SECTION 28 4600
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.

B. RF Survey for Emergency Responder Communications.

1.02 RELATED REQUIREMENTS

A. Section 21 3000 - Fire Pumps: For interface with fire alarm system.

B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: For non-power-limited cables.

C. Section 26 0533.16 - Boxes for Electrical Systems.

1.03 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authorities having jurisdiction.

B. BAS: Building automation system.

C. DMNS: Distributed mass notification system.

D. ECS: Emergency communications system.

E. EoL: End-of-line.

F. EVACS: Emergency voice/audio communication systems.

G. FACU: Fire alarm control unit.

H. HVAC: Heating, ventilation, and air conditioning.

I. IDC: Initiating device circuit.

J. LAN: Local area network.

K. MNS: Mass notification system.

L. NAC: Notification appliance circuit.

M. NPLFA: Non-power-limited fire alarm.

N. PLFA: Power-limited fire alarm.

O. SLC: Signaling line circuit.

P. SOO: Sequence of operation.

1.04 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

C. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

E. NECA 305 - Standard for Fire Alarm System Job Practices; 2018.

F. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

J. UL 38 - Standard for Manual Signaling Boxes for Fire Alarm Systems; Current Edition, Including All Revisions.

K. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

L. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.

M. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.

N. UL 497B - Standard for Protectors for Data Communications and Fire-Alarm Circuits; Current Edition, Including All Revisions.

O. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.

P. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.

Q. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

R. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

S. UL 2075 - Standard for Gas and Vapor Detectors and Sensors; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate arrangement of equipment with dimensions and clearance requirements of actual equipment.
   2. Coordinate placement of devices and notification appliances with potential conflicts or view obstructions.
   3. Coordinate work to provide power for equipment at required locations (e.g., smoke dampers, type of actuators, line or local control transformer, zoning, grouping and circuit activations).
   4. Coordinate fire suppression systemdevice requirements, monitoring, control, and associated interconnections.
   5. Coordinate requirements for branch circuit protection, identification, and shunt trip if applicable.
   6. Coordinate kitchen equipment requirements for fire alarm system interconnections based on selected equipment.
   7. Coordinate reflected ceiling plans to avoid conflicting placements; maintain minimum diffuser and detector clearances as indicated.
   8. Coordinate submittals to confirm equipment and associated components are capable of indicated settings, and manufacturer documentation identifies required compatible product listings.
   9. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
   10. Non-Power-Limited Cables: See Section 26 0519.

B. Sequencing:
   1. Verify exact termination locations required for boxes, enclosures, and equipment.
   2. Do not install devices or notification appliances until final surface finishes, painting, and cleaning are complete, unless otherwise required by AHJ.
   3. Do not begin installation of conductors and cables until installation of conduit and pathways between termination points is complete.
   4. Sequence work to protect cabling (e.g., overspray painting, physical stress, and insulation damage or covering markings).
   5. Verify naming convention for equipment identification, including room names and numbers, prior to creation of final drawings, reports, and labels.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Evidence of designer qualifications.

C. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification information.

D. Design Documents: Submit all information required for plan review and permitting by AHJ, signed and sealed by a licensed professional engineer registered in the project's state or other applicable jurisdiction, including floor plans, riser diagrams, and description of operation.
   1. Copy (if any) of list of data required by AHJ.
   2. NFPA 72 "Record of Completion", filled out to extent known at time.
   3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A, and complete listing of software required.
   4. Manufacturer's detailed product data sheet for each component, including wiring diagrams, and circuit length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.
   5. Certification by manufacturer of FACU that system design complies with Contract Documents.
   6. Certification by Contractor that system design complies with Contract Documents.

E. RF Survey Field Report
   1. Include test results for each building level, as applicable.
   2. Prepare floor plan drawings indicating RF field strength for each frequency band of interest.
      a. Plan shall indicate areas that fail or pass test parameters.

F. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.
   1. System zone boundaries and interfaces to fire safety systems.
   2. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
   3. Include elevations and details of proposed equipment arrangements.
   4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
   5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and EoL and power supervisory devices.
   6. Include requirements and control diagrams for interfacing with other systems.
   7. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; standby and spare capacity calculations; notification appliance circuit loop resistance and voltage drop calculations, including spare capacity.

8. List of devices and notification appliances on each SLC, with spare capacity indicated.
9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
11. Detailed drawing of graphic annunciators, displays, and interfaces.
12. Certification by either FACU manufacturer or manufacturer of related equipment.
13. Certification by FACU manufacturer that system design complies with Contract Documents.
14. Certification by Contractor that system design complies with Contract Documents.

