unit fusing shall be externally accessible.
- C. Line voltage surge protective device for nominal 24 VAC, for alarm telephone dialer, or ethernet connection shall be UL 497B listed and have a maximum response time of 1-nanosecond. The surge protective device shall feature multi-stage construction and be self-resetting. The surge protective device shall be a base and plug style. The base assembly shall have screw terminals for fire-alarm wiring. The base assembly shall accept a "plug-in" surge protective module.
- D. All surge protective devices (SPD) shall be the standard product of a single manufacturer and be equal or better than the following:
 - 1. For 120 VAC nominal line voltage: DITEK DTK-120S20A series-connected, 20 A AC power SPD.
 - 2. For 24-volt nominal line voltage: DITEK DTK-24MHLP24BWB series-connected, modular, 5A maximum current SPD.
 - 3. For alarm telephone dialers: DITEK DTK-MRJ31XSCPWP or approved equal.
 - 4. For IP-DACTs: DITEK DTK-MRJETHS or approved equal.

2.20 WIRING

- A. Alarm Wiring: SLC and IDC wiring shall be solid copper cable in accordance with the manufacturer's requirements. Copper signaling line circuits and initiating device circuit field wiring shall be No. 18 AWG size twisted and shielded solid conductors at a minimum. Visual notification appliance circuit conductors and notification appliances, other than speakers, shall be solid copper No. 14 AWG size conductors at a minimum.

Speaker circuits shall be stranded or solid copper No. 16 AWG size twisted and shielded conductors at a minimum. Wire size shall be sufficient to prevent voltage drop below manufacturer's recommendations. Power wiring, operating at 120 VAC minimum, shall be a minimum of No. 12 AWG solid copper having similar insulation. Acceptable power-limited cables are FPL, FPLR or FPLP as appropriate with red colored covering. Non-power-limited cables shall comply with NFPA 70.

- B. All wiring not in conduit or raceway shall be plenum rated as described in NFPA 70.

2.21 ENVIRONMENTAL ENCLOSURES OR GUARDS

- A. Environmental enclosures shall be provided to permit fire-alarm components to be used in areas that exceed the environmental limits of the listing. The enclosure shall be listed for the device or appliance as either a manufactured part number or as a listed compatible accessory for the UL category that the component is currently listed. Guards required to deter mechanical damage shall be either a listed manufactured part or a listed accessory for the category of the initiating device or notification appliance.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. The contractor shall plan and use caution while removing existing ceiling tiles for the installation of the fire-alarm system and voice evacuation components. All ceiling tiles shall be re-installed by the contractor. Broken ceiling tiles and their location shall be reported to SRP.
- B. The supervisory work of the qualified manufacturer's technical representative shall include, but not necessarily be limited to, checking all the system wiring connections; advising the contractor regarding technical details of the installation; and the adjustment and testing of all components of the system in order to ensure a complete and satisfactorily operable system.
 1. The manufacturer's technical representative shall be on site, as required by SRP, during the entire installation and connection of the new control equipment.
 2. The technical representative shall monitor all wiring changes and assist the contractor to ensure a smooth transition to the new control equipment.
 3. The cost of the technical representative shall be paid by the contractor and shall be included in the bid price.
 4. The minimum number of man-hours for this technical representative to be carried is 40 hours.
 5. The contractor shall identify the amount of manufacturer's technical representative's man-hours that shall be provided and the per-hour cost (including the cost for possible overtime premium (hours) for the technical representative's time.
 6. The manufacturer's technical representative shall also be required to instruct designated building and management personnel in the general operation of the system and to give the designated personnel an overview of the system functions

when the system is in normal, supervisory mode, alarm mode, and trouble mode, as specified in this Specification section.

