

SECTION 284621.11 ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Nonsystem smoke detectors.
6. Heat detectors.
7. Notification appliances.
8. Device guards.
9. Firefighters' two-way telephone communication service.
10. Firefighters' smoke-control station.
11. Magnetic door holders.
12. Remote annunciator.
13. Graphic annunciator.
14. Addressable interface device.
15. Digital alarm communicator transmitter.
16. Radio alarm transmitter.
17. Network communications.
18. System printer.
19. In Building Radio Communication Enhancement System.

- B. Related Sections include the following:

1. Division 01 Section "Construction Waste Management"

1.3 DESCRIPTION OF WORK

- A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation.
 1. The system shall be an addressable high-rise fire detection and voice alarm signaling system. It shall utilize distributed modular control panels that utilize digital communications in a network configuration to provide optimal fault-tolerance and support future modification and expansion with a minimum of future wiring and

- hardware additions. Provide multi-channel one way voice communications for selective, manual and pre-recorded tones and voice instructional messaging throughout the facility in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
2. The system shall include all necessary hardware, software and peripheral devices to perform the following functions, but not limited to:
 - a. Fire detection.
 - b. Occupant audible, visual and auxiliary notification.
 - c. One-way emergency voice/alarm communications.
 - d. In-building Radio Communications Enhancement System.
 - e. Supervising Station service.
 - f. Life safety functions to include:
 - 1) Emergency Elevator Service
 - 2) Smoke Management and Control
 - 3) Smoke door release service
 - g. Integration with and status monitoring of related systems including:
 - 1) Fire Pump.
 - 2) Fire Protection Suppression Systems.
 - 3) HVAC and Building Automation (BAS) systems.
 - 4) Security, communications and information technology systems.
 - 5) Stairwell Pressurization System
 - 6) Generator
 - 7) Active Shooter System.
 - h. Report system events to the Listed Supervising Station via the approved means.
 - i. System programming and re-programming of all changes as necessary to accommodate the phased construction, alteration and demolition activities.
 3. The system shall be in full compliance with National, New Jersey, Union County and the City of Elizabeth Codes. These published editions of following reference standards shall be used in system design, installation, operation and maintenance unless the applicable legally referenced standard provides more stringent requirements:
 - a. New Jersey Uniform Construction Code (International Building Code 2021 Edition)
 - b. New Jersey Electrical Code (2020 Edition - National Electrical Code)
 - c. Underwriters Laboratories (UL) Listings.
 - d. City of Elizabeth Fire Department Regulations
 - e. Americans with Disabilities Act (ADA), the Architectural Barriers Act (ABA), and Accessibility Regulations of the local jurisdiction.
 4. The system shall include all required hardware, raceways, interconnecting wiring, and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein. All devices installed outdoors or within areas exposed to unconditioned spaces or wet locations shall be listed for "outdoor use". Electrical raceway, fittings and enclosures shall be NEMA Type 4.
 5. All equipment furnished shall be new and the latest state-of-the-art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over 20 years.
 6. Provide the services of qualified system designers to generate shop drawings, and field technicians to provide installation oversight during construction and system startup. Technicians shall inspect, program, test and make any necessary adjustments to the

- completed system, to ensure compliance with the manufacturer's recommended practices and the approved shop drawings.
7. The system as specified shall be supplied, installed, & tested by the electrical contractor and approved by the local Authority Having Jurisdiction, and turned over to the owner in an operational condition.
 8. In the interest of job coordination and responsibilities, the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, inspection and tests. All control panel assemblies and connected field appliances shall be provided by the same system supplier and shall be designed and tested to ensure that the system operates as specified.
 9. The basis of design is a Siemens Industry, XLS system which meets the project requirements. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
 10. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception.
 11. Provide for control, monitoring, and supervision of the smoke control system as shown on drawings.
 12. Provide for equipment monitoring and control as shown on the drawings.
 13. Provide direct interface with the Building Automation System.
 14. Refer to plans for new smoke control system panel, components, and associated requirements.
 15. Refer to plans for Smoke Control System – Sequence of Operation requirements.
 16. Refer to plans for Fire Alarm Smoke Control System Diagram and associated requirements.
- B. The smoke control system will provide for monitoring and control of items identified below. This includes but is not limited to:
1. (2) new stairwell pressurization fans (SPF-1 and SPF-2)
 2. Motor operated dampers.
 3. Control signal to BMS for stairwell pressurization system start signal.
 4. Monitoring of equipment as noted on plans.
 5. Shutdown of existing HVAC equipment to allow for smoke control system operation.
 6. Monitoring and control of equipment must include but is not limited to providing all auxiliary devices such as undervoltage relays, end switches, current monitors, and tie ins to existing fans, starters, VFD's, and damper equipment.

1.4 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. ASME: American Society of Mechanical Engineers.

- F. Broadcast Media: The speakers, radio, cell phone, and other media that will carry the selected message to the selected audience. FACP: Fire alarm control panel.
- G. FM: FM Global (Factory Mutual).
- H. Furnish: To supply the stated equipment or materials.
- I. Install: To set in position and connect or adjust for use.
- J. LED: Light-emitting diode.
- K. LOC: Local Operating Console.
- L. MNS: Mass Notification System.
- M. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- N. Provide: To furnish and install the stated equipment or materials.
- O. UL: Underwriters Laboratory.
- P. PC: Personal computer.

1.5 FIRE CONTROL PANEL

- A. The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor based operating system having the following capabilities, features, and capacities:
- B. All control equipment shall be listed to the latest edition of UL Standard 864 (9th Edition)-categories UOJZ, UOXX and UUKL as applicable with the following features:
 - 1. Support of TechAdvance+ mobile test system capable of providing point test reports in NFPA standard format without manual report entries.
 - 2. The control panel shall allow control and monitoring from a wireless handheld display device during maintenance, inspection and troubleshooting tasks.
 - 3. The control panel shall allow complete control and monitoring from a wireless handheld display device during one-man testing of the system.
 - 4. Testing supported should be real smoke testing of devices, automatically logged and made available in NFPA format reports. Manual test entries will not be accepted.
 - 5. System shall provide an output port for monitoring purposes by external systems. Communications to an external system shall be RS-232 or RS-485 communications.
 - 6. A single node or system shall support at least 50 remote transponders.
 - 7. At least 64 nodes shall be networkable.
 - 8. Communications between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide display. Any network node shall be capable of supporting a local system in excess of 4000 input/output points.
 - 9. The local system shall provide status indicators and control switches for all of the following functions:
 - a. Audible notification alarm circuit zone control for high-rise applications.