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

H. Evidence of cybersecurity compliance in accordance with NFPA 72.

I. Evidence of installer qualifications.

J. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test," filled out.

K. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by AHJ.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures require recording of system trouble events by qualified personnel, such as when routine testing is being conducted for fire drills and when entering into contracts for building renovations.

L. Project Record Documents: See Section 01 7800 for additional requirements, have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
2. "As installed" wiring and schematic diagrams, with final terminal identifications.
3. "As programmed" operating sequences, including control events by device, and updated input/output chart.

M. Closeout Documents:
1. Certification by manufacturer that system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
2. NFPA 72 "Record of Completion," filled out completely and signed by installer and authorized representative of AHJ.

N. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.

1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.

1.07 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III (three) or Level IV (four) certified fire alarm technician or registered fire protection engineer, employed by FACU manufacturer, Contractor, or installer, with experience designing fire alarm systems in jurisdictional area of AHJ.

B. Installer Qualifications: Firm with minimum three years documented experience installing fire alarm systems of specified type and providing contract maintenance service as regular part of their business.
   1. Authorized representative of FACU manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least two years of experience installing fire alarm systems.
   3. Supervisor: Level III (three) or Level IV (four) certified fire alarm technician; furnish name and address.

C. Manufacturer Qualifications: Company specialized in manufacturing products specified in this section with at least three years of documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 305.

C. Handle carefully to avoid damage to internal components, enclosure, and finish.

D. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

B. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

C. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Fire Alarm Control Units and Accessory Equipment: Provide minimum 3-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

C. Fire Alarm Manual Pull Stations: Provide minimum 1-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

D. Fire Alarm System Detectors: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

E. Fire Alarm System Notification Appliances: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

A. General Requirements:
1. Provide new fire alarm system complying with NFPA 70, NFPA 72, NFPA 90A, and consisting of required equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as necessary for complete operating system that provides functional intent indicated.
2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
    a. 36 CFR 1191 and ADA Standards.
    b. Requirements of AHJ.
    c. Applicable local codes.
    d. Contract Documents.
    e. NFPA 72; "should" is mandatory; where conflicts between requirements require deviation, identify deviations clearly on design documents.
3. Fire Alarm System Products:
    a. Listed, classified, and labeled as suitable for purpose intended.
    b. Installation Environments: Provide products suitable for their respective indoor and outdoor applications.
    c. Cybersecurity:
        1) Network communication for control or monitoring of system components protects users by data encryption, mutual device authentication, firmware protection, tamper-proof hardware, and authenticated user access.
        2) Modular component fire alarm system maintains valid cybersecurity certificate from National Registered Testing Laboratory (NRTL), renewed annually.
        3) Firmware upgrades incorporate signature receipts to avoid unauthorized access.
        4) Privacy and Security:
            (a) Authorized password protection is required for accessing and modifying system.
            (b) User access level control functionality is configurable.
            (c) Includes independent firewall protection.
            (d) Incorporates user profiles or other means of data preservation and archiving (e.g., historical changes logs for settings of devices, zones, scenes).
            (e) Provide similar devices and equipment to maintain same firmware version.
4. Fire Alarm System Design Information:
    a. Building Code: Comply with ICC (IBC).
        1) Principle Occupancy: As indicated on Architect code summary drawings.
        2) Principle Use: As indicated on Architect code summary drawings.
        3) Occupant Evacuation Method: Total building.
        4) Equipment Room Rating: Two-hour.
        5) Fire Suppression System: Fully sprinkled.
            (a) Types:
    b. NFPA 72 Fire Alarm System Classification: Protected premises.
    c. Smoke and Heat Detector Coverage: Partial or selective coverage in accordance with NFPA 72.
    d. Signal Priorities:
        1) See fire alarm system matrix indicated on drawings.
5. Provide fire alarm circuits in accordance with NFPA 70.