3.2 DEVICE/EQUIPMENT INSTALLATION

- A. FACU: Locate the FACU where indicated on the Drawings. Mount the enclosure semi-flush, with the top of the cabinet 6 feet above the finished floor or center the cabinet at 4 feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FACU.
- B. Manual Stations: Locate manual stations as required by NFPA 72 and as shown on the Drawings. Mount stations so that their operating handles are no more than 4 feet above the finished floor. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally.
- C. Notification Appliances: Locate notification appliances as required by NFPA 72. Notification appliance circuits shall not be installed in the same raceway with signaling line circuits unless approved in writing by the FACU manufacturer.
- D. Heat Detectors: Locate detectors as required by NFPA 72 and their listing on a 4-inch backbox. Install heat detectors not less than 4 inches from a side wall to the near edge. Heat detectors located on the wall shall have to top of the detector at least 4 inches below the ceiling, but not more than 12 inches below the ceiling.
- E. Smoke Detectors: Locate detectors as required by NFPA 72 and their listing on a 4-inch backbox. Smoke detectors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling. Install smoke detectors no closer than 5 feet from air-handling supply outlets.
- F. Air Sampling Smoke Detector: Locate air aspirating smoke detectors in accordance with the manufacturer's instructions. Air sampling smoke detectors shall be installed as follows:
 - 1. Air Sampling Smoke Detector Assembly.
 - a. Detector assembly shall be mounted to a wall at a height between 48 to 60 inches to top of detector measured above the finished floor.
 - b. Mounting location shall be a fully accessible and visible location.
 - c. Mounting or attachment to site equipment, cable trays, movable walls, other equipment or equipment supports is not permitted.
 - d. Piping network insertion into the detector inlet shall not be glued.
 - e. Air sampling smoke detector assembly shall be installed in accordance with this Specification section and the manufacturer's installation and instruction manuals.
 - f. Flexible tubing for termination of the sampling pipe network into detector inlet is not permitted unless allowed by its listing.
 - 2. Pipe and Sample Tube Mounting.

- a. The pipe and sample tubing detection network shall be mounted as per the design and manufacturer's specification. The hardware used for mounting will depend upon the design and site requirements.
 - b. To minimize flexing, pipes shall be secured every 5 feet.
 - c. Pipes shall be suspended between 1 and 4 inches below the ceiling. Where false ceilings are installed, the sampling tubes shall be installed above the ceiling, and sampling ports shall be installed on the ceiling and connected to the sampling tube.
 - d. The sampling tubes shall be of the same length or use the manufacturer's guidelines to run tubes of the required lengths using two diameter tubes (0.24-inch and 0.16-inch OD).
 - e. When installing a pipe network in areas subject to high temperature fluctuations allow for the contraction and expansion of pipes.
 - f. Where expansion or contraction of pipes is likely either after installation or on a continuous basis, do not place pipe clips adjacent to couplings and socket unions as these may interfere with the movement of the pipe.
 - g. No bends are permitted within the first 18 inches from the detector inlet.
 - h. The routing of the piping and sample tube network shall be coordinated with potential obstructions, including cable trays, grounding bars, and HVAC ductwork.
 - i. All changes in direction shall be made with standard elbows or tees.
 - j. All joints shall be air-tight and made by using solvent cement, except at the entry to the detector assembly. Refer to ASTM F402-05 standard practice for safe handling of solvent cements, primers, and cleaners used for joining thermoplastic pipe and fittings.
 - k. All pipes shall be supported by mechanical hangers attached to the structure of the building. Not more than 1-foot of pipe shall extend beyond the last hanger of each sampling pipe. The final installation shall result in no noticeable deflection in the piping network.
 - l. Attachment of air sampling pipes to cable trays "gray iron" and telecommunications equipment is prohibited.
 - m. Piping shall be labeled with the air sampling smoke detection system manufacturer's identification at least at 20-foot intervals.
 - n. Placement of the sampling tube shall take into consideration appropriate sampling point locations and spacing.
3. Air Sampling Points: Open area ceiling sampling points shall be oriented downward and shall be within 1 to 4 inches below the underside of the ceiling above where the ceiling is smooth. For ceilings with beams, girders, solid joist, or a waffle-like construction, etc., mount detectors in accordance with the special provisions in NFPA 72.
- G. Addressable interface devices: Shall include a mounting plate for installation in a junction box or shall be mounted in a locked cabinet or approved box.
- H. Annunciator: Locate the annunciator as shown on the Drawings. Flush-mount the panel with the top of the panel 6 feet above the finished floor or center the panel at 4 feet, whichever is lower.