- b. Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.
 - c. Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.
 - d. Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.
 - e. Elevator recall By-Pass Switch: Shall prevent the elevators from recalling upon operation of any of the devices installed to perform that function. A system trouble alarm shall be energized when the switch is in the abnormal position.
 - f. HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.
 - g. Any additional status or control functions as indicated on the drawings, including but not limited to: emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.
- 10. The system shall be UL 1076 listed for monitoring and reporting security System Zoning.
 - 11. Each intelligent addressable device or conventional zone on the system shall be displayed at the Central Alarm Receiving Terminal and the local fire alarm control panel by a unique alphanumeric label identifying its location.
- C. The system shall be complete, electrically supervised evacuation system using one way communication and smoke control systems with microprocessor-based operating system having the following capabilities, features and capacities:
- 1. Voice amplification shall be supervised and backed up with like amplifiers. Back up shall be one for one. Backup amplifiers shall not share components and must be fully stand-alone.
 - 2. Amplifiers shall be rated for 25V or 70.7V RMS, and 40 or 180 watts.
 - 3. Amplifiers shall be sized as minimum, to accommodate speakers in corridors at 2 watts and other locations 1 watt.
 - 4. There shall be a separate booster amplifier. Amplifiers shall be rated for 25V or 70.7V RMS, 100 watts. The system shall have the capability to support Peer-to-Peer or Master-Slave network and voice configurations.
 - 5. Multiple nodes shall provide peer-to-peer voice capability in order to eliminate a single point of failure.
 - 6. Audio shall be synchronized between nodes in order to take into account common areas.
 - 7. Speakers shall have the ability to play coded audio tones.
 - 8. The system shall provide status indicators and control switches for all of the following functions:
 - a. Firefighters' override functions controlling smoke management.
 - b. Audible and visual notification alarm circuit zone control.
 - c. Speaker circuit zone control.
 - d. Status indicators for sprinkler system water flow and valve supervisory devices.
 - e. Any additional status or control functions as indicated on the drawings, including but not limited to: emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

1.6 FIREFIGHTER'S OVERRIDE PANEL

- A. The Firefighter's Smoke Control Override Panel shall provide a user-friendly interface to the smoke management systems for firefighters. Switches are provided for fan and damper control, while LEDs indicate the status of fans and dampers. A multi-color graphic depicting the building provides a clear picture relating each switch and indicator to the appropriate floor or building zone. Critical areas like stairways, elevator shafts, and HVAC interfaces shall be show.
- B. Required Firefighter panel components:
 - 1. Lamp Test pushbutton
 - 2. Panel enable key switches
 - 3. Panel power-on LED
 - 4. Switch, and three position toggle switch (standard) for ON-AUTO-OFF fan control and OPEN-AUTO-OFF damper control or four position rotary switch which is standard for PURGE-AUTO-PRESSURIZE-OFF operations on zone control panels.
 - 5. LED for equipment status
 - 6. Colors are determined by local building or fire codes.
- C. Dedicated Smoke Control Functions
 - 1. All equipment that serves dedicated smoke control functions (including, but not limited to stairwell pressurization) shall be controlled directly by the HVAC BMS and/or the Fire Alarm System. Coordinate with the HVAC and Fire Alarm project design documents for requirements. Equipment shall include the following:
 - a. Provide signals to the controlled equipment to initiate the required sequencing in accordance with applicable code and according to the required Sequence of Operation for related systems.
 - b. Provide equipment status monitoring with LED feedback of dedicated smoke control equipment per building code requirements.
- D. Non-dedicated Smoke Control Functions
 - 1. All equipment that serves non-dedicated smoke control functions (including, but not limited to post-fire smoke purge) shall include the following:
 - a. Control of all HVAC/ATC equipment that is operated regularly as part of normal HVAC functions and also serve smoke control functions shall be the responsibility of the Mechanical Contractor.
 - b. Initial fire and life safety-related command signals will be sent directly from the Fire Alarm System to the ATC System to commence sequencing.
 - c. Actual control of non-dedicated equipment and sequencing shall be the responsibility of the Mechanical Contractor. Programmed outputs from the Fire Alarm System will be used to initiate the required sequencing, and end-status feedback from the ATC system will report that the sequence is complete.
 - d. Equipment status monitoring not required.

1.7 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72 and all contract documents and specification requirements.

1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
 2. The voice evacuation system amplifiers shall be configured as distributed audio. Provide 8 channels one way voice communications for selective, manual and pre-recorded tones and voice instructional messaging throughout the facility.
 3. Strobes shall be synchronized throughout the entire building.
 4. Provide a dedicated smoke management graphical panel with firefighter's override functions and system status lights.
 5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
 6. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
- B. The system shall be designed such that in the event of a network communications failure, any remaining interconnected panels will operate as a sub-network and any isolated panels will operate in standalone mode. Upon communications failure, a trouble condition will be reported across the network and the disconnected panel shall continue to function in standalone mode.
- C. Circuits and Pathways
1. Network Communications and vertical trunk wiring
 - a. All network wiring and audio risers shall be Class A, circuits as defined in NFPA 72, utilizing physically separated outgoing and return loops and Level 2 survivability (minimum).
 - b. Addressable Signaling Line Circuit (SLC) wiring shall be configured as Class B circuits, with a minimum Level 1.
 - 1) SLC wiring shall utilize fault isolation modules so that a single wiring fault on the conductors serving one floor or evacuation signaling zone will not affect the operation of devices serving any other zone.
 - 2) SLCs shall not exceed 75% of the number of each type of device the circuit is capable of supporting.
 - c. Visual Notification Appliance Circuit (NAC) wiring shall be configured as Class B circuits, with a minimum Level 2 pathway survivability from their point of origin to the area served, and Level 1 within the evacuation signaling zone served.
 - 1) The system shall be provided with a minimum of two (2) visual NACs for each floor, evacuation zone or smoke compartment; whichever is greater. The actual number of circuits to be installed shall be coordinated with the supplier's shop drawings.
 - d. Speaker Notification Appliance Circuits (NAC) shall be configured as Class B circuits, with a minimum Level 2 pathway survivability from their point of origin to the area served, and Level 1 within the evacuation signaling zone served. The system shall be provided with the minimum listed speaker circuits as follows:
 - 1) Two (2) speaker circuits for each evacuation signaling zone or smoke compartment; whichever is greater.
 - 2) One (1) speaker circuit for each stairwell, configured as a vertical paging zone.
 - 3) One (1) speaker circuit for each elevator group.
 - 4) Speaker circuits shall be individually selective by evacuation signaling zones and shall be zoned to correspond with the building fire barriers and other building features.
- D. The system shall provide the following notification functions and operating features:

1. Upon receipt of an alarm signal from the building fire alarm system, the voice communication system shall automatically transmit a 3 second pre-announce tone and a pre-recorded 'FIRE ZONE' digital evacuation message throughout the floor on the floor of alarm origin, the floor immediately above the floor of origin, and the floor immediately below the floor of origin. In addition, the visual alarm indicating circuit(s) shall be activated on the floor of alarm origin, the floor immediately above the floor of origin, and one floor immediately below the floor of origin. This sequence shall be repeated until the control panel is reset.
 2. A simultaneous "Safe Area Zone" message shall be delivered via all alarm speakers installed on the remaining floors indicating the requirement for occupants of these floors to remain alert for further instructions. However, the visual alarm indicating circuit(s) shall not be activated on these floors. The "Safe Area Zone" message shall activate for two complete rounds and silence automatically. After five minutes, the "Safe Area Zone" message shall automatically start and activate for two complete rounds and silence again. This sequence shall be repeated until the fire alarm system is reset. In the event a subsequent fire alarm is received at the fire alarm control panel by a floor that was previously receiving a "Safe Area Zone" message, this floor shall automatically revert to perform the actions for a Fire Zone" message.
 3. A live voice message shall override the automatic output through use of a microphone input at the control panel. When using the microphone, live messages shall be broadcast through speakers in stairs, in elevator cabs, and throughout a selected floor or floors. All stairwell speakers shall have a dedicated zone activation switch. All elevator speakers shall have a dedicated zone activation switch. An "All Call" switch shall be provided which activates all speakers in the building simultaneously.
 - a. Status lights next to speaker selection switches on the main fire alarm control panel shall indicate speaker circuit selection.
 - b. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmed to flash until system reset or alarm silencing, as required by the AHJ.
 4. Each Stair-tower speaker zone shall be separately zoned and controlled. Fire alarm speakers shall be installed in elevator cabs and exit stairways; however they shall only be activated to broadcast live voice messages (e.g., manual announcements only). The automatic voice messages shall be broadcast through the fire alarm speakers on the appropriate floors, but not in stairs or elevator cabs.
- E. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals and trouble signals shall be logged on the system printer and in system history during the walktest.
- F. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- G. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using basic graphics and multiple detail screens.
1. Fire Alarm Condition:
 - a. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm in a graphic display.
 - b. Log into the system history archives all activity pertaining to the alarm condition.
 - c. Print alarm condition on system printer.