a. Comply with methods of interconnecting FACUs in accordance with NFPA 72 and NFPA 70.
b. Power Sources:
    1) Comply with requirements for power supplies of emergency systems in accordance with NFPA 70.
    2) Primary: Dedicated branch circuits from facility power distribution system.
    3) Secondary: Storage batteries with capacity to operate system for period specified by NFPA 72.
c. Wiring and Wiring Methods:
    1) General Requirements:
        (a) Comply with requirements for wiring and wiring methods in accordance with NFPA 70.
        (b) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed and labeled as suitable for use in return air plenums.
        (c) Special Occupancies: Comply with NFPA 70.
        (d) Comply with NFPA 70 for wire and cable plenum, riser, general-purpose, limited-use, undercarpet, and underground applications.
    2) Fire Alarm Circuits:
        (a) Comply with NFPA 70 for conditions and types required for multiconductor cable systems.
        (b) Non-Power-Limited Fire Alarm (NPLFA) Circuits:
            (1) Provide dedicated NPLFA non-GFCI branch circuits for fire alarm equipment and marked by red identification in accordance with NFPA 70.
        (c) Power-Limited Fire Alarm (PLFA) Circuits:
            (1) Provide identification for PLFA circuits in accordance with NFPA 70.

6. Provide pathway class designations and pathway survivability, as defined in NFPA 72.
    a. Provide monitoring of conductors and other signaling channels for integrity and circuit performance.
    b. Pathway Class Designations:
        1) Unless otherwise indicated or required, pathways to meet the following requirements:
            (a) SLCs: Class B (star, tee-tap, multi-tap, with no return).
            (b) IDCs: Class B (daisy-chain with EoL resistor device installed at end of circuit).
            (c) NACs: Class B (daisy-chain with EoL resistor device installed at end of circuit).
            (d) Network Communications: Class B.
            (e) Other Wiring:
                (1) Other life safety control features not covered above (e.g., door holder circuits, elevator recall circuits, fire smoke dampers, and air handling system interfaces), wired as Class D (failsafe, intended operation is performed in event of pathway failure).
                (2) Where Class D wiring is not possible due to limitation of equipment, wiring limited to 3-feet between addressable control module and equipment and be installed in metallic conduit.
7. Spare System Capacity:
    a. SLCs: Minimum 25 percent spare capacity.
    b. NACs: Minimum 25 percent spare capacity.
8. Secondary Power Source - Battery Storage Capacity:

a. Provide standby (nonalarm) operation sufficient for 24 hours.
b. Provide additional alarm operation for 15 minutes.
c. Calculate combined of standby load plus alarm load for overall battery storage capacity requirements, per power supply.
d. Provide 25 percent additional overall battery capacity correction factor.

B. Fire Alarm System Interfaces and Control Functions:
1. UL 864 listed unless otherwise indicated.
2. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.
3. Provide initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with NFPA 72.
4. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.
5. Fire Suppression Systems:
   a. Provide minimum of four monitoring point inputs per system unless otherwise indicated.
   b. Kitchen Hood Suppression Systems: Provide minimum of one monitoring point input per system.
   c. Fire Sprinkler Systems:
      1) Waterflow Switches: Provide minimum of one monitoring point input per switch.
      2) Control Valve Supervisory (Tamper) Switches: Provide minimum of one monitoring point input per switch.
      3) Pressure Supervisory (High/Low Pressure) Switches: Provide minimum of two monitoring point inputs per switch (separate points for high/low pressure signals).
      4) Preaction Control Panels: Provide minimum of four monitoring point inputs per system.
      5) Freeze Protection: For each sprinkler riser location, provide room temperature sensor to provide supervisory signal to FACU.
6. Fire and Smoke Doors/Shutters/Curtains:
   a. Electromagnetic Door Holder Release:
      1) Provide output signal for release of electromagnetic door holders via addressable relay module and power isolation relay.
      2) Door holders powered via 24 VDC unless otherwise indicated.
      3) Door release activated as determined by AHJ.
         (a) Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor.
7. Lighting/Dimming Control Systems:
   a. System Override:
      1) Provide output signal to override lighting/dimming controls via addressable relay module and power isolation relay.
      2) Provide connection to UL 864 listed control system interface or interface with system control power where interruption of control power overrides system.
8. Other Interconnected Systems: For systems listed below, provide minimum of two monitoring point inputs each.
   a. Gas Detection Systems: Including providing notification appliances as indicated on plans for NOX - Nitrous Oxide, CO2 - Carbon Dioxide, CO - Carbon Monoxide, and HC - Hydrocarbon.
9. HVAC Systems:
   a. Air Handling Units (AHUs) and Roof Top Units (RTUs):

1) Provide duct smoke detector on supply side of air stream for units over 2,000 cfm.
2) Provide duct smoke detector on return side of air stream for units over 15,000 cfm.
3) Provide remote test station for each duct smoke detector unless explicitly indicated as not required.
4) Provide output signal to shut down units with at least one duct smoke detector via addressable relay module.
5) Where fire/smoke dampers are located downstream of unit, provide monitoring point input to determine that unit is not operational and subsequently provide output signal to close such dampers via addressable relay module and power isolation relay.

b. Remote Test Stations: Provide remote test station for each duct smoke detector unless explicitly indicated as not required. Unless otherwise indicated, use remote test stations only in clean, dry, indoor, nonhazardous locations.