- I. [NOTI-FIRE-NET web server: The location of the internet connection will be coordinated between the contractor and SRP.]
- J. Instructions: Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the instructions on the interior of the CFACU. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by SRP before being posted.
- K. Labeling and Marking: All of the hardware covered in Part 2 and Part 3.1 of this Specification section shall have Brady adhesive markers, or SRP approved equal, attached to them indicating the address of the hardware. Markers shall be installed, by the contractor, on the inside of the base and lettering shall be a minimum of 12-point.

3.3 SYSTEM FIELD WIRING

- A. Wiring within Cabinets, Enclosures, and Boxes: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to screw-type terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. The use of wire nuts or similar devices is prohibited. Wiring shall conform to NFPA 70.
- B. Terminal Cabinets: Terminal size shall be appropriate for the size of the wiring to be connected. Minimum size is 8 inches by 8 inches. Only screw-type terminals are permitted.
- C. Alarm Wiring: Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Provide all wiring in electrical metallic conduit. The use of flexible conduit not exceeding a 6-foot length shall be permitted to a single device or appliance.
 - 1. Run conduit or tubing (rigid, IMC, EMT, FMC, etc., as permitted by NFPA 72 and NFPA 70) concealed unless specifically indicated otherwise on the Drawings.
 - 2. For shielded wiring, ground the shield at only one point that is in or adjacent to the FACU.
 - 3. Pigtail or T-tap connections to signal line circuits, supervisory alarm circuits, and notification appliance circuits are prohibited.
 - 4. Color coding is required for circuits and shall be maintained throughout the circuit.
 - 5. Conductors used for the same function shall be similarly color coded.
- D. Conductor Terminations: Labeling of conductors at terminal blocks in terminal cabinets and at the FACU shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FACU, NAC panel, and remote FACU shall contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated

drawing shall be neat, using 12-point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals.

- E. Conductors for the notification appliance circuits shall not be installed in the same raceway as the conductors for signaling line circuits unless written certification from the manufacturer is supplied to SRP indicating that the inclusion of these circuits in the same raceway is acceptable and that no additional consideration is needed for these circuits.
- F. All existing wiring shall be tested for abnormal conditions (grounds, shorts, opens, etc.) prior to reuse. In general, existing initiating device circuits shall be re-used as signaling line circuits, if the circuit is not loaded to more than 75 percent of the available circuit loading and the distance limitations as set forth by the manufacturers recommended specifications are not exceeded; existing notification appliance circuits shall be re-used, only if the existing circuit is not loaded to more than 75% of the available power for the circuit from the FACU. In the event that a signaling line circuit or a notification appliance circuit load exceeds 75 percent of the available circuit loading new circuits shall be installed.
- G. Color coding of conductors shall be approved by SRP. Unless otherwise indicated, the color code for all fire-alarm and emergency voice evacuation system conductors shall be as follows:
 - 1. Signaling line circuits and initiating device circuits shall be red and black. Red shall be positive and black shall be negative.
 - 2. Audible notification appliance circuits shall be blue and white. Blue shall be positive and white shall be negative (NAC).
 - 3. Flashing strobe circuits shall be orange and yellow. Orange shall be positive and yellow shall be negative (NAC).
 - 4. Two wire notification appliance circuits shall be blue and white. Blue shall be positive and white shall be negative.
 - 5. Sprinkler/standpipe circuits shall be red and black. Red shall be positive and black shall be negative.
 - 6. Smoke detector power circuits shall be brown and violet. Violet shall be positive and brown shall be negative.
 - 7. Auxiliary remote power supply circuits shall be brown and violet. Violet shall be positive and brown shall be negative.
 - 8. Electro-magnetic door hold-open circuits shall be gray and gray.
 - 9. HVAC shut-down and damper circuits shall be orange and yellow.
 - 10. Bond wires from the control unit to the ground rod, and all required bonding conductors shall be green.
 - 11. AC supply circuit to the main FACU shall be white, black and red. The black shall be one phase, and the red shall be the opposite phase, if required. The white shall be the neutral. If a separate feed is required for the battery charger, it shall be black and white unless the main FACU requires only one AC feed. In that case, the conductors to the battery charger shall be red and white.