- d. Sound the ANSI 117-1 signal with synchronized audible and synchronized strobes throughout the facility.
 - e. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
 - f. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - g. The alarm information shall be displayed on a graphic annunciator located where shown on drawing.
 - h. Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the main exit discharge and the lockout of controls. In the event of recall initiation by a detector in the main extinguishing discharge lobby, the recall shall be to the alternate floor as determined by the AHJ.
 - i. Where indicated on drawings, heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
 - j. System operated duct detectors as per local requirements shall accomplish HVAC shut down.
 - k. Door closure devices shall operate by within fire barrier areas, by floor, by local requirements or by local requirements.
 - l. Status lights next to speaker selection switches on the control panel shall indicate speaker circuit selection.
 - m. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmed to flash until system reset or alarm silencing, as required by the AHJ.
2. Supervisory Condition:
- a. Display the origin of the supervisory condition report at the local fire alarm control panel graphic LCD display.
 - b. Activate supervisory audible and dedicated visual signal.
 - c. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
 - d. Record within system history the initiating device and time of occurrence of the event.
 - e. Print supervisory condition to system printer.
 - f. Send the event information to the Management Station with the device type and custom message.
3. Trouble Condition
- a. Display at the local fire alarm control panel graphic LCD display, the origin of the trouble condition report.
 - b. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
 - c. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
 - d. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.

- e. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
 - f. Record within system history: the occurrence of the event, the time of occurrence and the device initiating the event.
 - g. Print trouble condition to system printer.
 - h. Send the event information to the Management Station the device type and custom message.
4. Security Condition:
- a. Display at the local fire alarm control panel graphic LCD display, the origin of the security condition report. A dedicated security LED shall flash until the alarm has been acknowledged, then revert to a steady "ON" state.
 - b. The control system shall be capable of bypassing the alarms from an individual security system installed within selected areas. The pass code allowing this function shall be assignable to individual security personnel and each bypass action shall be logged to system history. Intrusion alarms occurring during a bypass period shall be logged to history and displayed but no audible alarm shall occur at the control panel.
 - c. Print security condition on system printer.
 - d. Send the event information to the Management Station with the device type and custom message.
 - e. The Local Fire Control Panel shall be UL 1076 listed for security purposes.

1.8 ACTION SUBMITTALS

- A. The equipment supplier responsibilities will include the selection of equipment, devices and materials based on the performance criteria and project requirements shown and specified, and their proper application based on the manufacturer's limitations, operating characteristics and recommended practices.
- 1. The system designer shall coordinate the installation and system operation with the work of related trades.
- B. Product Data: For each type of product, including furnished options and accessories.
- 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
- 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, details, and attachments to other work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Detail assembly and support requirements.
 - 5. Include voltage drop calculations for notification-appliance circuits.
 - 6. Power supply and battery capacity calculations. Provide system calculations for all notification circuits, amplifiers and power supplies. Notification Appliance Circuit

- calculations shall use the end-loading method described in NFPA recommended practices. Provide the following supporting information:
- a. Supervisory power requirements for all equipment.
 - b. Alarm power requirements for all equipment.
 - c. Show wire size, estimated circuit length, and maximum allowable wiring distance as designed. Voltage drop calculations for wiring runs demonstrating worst-case condition.
 - d. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 - e. NAC circuit design shall incorporate a 20% spare capacity for future expansion.
7. Include input/output matrix.
 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 9. Include performance parameters and installation details for each detector.
 10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
 12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
 - c. Locate detectors according to manufacturer's written recommendations.
 - d. Show air-sampling detector pipe routing.
 13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. The shop drawing submittal shall clearly indicate all proposed equipment and devices (type and quantity), with wiring diagrams, detailed operational sequences, and interfaces to related systems. They shall be prepared in accordance with NFPA 72 recommended practices and include the following:
1. Floor plans showing all devices and equipment to be installed with corresponding field settings, circuit, and device designations noted. Settings shall include the device address and candela rating as applicable. Circuit identifiers, device numbers and symbols used shall be clearly defined and consistent between all related documents.
 2. Complete point-to-point riser diagrams showing all equipment including size, type, number and reference designations for all circuits and devices. Each device shall be shown with address numbers or any other required field device settings including candela rating of notification appliances. Riser diagrams shall consist of:
 - a. A complete one-line Network Riser Diagram showing interconnected control panels and intended room locations.
 - b. Detailed point-to-point riser diagram(s) showing all equipment, circuits and devices connected to each fire alarm control panel.

3. Scaled drawings of each system panel showing dimensions, internal module placement, field wiring terminations with spare capacity allowances, and any applicable operator's display and panel switch label assignments. Where multiple equipment cabinets are used in a single location these shall be shown together in elevation for coordination of equipment installation and wireways, and to ensure proper space allocation.
4. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
5. Provide a complete sequence of operation in the form of an NFPA Input/Output programming matrix for the entire system as shown in NFPA 72. The matrix shall reflect each unique programmed sequence, whether the sequence is initiated by an individual or common group of similar devices.
6. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - a. Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
 - b. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.
7. Installation drawings shop drawings, and as-built drawings shall be prepared by a NICET II or higher individual experienced with the work specified herein.
8. Copies of the approved shop drawings shall be maintained on-site to serve as working documents during installation for preparing as-builts.
9. Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.
 - a. Disposition of shop drawings shall not relieve the Contractor from responsibility for deviations from drawings and specifications, unless the deviations are specifically noted in writing at the time of submission, and written acknowledgement has been received from the Engineer of Record. The disposition of shop drawings shall not relieve the Contractor from responsibility for errors in shop drawings or schedules.

E. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level IV minimum.
 - c. Licensed or certified by authorities having jurisdiction.

F. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.9 LEED SUBMITTALS:

- A. Provide submittals for the products named herein as delineated in Division 01 Section, "Sustainable Design Requirements - LEED V4 BD+C" Article 1.6, Action Submittals, subparagraph 1.6.C.9 for VOC content of sealants and adhesives.

1.10 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Field quality-control reports.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. As-Built drawings consisting of: a scaled plan of each building showing the placement of each individual item of the Integrated Life Safety System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer

and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.