10. High Volume Low Speed (HVLS) Fans:
    a. Provide interlocked shut down of all HVLS fans upon activation of waterflow switch, in accordance with NFPA 13 and NFPA 72.
    b. HVLS Fan Shutoff:
        1) Provide output signal to stop fans via addressable relay module and power isolation relay.
        2) Fan shutoff activated by building smoke detection.
11. Fire/Smoke Dampers:
    a. Provide output signal to close fire/smoke damper via addressable relay module and power isolation relay.
    b. Fire/smoke damper activated by the following method(s); where more than one method is listed see drawings for method used at each location.
        1) By addressable duct smoke detector.
        2) By conventional duct smoke detector furnished with fire/smoke damper (along with remote test station); provide addressable monitor module.
        3) By corridor smoke detection, where fire/smoke dampers serve only corridors provided with smoke detection throughout and all dampers serving such corridor are activated.
        4) By smoke detector installed within 5 feet of fire/smoke damper air diffuser (in lieu of duct smoke detection), where fire/smoke dampers serve spaces other than corridors or corridors not provided with smoke detection; smoke detectors installed solely for activation of fire/smoke damper programmed as supervisory signal (not alarm) unless otherwise required by AHJ.
        5) By room/area smoke detection (in lieu of duct smoke detection), where area/room is provided with smoke detection throughout and all dampers serving such room/area are activated.

C. Sleeping Areas:
    1. Quantity of Sleeping Locations or Units: As indicated on drawings.
    2. Devices Within Units:
        a. Use fire alarm system-connected addressable devices for local unit detection/alarm (in lieu of single- and multiple-station alarms) and for building fire alarm event notification.
        b. Local Unit Detection/Alarm:
            1) Provide low frequency sounder bases for detectors (smoke and carbon monoxide as indicated).
            2) Smoke Detector Activation:

(a) Provide dedicated local unit supervisory signal to fire alarm system (separate from carbon monoxide detection).
(b) Activate low-frequency sounder bases within same unit to provide NFPA 72-compliant temporal 3 pattern.
(c) Detector Restoration: Device activation to automatically restore to normal condition when smoke chamber obscuration levels drop below activation threshold.

3) Carbon Monoxide Detector Activation:
(a) Provide dedicated local unit carbon monoxide supervisory signal to fire alarm system (separate from smoke detection).
(b) Activate low-frequency sounder bases within same unit to provide NFPA 72-compliant temporal 4 pattern.
(c) Detector Restoration: Device activation to latch and only restore to normal condition upon reset command from FACU.

4) Synchronize notification appliances (sounders and strobes) within unit with each other.
5) Exclude local unit detection/alarm from any fire alarm system bypass/disable operation.

c. Building Fire Alarm Event Notification:
1) Provide low frequency sounders in each unit as indicated and as required to achieve minimum of 75 dB at pillow in legally-defined bedrooms and 15 dB over ambient in other interior areas of unit.
2) In lieu of providing separate low frequency sounders, system may activate detector low frequency sounder bases provided under local unit detection/alarm above.
3) Synchronize notification appliances (sounders and strobes) within unit with each other and with common area notification appliances on same floor.
4) FACU to control activation mapping, silencing, and restoration.

2.02 FIRE ALARM CONTROL UNITS AND RELATED EQUIPMENT

A. Fire Alarm Control Units and Related Equipment: Listed and labeled as complying with UL 864.

B. Provide cabinets and enclosures as indicated or as required to house system components.

C. Seismic Qualification: Provide fire alarm system and associated components suitable for application under project seismic design criteria where required. Include certification of compliance with submittals.

D. Fire Alarm Control Unit (FACU): Addressable.
1. SLCs and IDCs: Configurable for Class B or Class A with additional modules.
2. NACs: Integral and programmable with synchronization modules or cards as required.
3. Power Supply: 120 VAC, 60 Hz, supplying necessary power for FACU.
4. User-Interface: Touchscreen display for system interfacing and service mode settings, include password and user credentials; configurable for custom actions and incorporates historical event log.
5. Support self-testing detector capability.
6. Remote Annunciator Support: Up to 10.
7. Provide NAC expansion as required.