3.4 FIRESTOPPING

- A. Provide firestopping for holes at conduit penetrations through floor slabs, fire-rated walls, partitions, with fire-rated doors, corridor walls, and vertical service shafts.
- B. Comply with provisions of Section 07 84 13 "Penetration Firestopping."

3.5 PAINTING

- A. Paint exposed electrical, fire-alarm conduit and surface metal raceway to match adjacent finishes in exposed areas. Paint junction boxes red and conduits and surface metal raceways with a 1-inch wide red band every 10 feet in unfinished areas.

3.6 FIELD QUALITY CONTROL

- A. Testing Procedures: Submit detailed test procedures, prepared and signed by the qualified test personnel for the detection and alarm system 21 days prior to performing system tests. All tests shall be conducted in the presence of SRP and other parties identified by SRP and shall not be conducted until the "Test Procedures" are approved. Detailed test procedures shall list all components of the installed system such as initiating devices and circuits, notification appliances and circuits, signaling line devices and circuits, control devices/equipment, batteries, transmitting and receiving equipment, power sources/supply, annunciators, interface equipment, and transient (surge) protective devices. Test procedures shall include sequence of testing, time estimate for each test, and sample test data forms. The test data forms shall be in a check-off format (pass/fail with space to add applicable test data, similar to the form in NFPA 72) and shall be used for the preliminary testing and the acceptance testing. The test data forms shall record the test results and shall:
 - 1. Identify the NPFA Class of all initiating device circuits (IDC), notification appliance circuits (NAC), [and voice notification system circuits (NAC audio), [and signaling line circuits (SLC).
 - 2. Identify each test required by NFPA 72 Test Methods and required test herein to be performed on each component, and describe how this test shall be performed.
 - 3. Identify each component and circuit as to the type, location within the facility, and unique identity within the installed system. Provide necessary floor plan sheets showing each component location, test location, and alphanumeric identity.
 - 4. Identify all test equipment and personnel required to perform each test (including equipment necessary for testing smoke detectors).
 - 5. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.
- B. Preliminary Testing: Conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests". After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly, panel functions were tested and operated properly, and shall include the names and titles of

the witnesses to the preliminary tests. The installer and qualified test personnel shall be in attendance at both the preliminary and final tests to make necessary adjustments.