- d. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
- e. Riser diagram.
- f. Device addresses.
- g. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
- h. Record copy of site-specific software.
- i. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
- j. Manufacturer's required maintenance related to system warranty requirements.
- k. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.
- 2. Program Software Backup: On magnetic media, USB drive, or compact disk, complete with data files.
- 3. Device address list.
- 4. Printout of software application and graphic screens.

1.12 SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for 1 year.
- B. Upgrade Service: Update software, firmware, to latest version at project completion. Install and program software upgrades that become available within one year from date of substantial completion. Upgrading software, firmware shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.13 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.
10. In addition to extra materials listed above, the contractor shall provide the quantity as listed on the design plans for Smoke Detectors, Heat Detectors, Speaker/Strobe Units, Speaker Units, Strobe Units, Duct Mounted Smoke Detectors, Pull Stations, Fire Alarm Monitor Modules, and Fire Alarm Control Modules: Refer to plans for required quantities. Contractor must include for complete device installation including associated wiring, raceways, and backboxes.

1.14 QUALITY ASSURANCE

- A. The following shall be adhered to:
 1. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
 2. Owner's best practices for fire alarm installations/ operations including compliance with site standard operating procedures (SOP's).
- B. Equipment Supplier Qualifications
 1. The supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid. The distribution shall be from factory branches as well as independent distributors to allow the end user with the ability to utilize factory trained and authorized competitive service providers after system installation and commissioning. Single source system suppliers are not acceptable. The initial installation and commissioning shall be provided by a factory direct branch to ensure a high level of quality for the customer.
 2. A service office must be within 50 miles of the project site.
 3. The manufacturer shall provide evidence of successfully installed similar fire detection and notification systems on comparable size and scope. The owner reserves the right to reject any installer's bid for which evidence of a successful prior installation by the contractor cannot be provided.
 - a. The equipment and service provider shall have a minimum of 10 years experience in the fire protective signaling systems industry.
 4. Shall be licensed in the jurisdiction if required.
 5. The equipment supplier shall have a licensed fire protection engineer on staff to assist with all aspects of the installation including interfacing with the local AHJ and code consulting.

6. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
7. The manufacturer shall have in-house engineering and project management capability consistent with the requirements of this project. Factory trained representatives of the system manufacturer shall perform the detailed engineering of the system.

C. Installer Qualifications:

1. Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.
2. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
3. The contractor shall submit copies of all required licenses and bonds as required in the State having jurisdiction.
4. The system installer shall work with the system supplier/designers to ensure all equipment is installed as shown in the Shop Drawings and manufacturer's requirements and programmed to comply with the project requirements.
5. The manufacturer's representative shall be qualified by UL for certifying fire alarm systems if required by local jurisdiction. Upon completion of the installation, the contractor shall certify the final system meets UL ongoing maintenance.
6. The installing contractor is responsible for coordination with related trades, and complete (1st party) testing of the system as installed, to include verification that the system performs as intended, and all devices and fault conditions are properly supervised and reported as specified herein.

D. Testing Agency Qualifications: Qualified for testing indicated.

E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.15 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

- B. Noncoded, UL-certified (UUKL) addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- C. Automatic sensitivity control of certain smoke detectors.
- D. All components provided shall be listed for use with the selected system.
- E. 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Flame detectors.
 - 4. Smoke detectors.
 - 5. Duct smoke detectors.
 - 6. Air-sampling smoke-detection system (VESDA).
 - 7. Carbon monoxide detectors.
 - 8. Combustible gas detectors.
 - 9. Automatic sprinkler system water flow.
 - 10. Preaction system.
 - 11. Fire-extinguishing system operation.
 - 12. Fire standpipe system.
 - 13. Dry system pressure flow switch.
 - 14. Fire pump running.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances, including voice evacuation notices.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice/alarm communication system.
 - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 9. Activate stairwell and elevator-shaft pressurization systems.
 - 10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 11. Activate preaction system.
 - 12. Recall elevators to primary or alternate recall floors.
 - 13. Activate elevator power shunt trip upon signal from designated heat detector(s).
 - 14. Activate emergency lighting control.
 - 15. Activate emergency shutoffs for gas and fuel supplies (Generator Gas Supply must remain intact).
 - 16. Record events in the system memory.

17. Record events by the system printer.
18. Indicate device in alarm on the graphic annunciator.

C. Carbon Monoxide Detection signal shall initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation notices within area of detection.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate voice/alarm communication system.
5. Record events in the system memory.
6. Record events by the system printer.
7. Indicate device in alarm on the graphic annunciator.

D. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Elevator shunt-trip supervision.
5. Fire pump running.
6. Fire pump not in auto.
7. Fire pump running on alternate power source.
8. Fire pump loss of power.
9. Fire pump power phase reversal.
10. Independent fire-detection and -suppression systems.
11. User disabling of zones or individual devices.
12. Loss of communication with any panel on the network.

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 communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

F. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Record the event on system printer.

4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.
7. Hose cabinet door open.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Siemens Industry, Inc.; Fire Safety Division (Basis of Design Equipment)
 2. Edwards (EST); Carrier Corp.
 3. Or approved equal.
- B. General Requirements for Fire-Alarm Control Unit:
1. The fire alarm control panel shall be microprocessor-based using multiple microprocessors throughout the system, providing rapid processing of smoke detector and other initiation device information to control system output functions.
 2. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program the panel shall activate a trouble signal and reset the panel.
 3. The system modules shall communicate with an RS 485 network communications protocol. All module wiring shall be to terminal blocks, which will plug into the system card cage. The control panel shall be capable of expansion via up to 100 SLC's. Maximum system capacity shall be at least 2500 intelligent initiation devices per panel.
 4. The signal line circuits (SLC) shall be polarity insensitive for all addressable devices. This permits the fire detection devices to operate even when detector and module wiring polarity are inverted on the wrong screw terminals.
 5. The system shall have the capability to provide a 300-message capacity with 100 minutes of recording time and enables multi-layered and custom (pinpoint specific) messages. The format shall support MP3 and WAV files.
 6. The primary control panel interface shall provide the system information on a minimum ¼ VGA Color LCD, with Touch Screen and LED display. Color must be event specific based on regulatory requirements alarms-red, Supervisory-blue, security-magenta, trouble yellow. Graphic user interface shall be menu driven with (4) tabs showing the level and the total events for each tab. The tabs shall be: Alarm, Supervisory, Trouble and Security. At least five (5) events shall be shown simultaneously with two full lines of

text message for each event. Each event shall have a minimum 32 character custom message describing the event's location. In addition, the time stamp and category of the event (ie. Smoke, Water Flow, Manual, etc) shall be displayed. The LED displays shall indicate Power, Audibles On or Silenced, and Partial System Disabled. Systems not having the above LEDs shall provide separate LEDs within the control panel enclosure with appropriate labels. Selection buttons shall be backlit to aid the operator in the selection process. There shall be controls for scrolling throughout the event list. A button shall provide zoom in and zoom out control for the amount of information desired for a specific entry. The following addition device information shall also have the ability to display a detailed screen that provides the following:

- a. 200 character custom message associated with the group of the device and physical location in the building to alert personnel
 - b. NFPA symbols representing fire service equipment in the area
 - c. NFPA symbols representing hazards in the area
 - d. NFPA symbols representing people in the area
 - e. Number of devices in the associated group that are in alarm
 - f. Name and phone number of emergency contact
7. System response time from alarm to output shall be an average of three (3) seconds.
 8. To expedite system troubleshooting, the system cards shall have ground fault detection and diagnostic LEDs by card.
 9. All system cards and modules shall have Flash memory for downloading the latest module firmware.
 10. Passwords:
 - a. Maintenance/Control Password - There shall be a 5 character password that a user must enter into the control panel in order to perform such maintenance- and control-related functions.
 11. Networking:
 - a. Digital communication capabilities supporting Style 4 (Class B) or Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with at least 50 remote transponders.
 - b. Digital communication capabilities supporting Style 4 (Class B) or Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with at least 59 network nodes.
 - c. Capability shall exist within the system to extend the network at any node. The system shall support a maximum of two network extension circuits in series on any system branch, extending the inherent distance limitations for network communications.
 - d. Communication protocol shall be of the CSMA/CD (carrier sense, multiple access, collision detect) type, eliminating delays incorporated into other protocols. Communication techniques using token passing and requiring sensing of delays and re-generation of the token to re-establish network communications in the event of a fault shall not be acceptable.
 12. Degrade Mode Alarm Activation:
 - a. Each data gathering panel shall support the ability to have its corresponding ZIC-4A, ZIC-8B and output devices on a DLC's loop activate when the DLC or CDC-4 is in Degrade Mode (has lost HNET communication with the PMI control panel). For example, if the device loop includes HFP detectors with relay bases and lamps,

- the relays and lamps will activate upon any system alarm when the DLC is in Degraded Mode.
- b. Degraded Mode Alarm Activation with Voice: Each data gathering panel shall support the ability to have its corresponding DAC-NET turn on audio when the DLC or CDC-4 is in Degraded Mode (has lost HNET communication with the PMI control panel).
- 13. The fire control panel shall have the ability to be configured as a smoke control station that complies with UL/UUKL (UL 864) and NFPA 92A requirements. The system shall have the capability to monitor and override smoke control systems and equipment provided at designated locations within the same building.
 - 14. Digital Voice Command: In addition to the voice controls on the main fire control panel, they system shall support up to 5 mirrored Voice Command Center. This shall include speaker zone indication and control, and control, digital voice units, and microphone.
 - 15. Software Modifications: The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made. Systems that require the use of external programmers or change of EPROMs are not acceptable.
 - 16. Mass Notification Interface: The fire alarm control panel shall be capable of connection to external and internal building paging subsystems UL2572 Mass Notification system via the AIC and be a supervised connection.
 - 17. Logic: The fire alarm system shall support generic functions that deal with binary states (True/False, high/low), and produce desired outputs from one or more binary inputs (for example, alarm outputs from spot detectors, VESDA detectors, monitor modules or manual station inputs). AND, OR, NOT, Any N, D Latch, RS Latch, Time Base Control, Start Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function. The system shall support 2500 logic functions.
 - 18. History: The system shall store 5000 events in history while in straight mode and 4500 in circular mode. In straight mode, trouble warnings will occur at 4000 and 4500 events. In circular mode, the control panels shall maintain a 2000 event Alarm History buffer, which consists of the 2000 most recent alarm events from the 4500 event history file.

2.5 PRIMARY POWER SUPPLY

- A. The control panels, transponders NAC power booster panels, and any other fire alarm equipment shall receive their primary power from a dedicated 120VAC disconnect circuit.
 - 1. The circuit must be properly sized and protected in accordance with NEC requirements.
 - 2. This requirement does not limit that one dedicated branch circuit to serving only one power supply within a system. The dedicated branch circuit could supply several fire alarm power supplies within a control unit or within multiple interconnected control units that serve the signaling system.
 - a. The dedicated circuit can be supplied from any properly installed electrical panel board or sub-panel.
 - 3. The circuit disconnecting means shall be labeled 'FIRE ALARM' and any other local identification requirements. Its location must be listed at the point of connection to the fire alarm control equipment. Provide a dedicated breaker lock unless the breaker is located in locked panel board or if it is in a locked electrical room.
 - 4. The 120VAC power circuit must be on emergency power for high-rise compliance.
- B. The fire alarm control panel and transponder panel power supply/charger (PSC) shall be a 12-amp supply with battery charger. The power supply shall be filtered and regulated. The power

supply shall have a minimum of 1 power limited output rated at 4 amps, and a minimum of 1 output rated at 12 amps. Each panel shall have the capacity to be expanded up to 48 amps. The auxiliary power supply module shall share common batteries with the primary power supply. The system power supply shall have 4 relays, 1 for common alarm, one for common trouble and two programmable relays. The power supply shall be rated for 120/240V AC 50/60 Hz. The module shall be model number PSC-12 or PSX-12 for expansion application.

1. Provide sufficient capacity to operate the complete alarm system and 100% of the notification appliances in alarm operated at the same time, under both the primary (AC) power conditions. Under no circumstances shall the power supplies exceed a MAXIMUM of 70% of the power supplies battery capabilities throughout the entire project.
 2. The primary power supply shall be sized by the equipment vendor.
 3. The battery charger shall be able to charge the system batteries up to 100 AH batteries. Battery charging shall be microprocessor controlled and programmed with an optional thermistor for monitoring battery temperature to control charging rate shall be available. All battery charging and recharging operations shall be automatic.
 - a. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
 4. The power supply shall have a plug for an AC adapter cable, which allows a technician to plug in a laptop computer for up or down loading program information or test equipment.
 5. Transfer from AC to battery power shall be instantaneous when AC voltage drops less than 90% or brown out conditions it is not sufficient for normal operation.
- C. Loss of primary AC power shall sound a trouble signal at the FACP. The FACP shall indicate when the system is operating on an alternate power supply.

2.6 SECONDARY POWER SUPPLY

- A. When the primary AC power is lost, the system shall automatically switch to the secondary power supply.
- B. The control panels, transponders, and NAC power booster panels shall receive their secondary power from batteries.
 1. Battery shall be of the sealed lead-acid, maintenance free type, 24-volt nominal, suitable for life safety application.
 2. Provide sufficient capacity to operate the complete alarm system in quiescent standby load (system operating in a non alarm condition) for a period of 24 hours and shall have sufficient capacity to operate all alarm notification appliances and all other connected loads for a period of 15 minutes.
 3. Batteries shall be secured in seismic areas 2B, 3, or 4 as defined by the Building Code.

2.7 SYSTEM ENCLOSURE

- A. The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rust resistant prime coat, and manufacturer's standard finish. The outer doors shall be capable of being a left hand open or a right hand open. The inner door shall have a left hand opening. System enclosure doors shall provide where required ventilation for the modules or cards in the enclosure.
- B. Enclosure needed to hold all the cards and modules as specified with at least 25% spare capacity for extra cards.

- C. Provide system enclosure for all amplifiers. Where required by the manufacturer, provide means for venting heat from the enclosure either by having enclosure sides and top vented or the doors vented.

2.8 SYSTEM PRINTERS

- A. The system dot-matrix printer shall be operated from a Remote Printer Module (RPM) and located in the fire command center.
 - 1. The RPM module shall provide a parallel port and 2 serial ports for RS 232 protocol. One of the serial ports shall be able to be programmed for RS485 protocol. The module shall be model number RPM.
 - 2. Printer shall be the automatic type, printing the date, time and location for all alarm, supervisory, and trouble conditions.