E. Notification Appliance Circuit Expansion:
1. Where notification appliance circuit requirements exceed capacity of FACU, provide accessories and cabinets as required for expansion.

F. Addressable Interface Modules:
1. General Requirements:

a. Provide addressable modules suitable for connection to FACU SLCs.
b. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.

2. Addressable Monitor Modules: Unless devices are explicitly permitted connected together on one zone; provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable FACU.
3. Addressable Relay Modules:
   a. Provide as indicated or as required to perform necessary functions via dry-contact interface.
   b. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.

G. Alarm Communication:
1. Protected Premises Alarm and Signaling Systems:
   a. Provide accessories as required for interface as indicated and as required by AHJ.
   b. Provide accessories in accordance with building code, fire code, and life safety code requirements for occupancy classifications and use cases.
   c. Include software and firmware control, required features, special requirements for low-power radio (wireless) systems, and fire alarm system interconnections required by NFPA 72.

H. Remote Annunciators:
1. LCD Remote Annunciators:
   a. Provide backlit LCD display that mimics FACU display.
   b. Provide dedicated status indications for power and alarm, supervisory, and trouble conditions.
   c. Enable system control functions including acknowledge, silence, and reset.
   d. Provide local audible alarm.
   e. Mounting: Wall-mounted; provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.

2.03 FIRE ALARM SYSTEM INITIATING DEVICES

A. General Requirements:
1. Addressable Systems:
   a. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs.
   b. Conventional/Nonaddressable Devices: Provide addressable interface modules as indicated or as required for connection to addressable FACU. Unless devices are explicitly permitted to be connected together as one zone, provide separate addressable monitoring point for each device in order to be individually identifiable by addressable FACU.
2. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable interface modules only in clean, dry, indoor, nonhazardous locations.
3. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
4. Devices for Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.
5. Devices for Hazardous/Classified Locations: Listed and labeled as suitable for classification of installed location.

B. Manual Fire Alarm Boxes/Pull Stations:

1. Description: Noncoded manual signaling boxes listed and labeled as complying with UL 38.
2. Alarm Initiation: Configured for general alarm initiation unless otherwise indicated; presignal stations (where indicated) require use of key to initiate general alarm.
3. Operation: Dual-action unless otherwise indicated or required.
   a. Dual-Action Operation: First requires pushing, pulling, or lifting, then pulling of lever.
4. Color: Red, in accordance with NFPA 72.
5. Station Reset: Requires use of key or tool.

C. Spot-Type Detectors:
1. Utilize plug-in mounting to separate base with tamper-resistant feature; provide bases as indicated or as required.
2. Addressable Detectors:
   a. Provide LED indication of normal operation and regular communication with FACU and alarm condition.
3. Smoke Detectors:
   a. Listed and labeled as complying with UL 268.
   b. Provide sensor type (e.g., photoelectric, ionization) as indicated.
4. Thermal/Heat Detectors:
   a. Listed and labeled as complying with UL 521.
   b. Provide sensor type (e.g., fixed temperature, rate-of-rise) and rating as indicated.
5. Carbon Monoxide Detectors:
   a. Listed and labeled as complying with UL 2075.
   b. Provide end-of-life notification.
6. Combination and Multi-Criteria Detectors: Comply with respective requirements for each detection method.

D. Duct Smoke Detectors:
1. Listed and labeled as complying with UL 268A.
2. Ratings: Compatible with air velocity, temperature, and humidity requirements for installed duct.
3. Housing: Select as required for application.
4. Sampling Tubes: Select as required for installation in duct to be monitored.

E. Accessories:
1. Remote Test Stations: Allows for detector key switch test and reset; provides visual and audible indication of alarm condition.
2. Provide Detector Bases As Indicated:
   a. Color: White, unless otherwise indicated.
   b. Sounder bases.
3. Provide power supervision relays as required.

2.04 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

A. General Requirements:
1. Provide signaling notification appliances listed for fire-protective service and intended operating mode, public or private; suitable for connection to FACU notification appliance circuits.
2. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (e.g. ceiling, wall).
3. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
4. Exterior Notification:

a. In addition to required occupant notification, provide notification appliances on exterior of building.
b. Outdoor and Damp/Wet Locations: Weatherproof, suitable for outdoor use; provide manufacturer's accessory backboxes or enclosures in accordance with product listing.