1. Request for Formal Inspection and Tests: When preliminary tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests to SRP.
 2. Final Testing: Notify SRP in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. The tests shall be performed in accordance with the approved test procedures in the presence of SRP or their representative. Furnish instruments, equipment, and personnel as required for the tests. A final acceptance test will not be scheduled until the following are provided at the job site:
 - a. Marked-up redline drawings of the system as actually installed.
 - b. Loop resistance test results.
 - c. Complete program printout including input/output addresses.
 3. The final tests will be witnessed by the SRP Representative. At this time, any and all required tests shall be repeated at their discretion.
 4. System Acceptance: Following acceptance of the system, as-built drawings and O&M manuals shall be delivered to SRP for review and acceptance. At least two sets of as-built (marked-up) drawings shall be provided at the time of, or prior to the final acceptance test.
 5. If the Final Acceptance Test fails, the contractor shall pay all costs incurred to SRP for any and all re-acceptance testing.
 6. Upon satisfactory completion of the tests, the contractor shall leave the fire-alarm and fiber network systems (if installed) in proper working order and without additional expense to SRP, shall replace any defective materials or equipment provided by the contractor under this Contract within two years from the date of final acceptance by the awarding authority.
 7. Warranty: Except as otherwise expressly provided in the Contract Documents, and excepting only items of routine maintenance, ordinary wear and tear or unusual abuse or neglect, contractor guarantees all work executed by the contractor and all supplies, materials, and devices of whatsoever nature incorporated in, or attached with the work, or otherwise delivered to SRP as part of the work pursuant to the contract to be absolutely free of all defects of workmanship and materials for a period of 2 years after final acceptance of the work by SRP. Include service directory with telephone numbers for 24-hour emergency service.
- C. Minimum System Tests: Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:
1. 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. Test results shall be recorded for use at the final acceptance test.
 2. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.

3. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.
4. Test each initiating device and notification appliance and circuit for proper operation and response at the control unit. Smoke detectors shall be tested in accordance with manufacturer's recommended test method. Use of magnets is prohibited. Testing of duct smoke detectors shall comply with the requirements of NFPA 72. If there is a failure of supervision at one device, then supervision shall be tested at each device.
5. Test the system for specified functions in accordance with the contract Drawings and Specification and the manufacturer's O&M manual.
6. Test both primary and secondary power. Verify, by test, the secondary power supply is capable of operating the system for the time period and in the manner specified.
7. Determine that the system is operable under trouble conditions as specified.
8. Visually inspect wiring for compliance with applicable circuit class.
9. Test battery charger and batteries.
10. Verify that software control and data files have been entered or programmed into the FACU. Hard copy records of the software shall be provided to SRP.
11. Verify that red-line drawings are accurate.
12. Disconnect the verification feature for smoke detectors during tests to minimize the amount of smoke needed to activate the detector.
13. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.
14. Open the circuit at not less than 10 percent of alarm initiating devices and notification appliances to test the wiring supervisory feature.
15. Intelligibility Tests: Intelligibility testing of the system shall be accomplished in accordance with NFPA 72 for Voice Evacuation Systems, IEC 60268-16 and ASA S3.2. Intelligibility requirements:
 - a. Verify intelligibility by measurement after installation.
 - b. Ensure that a CIS value greater than the required minimum value is provided in each area where building occupants typically could be found. The minimum required value for CIS is .7.
 - c. Areas of the building provided with hard wall and ceiling surfaces (such as metal or concrete) that are found to cause excessive sound reflections may be permitted to have a CIS score less than the minimum required value if approved by the SRP Representative, and if building occupants in these areas can determine that a voice signal is being broadcast and they must walk no more than 33 feet to find a location with at least the minimum required CIS value within the same area.
 - d. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than the minimum required value if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet to a location with at least the minimum required CIS value within the same area.

- e. Take measurements near the head level applicable for most personnel in the space under normal conditions (e.g., standing, sitting, sleeping, as appropriate).
- f. The distance the occupant must walk to a location meeting the minimum required CIS value shall be measured on the floor or other walking surface along the centerline of the natural path of travel, starting from any point subject to occupancy with less than the minimum required CIS value; curving around any corners or obstructions with a 12-inch clearance therefrom; terminating directly below the location where the minimum required CIS value has been obtained.
- g. Use commercially available test instrumentation to measure intelligibility as specified by ISO 7240-19 and ISO 7240-16 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.

3.7 TRAINING

- A. Instructor: Include in the Project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the employees designated by SRP, in the care, adjustment, maintenance, and operation of the fire-alarm system. Each instructor shall be thoroughly familiar with all parts of this installation. The instructor shall be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including training history to SRP prior to training..
- B. Required Instruction Time: Provide [4][8] hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as selected by SRP. The instruction may be divided into two or more periods at the discretion of SRP. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

END OF SECTION