2.9 INTELLIGENT INITIATING DEVICES

- A. General
 - 1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections.
 - 2. Operating Voltage: 24 VDC, nominal.
- B. Multi-criteria Smoke Detectors – Addressable
 - 1. Smoke detectors shall be analog sensors FDOT421 that utilize photoelectric-type sensing principles mounted within a smoke chamber to detect particles of combustion. They must provide at least 3 environmental parameter sets to assist the device sensitivity configuration.
 - 2. The control panel shall continually analyze the analog signal from each sensor to determine calibration, sensitivity and environmental changes that may affect sensor operation. The analog values from each device shall be displayed (in terms of percent of obscuration) at the control panel upon command.
 - 3. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: green for normal operation, amber for maintenance required, red for alarm. Each detector shall include an LED that will flash periodically to indicate an active polling cycle. When the sensor reaches a predetermine alarm threshold (2% obscuration unless otherwise directed), the detector shall latch in LED shall flash continuously until reset at the control panel.
 - a. The system shall have the ability to disable the detector's LED.
 - 4. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
 - 5. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address.
 - 6. Where indicated on the design drawings, provide remote indicator lamps and identification plates for detectors concealed from view. Each indicator will illuminate when the detector is in alarm. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position in the nearest common corridor or otherwise designated on the floorplans.
- C. Heat Detectors – Addressable
 - 1. Thermal Detectors shall be analog/addressable sensors individually programmable for either fixed temperature, rate-of-rise or combined operation, except where otherwise dictated. The thermal detector shall be Model FDT421 and have the following temperature settings:
 - a. Fixed temperature at 135°F, 145°F, 155°F, 165°F, 174°F

- b. Rate of Rise at 15°F/ min at 135°F
- c. Rate of Rise at 15°F/ min at 174°F
- 2. Analog sensors will also provide a low temperature warning (Supervisory condition) when the ambient temperature in a protected area reaches 40 degrees F.
- 3. Where ambient conditions dictate, provide conventional fixed temperature, weatherproof or explosion-proof heat detectors in lieu of analog detectors. Conventional devices shall be individually addressable via a dedicated addressable monitor module which shall be installed in an appropriately heated, ventilated location.
- 4. The detectors furnished shall have a listed spacing for coverage on smooth ceiling rating of up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage.

D. Duct Smoke Detectors – Addressable

- 1. The system supplier shall select the appropriate detector type, quantity and environmental configuration based on the manufacturer limitations, code requirements and the project HVAC system operating characteristics for air flow, velocity and environmental conditions.
- 2. Photoelectric type FDBZ-Series, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Where required there shall be available a duct housing with an on-board relay for fan shutdown.
 - a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.
 - b. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detector shall support the use of a remote test switch, relay or LED remote indicator.
 - c. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
 - d. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
- 3. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available. A NEMA-3R and NEMA-4X option shall be available. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.
- 4. Duct smoke detector housing shall allow use in duct systems with air velocity ranging from 100 to 4,000 feet per minute, within temperature ranges of 32°F to 120°F per minute, and with relative humidity ranging from 0 to 95%.
- 5. Traditional spot-type detectors from previous section may be used where permitted on ducts with access hatches within the manufacturer's limitations and applicable standards. Where mounted directly in the air flow, detectors shall be rated for airflows ranging from 0 – 1000 feet per minute.

E. Detector Bases – Addressable

- 1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4" square or octagonal electrical outlet box.
- 2. Multi-Criteria Fire Detector Model FDOOTC441 shall be listed as providing CO detection in duct application.
- 3. The model number for the standard base shall be DB-11 - 6" Version.

4. The model number for the standard base shall be DB-11E - 4" Version.
5. The model ABHW-4B houses a pre-wired, audible (sounder) device capable of generating a 3,000 Hz tone that provides a signal up to 85dBA at 10 feet for localized annunciation. With the exception of the 520Hz low frequency square wave, the ABHW-4B shall meet the requirements of UL464. When used with a Desigo intelligent detector, Model ABHW-4B has the option of being powered directly from a signal line circuit (SLC) in a two-wire configuration. All Model ABHW-4B bases are capable of sounding simultaneously, individually or in any combination — depending upon the system configuration used on a Siemens FACP.
6. The model ABHW-4S is a UL Listed supplementary smoke-detection device that meets or exceeds the 85dB at 10 ft. audibility requirement, including the low-frequency requirement of 520 Hz for 'Sleeping Areas'. The ABHW-4S shall meet the requirements of UL464. All model ABHW-4S bases are capable of sounding simultaneously, individually or in any combination: it is based upon the detector type, and when it used and configured with a compatible Siemens FACP.

F. Carbon Monoxide Detectors

1. Carbon Monoxide Detectors: Provide Analog/Addressable sensors that include a CO sensing element where shown and required. Detectors may be either standalone sensors, or employ multi-sensing technology integrated with smoke sensors, and shall be Listed to the appropriate ANSI/UL standards, including UL 2075 (carbon monoxide), UL 268 (smoke) and UL 521 (thermal) as applicable.
2. The CO element shall operate between 30-560 parts per million (ppm), with a standard set point of 70ppm for exposure of 60 minutes accordance with NFPA 720. CO Sensors shall operate on non-resettable 24vdc power provided by the FACP, and provide full analog values directly to the FACP. The detector shall have associated programmable control module outputs, and an integral piezo horn that produces 85dbA at 10ft. Activation of a CO Detector shall initiate a Priority 2 Supervisory CO Alarm event at the local Control Unit and Fire Response Center, and remote system Annunciators as described herein.
3. CO Sensors that are integrated into Mechanical Systems shall be designed for duct mounting or area detection, with a CO Alarm set point of not less than 50ppm, and be appropriately Listed by a Nationally-Recognized Testing Laboratory.
4. Sensors shall be provided and installed in accordance with the manufacturer's instructions. Sensors shall be monitored by the local Fire Alarm System for multiple alarm thresholds with corresponding addressable outputs to initiate equipment shutdown procedures and related life safety functions. Sensors will support periodic functional testing.
5. CO Sensors shall be monitored and programmed for Supervisory CO Alarm reporting in accordance with NFPA 720 and applicable code.

G. Linear Beam Smoke Detectors

1. Line-of-sight beam type smoke detectors shall consist of infrared transmitter and receivers to detect smoke obscuration across large distances. The beam shall traverse the protected area and its' signal will be processed by the receiver to initiate the appropriate alarm response.
2. The detector shall cover distances from 30 to 325 feet and shall be designed, installed and adjusted to ensure there will be no interference from sunlight or high output lighting in the space.
3. Each beam detector set shall include transmitter, receiver, addressable monitor module and remote key-operated test station with LED alarm indicator and be powered from auxiliary 24VDC power from the local Fire Alarm Control Panel.
 - a. For areas with direct exposed sunlight, utilize an end-to-end beam detector with powered senders and receivers.

- b. For areas without direct sunlight, utilize a single-point beam detector with a prism reflector with the ability to correct for slight building movement and self-correction alignment. Flat reflectors are not acceptable.