5. Notification Appliance Derating: Include device derating adjustments in accordance with listing where applicable, including the following.
   a. Where accessory protective guards or enclosures are utilized.
   b. Where required by field conditions (e.g., ambient temperature and sound).
6. Notification Appliance Color:
   a. Wall-Mounted: White.
   b. Ceiling-Mounted: White.
   c. See drawings for mounting configuration indicated by symbols on floor plans, system interconnection diagrams, and details.

B. Visible Notification Appliances:
   1. Public Mode Operation: Listed and labeled as complying with UL 1971.
   2. Strobes: Clear or nominal white lens with flash rate of 1 Hz unless otherwise indicated or required; xenon or LED light source with maximum pulse duration of 0.02 seconds; candela rating as indicated.

C. Audible Notification Appliances:
   1. Listed and labeled as complying with UL 464.
   2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dBA at 10 feet for public mode operation or 45 dBA at 10 feet for private mode operation in accordance with UL 464.
   3. Horns: Selectable tone, including at minimum NFPA 72 temporal 3 pattern and continuous; minimum of two selectable volume levels.
   4. Low-Frequency Sounders: Listed for producing 520 Hz low frequency alarm signal for sleeping areas in accordance with NFPA 72; selectable tone, including at minimum NFPA 72 temporal 3 pattern and continuous.

D. Combination Notification Appliances: Comply with respective requirements for each signaling method.

E. Accessories:
   1. Provide guards to protect notification appliances where subject to mechanical damage; listed for use with notification appliance.

2.05 WIRE AND CABLE

A. General Requirements:
   1. Comply with NFPA 70 listing and marking requirements for cables.
   2. Substitution of fire alarm listed cables for communication wiring, in accordance with NFPA 70, is not permitted.
   3. Provide cables as indicated or as required for connections between system components.
      a. Data Cables for IP Network Connections: Unshielded twisted pair (UTP) complying manufacturer's minimum requirements.

B. Power-Limited Fire Alarm Cables (PLFA):
   1. Comply with applications of listed cables in accordance with Chapter 7 of NFPA 70.
      a. Fire alarm cable substitutions in accordance with NFPA 70: Permitted.

C. Non-Power-Limited Fire Alarm Cables (NPLFA):
   1. Comply with NPLFA circuit conductor properties in accordance with NFPA 72.
   2. Comply with listing requirements in Chapter 7 of NFPA 70.

2.06 ACCESSORIES

A. Provide components as indicated or as required for connection of fire alarm system to devices and other systems indicated.

B. Provide EoL resistors as required for wiring supervision.

C. Protective Covers for Fire Alarm Devices:
   1. Listed to same standard as device being protected.
   2. Outdoor Covers: Weather resistant, suitable for outdoor use; use only with outdoor-rated devices.
   3. Provide guards to protect devices where subject to mechanical damage; listed for use with detector.

D. Documentation Cabinets:
   1. Provide cabinets, size as indicated or as required to comply with on-site documentation storage required by NFPA 72.
   2. Cabinet: Steel with red finish; keyed to match fire alarm system equipment unless otherwise required by AHJ.

E. Framed Passive Graphic Maps:
   1. Provide passive graphic maps, size as indicated or as required by AHJ.
   2. Identify information required by AHJ, including the following:
      a. Location of FACUs and remote annunciators.
      b. Addressable Systems: Location of addressable initiating devices; identify room/area.
      c. Current location, labeled "YOU ARE HERE."
      d. North reference.
   3. Utilize nomenclature consistent with FACU programming and device identification labels.
   4. Provide concealed mounting hardware.

F. Surge Protection:
   1. Line Voltage Surge Protection:
      a. Provide for each line voltage circuit serving fire alarm system control units and related equipment (e.g., FACU, field booster panels, nodes, and transponders).
      b. Listed and labeled as complying with UL 1449.
   2. Low Voltage Surge Protection:
      a. Provide for each power-limited fire alarm circuit that enters or exits a building.
      b. Listed as complying with UL 497B.
      c. Provide voltage/current ratings suitable for circuit to be protected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements, including future system expansion as indicated on Contract Documents.

B. Verify that system capacities listed in manufacturer instructions align with designed system.

C. Verify that mounting surfaces are ready to accept components and equipment, with suitable support frames and anchors installed where required.