H. Manual Pull Stations – Addressable

1. Provide single-action HMS-S addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control panel.
 - a. Station will mechanically latch upon operation and remain so until manually reset by opening with a supplied allen wrench.
 - b. Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".
 - c. The manual station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Flying lead terminals are not permitted.
 - d. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.
2. Where shown on the drawings, provide a protective shield.
 - a. Shall be constructed of a clear LEXAN shield and red frame that easily fits over manual pull stations.
 - b. When shield is lifted to gain access to the station, a battery powered piercing warning speaker shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
3. Where required, there shall also be available pull stations with break glass, capable of explosion proof installation, capable of weatherproof installation, reset key operation, and metal housings.

I. Addressable Interface Devices

1. Addressable Interface Devices shall be provided to monitor contacts for such items as water-flow, tamper, and PIV switches connected to the fire alarm system. These interface devices shall be able to monitor a single or dual contacts. An address will be provided for each contact. Where remote supervised relay is required the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be model number HTRI or FDCIO Series.
2. Single Device Damper Monitoring and Control: A single HTRI switch input shall be able to monitor all 3 states of a damper – open, closed, and in transit. A single HTRI-R shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.
3. Model FCIO422 addressable input/output module shall be insensitive to polarity and shall have capability for up to 4 separate inputs (Class B) or 2 separate Class A inputs and 4 separate outputs (Class B).
4. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:
 - a. Report faults to the host FACP.

- b. On-board Yellow LED provides module status.
- c. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

2.10 DEVICE PROGRAMMING UNIT

- A. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable. The programmer shall be model DPU with carrying case.
 - 1. Furnish a DPU to the owner at the completion of this project.

2.11 NOTIFICATION APPLIANCES

- A. Provide combination or individual audible and visual notification appliances as shown and permitted. All appliances shall be direct-wired; devices that utilize a multi-part assembly with swipe or non-mechanical pressure-type contact connections will not be considered acceptable.
 - 1. All inputs shall employ terminals that accept #12 to #18 AWG wire sizes
- B. Appliances shall have no identifying labels and have a red or white finish as directed by the Architect. The contractor shall provide fitted surface mount backboxes supplied by the appliance manufacturer and outdoor-rated appliances where site conditions dictate.
 - 1. Audible Speaker Appliances:
 - a. Speaker appliances shall be Series SE appliances or approved equals for maximum output (at minimum wattage) across a sizeable frequency range, 400 to 4000 Hz.
 - 1) Wall-mounted Speakers: Provide multi-tapped cone speakers with square or rectangular grille with where shown or required. Each speaker shall have selective 1/4, 1/2, 1, or 2 watt taps. Each speaker shall produce a sound output level of 84dbA at 10' (1 watt setting).
 - 2) Ceiling-mounted Speakers: Provide multi-tapped cone speakers with 7" round white grille and the appropriate backbox/baffle and ceiling tile bridge assemblies for ceiling mounting where shown or required. Each speaker shall have selective 1/4, 1/2, 1, or 2 watt taps. Each speaker shall produce a sound output level of 84dbA at 10' (1 watt setting).
 - b. For systems utilized for combination emergency messaging and convenience paging, utilize series 'SEH' of High-Fidelity (HiFi) speakers / speaker-strobes are comprised of high-efficient design for maximum output (at minimum wattage) across a sizeable frequency range, 300 to 8000 Hz
 - c. Provide high output re-entrant-type speakers with the appropriate weatherproof listings in outdoor or other high ambient noise areas, as shown on the contract drawings.
 - 1) Multiple tap setting up to 15 watts.
 - d. Speakers shall be UL Listed under Standard 1480 for Fire Protective Service, and speakers equipped with strobes shall be listed under UL Standard 1971 for Emergency Devices for the Hearing-Impaired. Speaker with strobes shall be certified to meet the requirements of FCC Part 15, Class B.
 - e. All speakers shall be designed for a field-selectable input of either 25 or 70 VRMS.

- f. All speaker and speaker-strobe appliances shall listed for Special Applications: Strobes are designed to flash at 1-flash-per-second minimum over their “Regulated Input Voltage Range”
- 2. Visual Strobe Appliances:
 - a. Visual-notification appliances shall meet and be listed for UL Standard 1971 (Emergency Devices for the Hearing-Impaired) for Indoor Fire Protection Service
 - b. Strobe shall be listed for indoor use, and shall meet the requirements of FCC Part 15 Class B.
 - c. Strobe intensity, where Multi-Candela appliances are specified, shall have field-selectable settings, and shall be rated per UL Standard 1971 for:
 - 1) 15/30/75/110cd
 - 2) 135/185cd
 - 3) 15/75 single Candela (wall mount)
 - 4) 15/30/75/95cd or 115/177cd (ceiling mount)
- 3. Strobe appliances shall produce a flash rate of one (1) flash per second over the Regulated Voltage Range, and shall incorporate a Xenon flashtube enclosed in a rugged Lexan lens
- 4. All inputs shall be compatible with standard, reverse polarity supervision of circuit wiring by a Fire Alarm Control Panel (FACP)
- 5. The selector switch for selecting the candela shall be tamper resistant
- 6. The strobes shall not drift out of synchronization at any time during operation
 - a. If the sync module or Power Supply fails to operate, (i.e. - contacts remain closed), the strobe shall revert to a non-synchronized flash rate

2.12 TWO-WAY RADIO ENHANCEMENT EMERGENCY COMMUNICATIONS

- A. Provide an approved distributed antenna system and FCC-certified signal boosters, or systems otherwise approved in order to achieve the required adequate radio coverage. The in-building radio system is an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable firefighter communications at the required signal strength within the specified areas.
 - 1. The system must be compatible with the Camden County radio communication system.
 - 2. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 99% floor area radio coverage.
 - 3. General building areas shall be provided with 95% radio coverage.
- B. Provide the necessary hardware, wiring and programming to supervise the following:
 - 1. Two-way radio enhancement system (amplifier fail, antenna fail, AC Power, charger and battery fail).
 - 2. The integrity of the circuit monitoring the signal booster(s) and power suppl(ies) shall comply with 4.4.7.1 of NFPA 72.

- C. A dedicated monitoring panel shall be provided within the emergency command center to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 - 1. Normal AC power
 - 2. Signal booster trouble (if available)
 - 3. Loss of normal AC power
 - 4. Failure of battery charger
 - 5. Low battery capacity (if available)
- D. A sign will be located at the dedicated monitoring panel with the name and telephone number of the radio service provider indicating that they shall be notified of any alarm.

2.13 MAGNETIC DOOR HOLD OPEN DEVICES

- A. Door Hold Open Devices: Door hold open devices shall be operate from 24vdc power supplied by the local FACP. The Contractor shall coordinate the proper voltage of these devices with the door hardware supplier to ensure that all required hardware and wiring is provided.
 - 1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
 - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
- B. Material and Finish: Match door hardware.