D. Verify ratings, configurations, and characteristics of system components.

E. Verify rough-ins for field connections.

F. Verify that work likely to damage fire alarm system has been completed.

G. Verify that interior of building has been protected from weather.

H. Perform preinstallation tests and inspections per manufacturer's instructions and in accordance with NECA 305.

I. Verify that system bonding is in accordance with Section 26 0526.

J. Do not energize system until deficiencies have been corrected.

K. Verify that branch circuit wiring installation is completed, tested, and ready for connection to fire alarm system. Overcurrent protection ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

3.02 RF SURVEY FOR EMERGENCY RESPONDER COMMUNICATIONS

A. Unless otherwise indicated or required by AHJ or local fire service, minimum signal strength shall be based on a -95dBm nominal signal.

B. Test equipment shall have been calibrated within one calendar year.

C. Test areas shall consist of a minimum 20 grid points per floor/level. If floor area esceeds 32,000 square feet, maximum test area shall not exceed 1,600 square feet.

D. Test shall include all critical areas as identified by NFPA or local authorities.

3.03 PREPARATION

A. Prior to installation, confirm environment of installation area is clean, and with ambient temperature, humidity, and ventilation requirements are per manufacturer’s written instructions.
   1. Clean and vacuum in accordance with manufacturer's written instructions. Confirm equipment ventilation holes are absent of obstructions and free for air flow.
   2. Clean pathways thoroughly to remove foreign materials before installing conductors and cables.
   3. Clean dirt, debris, plaster, and other foreign materials from equipment enclosures, cabinets, and outlet boxes.
   4. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Follow tool requirements for installation, including torquing adjustments, as listed in manufacturer documentation.

C. Remove detector dust covers prior to system energization.

3.04 INSTALLATION

A. Install field-devices, components, FACU and related equipment, and accessories in accordance with the following:

B. Field Locations:
   1. Obtain Owner's approval of locations of devices and notification appliances before installation.
   2. Arrange equipment to provide minimum operational clearances and required maintenance access in accordance with manufacturer's instructions and NFPA 70.
   3. Conceal wiring, conduit, outlet boxes, and supports where installed in finished areas; maintain code-required access.

C. Raceways and Supports:
   1. Coordinate locations of outlet boxes as required for installation. Only install boxes and equipment at locations based on application standards indicated in NFPA 72.
   2. Secure and support raceways at intervals complying with NFPA 70. Provide supports where vertical rise exceeds permissible limits.
   3. Provide minimum of four spare 1-inch trade size conduits out of each fire alarm panel stubbed into accessible space above ceiling.
   4. Install firestopping to preserve fire resistance rating of partitions and other elements.
   5. Provide required vibration isolation or seismic controls.
      a. See Section 26 0548.

D. Wiring and Connections:

1. Maintain separation of Class 1, Class 2, Class 3 remote-control, signaling, fire alarm circuits, and power-limited circuits in accordance with cable insulation class and NFPA 70.
2. Maintain circuit pathway and class designations in accordance with NFPA 72 for configuration, separation, and survivability.
3. Comply with permitted and not permitted installations for wires, cables, cable routing assemblies, communications circuits, and fire alarm circuits in accordance with NFPA 70.
4. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by AHJ. Provide independent support from building structure and suspended ceiling systems. Do not provide support from raceways, piping, ductwork, or other systems.
5. Provide grounding and bonding in accordance with Section 26 0526.
6. Comply with manufacturer's minimum cable sizes or ratings.
7. Do not exceed manufacturer's recommended maximum power, signal, or network cable lengths between components.
8. Provide network wiring in accordance with NFPA 70.
9. Neatly train and bundle conductors inside boxes, wireways, and cabinets.
10. See manufacturer's instructions for batteries.

E. Fire Alarm System Components:
   1. Install field-installed devices, components, relays, notification appliances, accessories, and when applicable EoL resistors.
      a. Install wiring to supervisory devices and associated EoL resistors as required for supervision of hardwired connections
   2. Install Wall-Mounted Equipment: Assemble component hardware within (e.g., card bays, sub-bays, expansion bays, signal cards, other card frames, networking, signal transmission, application modules, tamper monitoring devices, interconnecting modules, and auxiliary power supplies), including space for required spare capacity, and configure settings.
   3. Install Interconnect Wiring: Connect system cabinets, install processor and cards, cabling, connectors, terminations, and bonding.

F. Branch Power:
   1. After installation confirmations, follow manufacturer instructions to connect branch circuit power cables to premises fire alarm system components; comply with NFPA 70.
   2. Where accessories require auxiliary power, provide control power source and monitoring as indicated or as required to complete installation.
   3. Install auxiliary power supplies, including indicated monitoring, and connections necessary for remote equipment.

G. System Identification:
   1. Identify devices, notification appliances, components, cables, and equipment in accordance with approved submittals. See Section 26 0553.
   2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
   3. Mark location of disconnecting means for NPFLA circuits.
   4. Coordinate to provide red branch power circuit protective devices or identify them accordingly as required by NFPA 72 and NFPA 70.
   5. Mark date of batteries installed on inside cover of panels and formal maintenance logs.

H. Troubleshooting and Installer Checks:
   1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.

2. Check system operation for notification, FACU functions, circuit supervision, alarm initiating devices, supervisory initiating devices, dress panels/doors/covers, and programming before performing field tests.

I. Fire Alarm System Tests:
   1. Perform required tests of NFPA 72. Record measured values during operational checks.
   2. Confirm functional testing of fire alarm system is as indicated in Contract Documents.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Provide services of manufacturer's authorized representation to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's detailed testing procedures and field reports and with submittals.

C. Provide equipment, two-way radios for testing personnel use, tools, and supplies required to accomplish inspection and testing.

D. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

E. Inspect and test in accordance with manufacturer's instructions.

F. Inspect wiring and components for damage and defects.

G. Batteries and Power Supplies: Perform inspections and tests listed in manufacturer installation instructions.

H. Perform additional requirements related to testing and inspection during system startup.

I. Test for interface with other systems.

J. Test shunt trips to verify operation.

K. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

L. Submit detailed reports indicated inspection and testing results, corrective actions taken, and as-found and final adjusted settings.

3.06 SYSTEM STARTUP

A. Obtain Owner approval prior to performing system startup.

B. Prepare and start equipment and systems in accordance with manufacturer's instructions and recommendations.

3.07 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust initiating device and notification appliance settings to achieve desired operation as indicated in submittals.

C. Measure power supply primary and secondary voltages, log values for records, and make appropriate adjustments.

D. Adjust alignment of equipment covers and doors. Provide keys and spare keys to Owner.

E. Reprint and reinstall damaged or misinstalled labels; maintain neat and square to installed location good workmanship - see NECA 1; maintain consistent placements for identification on products of similar type.

F. Adjust devices or notification appliances and associated bases to be flush and level.

G. Program system parameters according to requirements of Owner.

3.08 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. See Section 01 7419 - Construction Waste Management and Disposal for field-generated construction waste requirements.

C. Check tightness of electrical connections. Replace damaged components and provide closure plates for vacant positions. Provide circuit directory updates for related power branch circuits.

D. Clean and repair existing materials and equipment that remain or are indicated for reuse.

E. Clean dirt, debris, plaster, and other foreign materials from outlet boxes and fire alarm system equipment and components.

F. Clean fire alarm system equipment and components according to manufacturer's instructions and NECA 305.

G. Clean surfaces and interiors of boxes and device cover plates in accordance with manufacturer's instructions to remove dirt, fingerprints, debris, plaster, and other foreign materials.

H. Repair scratched or marred exposed surfaces to match original factory finish.

I. Comply with federal (EPA), state, and local regulations for battery handling and disposal. Do not spill battery fluids down plumbing drains. Only use containers safe for transportation marked 'nonspillable.'

3.09 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify AHJ and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide services of installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required.

E. Provide tools, software, and supplies required to accomplish inspection, testing, and document results.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of AHJ; document each inspection and test.

G. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.

3.10 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

B. Administrative: One-hour session(s) covering issues necessary for nontechnical administrative staff; classroom:
   1. Initial Training: One session precloseout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: One session precloseout.

D. Use operation and maintenance documentation as primary instruction material; have paper copies available for attendees and supplement training material aids.

3.11 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals for additional submittals.

B. See Section 01 7900 - Demonstration and Training for additional requirements.

C. Closeout Demonstration: Demonstrate operation of all functions to Owner.
   1. Be prepared to conduct any of required tests.
   2. Have minimum one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of FACU manufacturer present during demonstration.
   4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
   5. Repeat demonstration until successful.

3.12 PROTECTION

A. Protect installed fire alarm system from subsequent construction operations.

END OF SECTION 28 4600