2.14 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush Surface cabinet, NEMA 250, Type 1.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.15 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.16 DIGITAL COMMUNICATOR

- A. The Multi-Point Digital Alarm Communicator shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remote Receiving Station. The MDACT shall support the following:
1. Ademco Contact ID or SIA protocol
 2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual points
 3. SIA selection shall provide the ability to transmit events for up to 2040 individual points
 4. Programming of accounts and phone numbers
 5. Dual phone line interface
 6. Line fault monitoring.
 7. Automatic 24-hour test
 8. Shall Interface with Internet Protocol Communication Dialer
 9. Shall Interface with Radio Communication Dialer

2.17 STAIRWELL PRESSURIZATION SYSTEM:

- A. Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.
1. Pressurization starts when any associated alarm is received at fire-alarm control unit.
 2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

2.18 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:
1. Common-talk type for firefighter use only.
 2. Selective-talk type for use by firefighters and fire wardens.
 3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously. An indicator lamp shall flash if a phone is disconnected from the talk circuits.

4. Addressable firefighters' phone modules to monitor and control a loop of firefighter phones. Module shall be capable of differentiating between normal, off-hook, and trouble conditions.
5. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is taken off the hook, it causes an audible signal to sound and a high-intensity lamp to flash at the fire-alarm control unit in the fire command center.
6. Selector panel controls to provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
7. Display: Graphic to indicate location of caller.
8. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.
 - a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Emergency Phone."
 - b. With "break-glass" type door access lock.
9. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Emergency Phone."
10. Handsets: Push-to-talk-type sets with noise-canceling microphone stored in a cabinet adjacent to fire-alarm control unit in the fire command center.

2.19 FIREFIGHTERS' SMOKE-CONTROL SYSTEM

A. Initiate Smoke-Management Sequence of Operation:

1. Comply with sequence of operation as described in Section 230993.11 "Sequence of Operations for HVAC DDC."
2. Fire-alarm system shall provide all interfaces and control points required to properly activate smoke-management systems.
3. First fire-alarm system initiating device to go into alarm condition shall activate the smoke-control functions.
4. Subsequent devices going into alarm condition shall have no effect on the smoke-control mode.

B. Addressable Relay Modules:

1. Provide address-setting means on the module. Store an internal identifying code for control panel use to identify the module type.
2. Allow the control panel to switch the relay contacts on command.
3. Have a minimum of two normally open and two normally closed contacts available for field wiring.
4. Listed for controlling HVAC fan motor controllers.

2.20 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 device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT (LEED)

- A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- C. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 2. Mount manual fire-alarm box on a background of a contrasting color.
 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- E. Smoke- or Heat-Detector Spacing:
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, 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 Annex A or Annex B in NFPA 72.
 5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- H. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
- I. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- J. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- K. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- L. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- M. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

- N. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- O. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph wind load with a gust factor of 1.3 without damage.

3.4 BOXES, ENCLOSURES AND WIRING DEVICES

- A. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- B. Fire Alarm: Terminal cabinets shall be provided in locations shown and as otherwise required to support wiring terminations, troubleshooting and future tenant fit-up. Cabinets shall be painted red and contain terminal blocks to support the system wiring where the Control Panels are remote from the devices served. Cabinets shall include accommodation for all wiring including SLCs, notification circuits, and related addressable and fault isolation modules for future expansion and modification.
 - 1. Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NFPA 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.
- C. Boxes shall be installed plumb and firmly in position.
- D. Extension rings with blank covers shall be installed on junction boxes where required.
- E. Junction boxes served by concealed conduit shall be flush mounted.
- F. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- G. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.
- H. Panel enclosures shall be installed to meet clearance requirements per NFPA 70 and local codes. Minimum requirements shall be 3 foot clearance in front of the enclosure.

3.5 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. All splices shall be made using solder-less connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- D. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

- E. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- F. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

3.6 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- C. A consistent color code for fire alarm system conductors throughout the installation.

3.8 PATHWAYS

- A. Pathways shall be installed in EMT.
- B. Exposed EMT shall be painted red enamel.

3.9 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 Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.

3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Magnetically held-open doors.
5. Electronically locked doors and access gates.
6. Alarm-initiating connection to elevator recall system and components.
7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Data communication circuits for connection to building management system.
12. Data communication circuits for connection to mass notification system.
13. Supervisory connections at fire-extinguisher locations.
14. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
15. Supervisory connections at fire-pump engine control panel.

3.10 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.11 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.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.12 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 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 the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "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 the "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" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- B. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- E. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.13 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.14 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.15 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the owner and test results recorded for use at the final acceptance test.
- E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- F. Testing requirements for pre-action systems in accordance with NFPA13
- G. Testing requirements and room integrity testing for clean agent suppression systems refer to NFPA 2001.
- H. Final Acceptance Test: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 30 calendar days prior to the test date. A final acceptance test will not be scheduled until the loop resistance test results, and the submittals required in Part 1 are provided to the owner. Test the system in accordance with the procedures outlined in NFPA 72.
 - 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
 - 3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 - 4. Visually inspect all wiring

5. Verify with all parties the required survivability of wiring, raceways, and junction boxes
 6. Verify that all software control and data files have been entered or programmed into the FACP.
 7. Verify that Shop Drawings reflecting as-built conditions are accurate. Upon final approval by all parties, provide two sets of AS-built documents in a cabinet adjacent to the main FACP or designated area within the building. Per NFPA 72 7.7.2 Measure the current in Notification appliance circuits under full load to assure that there is the calculated spare capacity for every circuit.
 8. Measure voltage readings for circuits to assure that voltage drop does not exceed specified design requirements.
 9. Field Verify and measure the voltage drop at the most remote appliance on each notification appliance circuit.
- I. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, shorted and grounded signal line circuits.
 - b. Open, shorted and grounded notification, releasing circuits.
 - c. Primary power or battery disconnected.
 2. System notification appliances shall be demonstrated as follows:
 - a. All alarm notification appliances actuate as programmed
 - b. Audibility and visibility at required levels.
 - c. VOICE Intelligibility measurements at the time of commissioning and with a follow up inspection six months after substantial competition to verify conditions.
 3. System indications shall be demonstrated as follows:
 - a. Correct message display for each alarm input at the control display.
 - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
 - c. Correct history logging for all system activity.
 4. System off-site reporting functions shall be demonstrated as follows:

- a. Correct zone transmitted for each alarm input
- b. Trouble signals received for disconnect
- 5. Secondary power capabilities shall be demonstrated as follows:
 - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
 - c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.16 SPECIAL INSPECTION TESTING

- A. Include a minimum of 10 full days of electrical services as listed below to aid the special inspector during special inspection testing.
- B. Provide on-site personnel to provide electrical, fire alarm, and fire alarm programming support.

3.17 DOCUMENTATION

- A. System documentation shall be furnished to the owner and shall include but not be limited to the following:
 - 1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
 - 2. System operation, installation and maintenance manuals.
 - 3. System matrix showing interaction of all input signals with output commands.
 - 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
 - 5. System program showing system functions, controls and labeling of equipment and devices.

3.18 PROTECTION

- A. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

3.19 DEMONSTRATION

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm system.
- B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the owner.
- C. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during working hours on such dates and times as are selected by the owner. The instruction may be divided into two or more periods at the discretion of the owner. One training session shall be videotaped by the contractor. Required owner format shall be delivered to the owner.
- D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the owner.
- E. Comprehensive system troubleshooting training shall be provided for a single individual designated by the owner. This session shall be separate and distinct from the above described sessions.
- F. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.
- G. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

END OF SECTION 284621.11