DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 13852 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 –GENERAL

1.01 RELATED DOCUMENTS

A. The General Provisions of the contract, including the General Provisions for Construction Projects (2016), Special Provisions, and General Requirements of the Specifications, apply to the work in this section.

1.02 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances
6. Device guards.
7. Digital alarm communicator transmitter (Auto Dialer).

1.03 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. PC: Personal computer

1.04 ACTION SUBMITTALS

A. 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, operation characteristics, and electrical characteristics.

B. 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. Include battery-size calculations.
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.

    a. Locate detectors according to manufacturer’s written recommendations.

10. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
11. 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.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to 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 III minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. 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.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification 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.

C. Field quality-control reports.

1.06 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 01300 “Submittals,” 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. 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.

d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. 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.

h. Manufacturer's required maintenance related to system warranty requirements.
i. 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 or compact disk complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

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

1.08 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: Two years from date of Substantial Completion.

PART 2 -PRODUCTS

2.01 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 addressable system, with multiplexed signal transmission and evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All componenets 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.

2.02 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. Smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate voice/alarm communication system
5. Record events in the system memory.

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

1. User disabling of zones or individual devices.
2. Loss of communication with any panel on the network.

D. 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.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit.
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.

2.03 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.”

2.04 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. Faraday.
2. Fike Corporation
3. Fire-Lite Alarms.
4. GAMEWELL
5. GE UTC Fire & Security; A United Technologies Company.
6. Notifier.
7. Siemens Industry, Inc.; Fire Safety Division.
8. Silent Knight.
9. Simplex Grinnell LP.
10. Edwards EST.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and super vision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

E. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.

2. Pathway Survivability: Level 1.
3. Install no more than 256 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

    a. One dedicated RS 485 port for central-station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interfae module (printer port).
    c. One USB port for PC configuration.

F. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an “alarm-verification” signal at fire-alarm control unit.
2. Activate an approved “alarm-verification” sequence at fire-alarm control unit and detector.
3. Sound general alarm if the alarm is verified.
4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

G. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three- pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view as defined in NFPA 72.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch. The batteries shall support the system for 24 hours in standby and 5 minutes of alarm.

1. Batteries: Sealed lead acid.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly

describe the functional operation of the system under normal, alarm, and trouble conditions.

2.05 MANUAL FIRE-ALARM BOXES

A. Manufacturers: To match the manufacturer of the Fire Alarm Control Panel.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate and alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.06 SYSTEM SMOKE DETECTORS

A. Manufacturers: Smoke detectors must be listed for use with the Fire Alarm Panel.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing characteristic of combination smoke-

and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

c. Multiple levels of detection sensitivity for each sensor.

d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.

b. Device type.

c. Present average value.

d. Present sensitivity selected.

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

2.07 HEAT DETECTORS

A. Manufacturers: Heat detectors must be listed for use with the Fire Alarm Panel.

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Adapter plate for outlet box mounting.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.08 NOTIFICATION APPLIANCES

A. Manufacturers: must be listed for use with the Fire Alarm Panel.

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounted as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.09 DIGITAL ALARM COMMUNICATOR TRANSMITTER (AUTO DIALER)

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

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

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

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

PART 3 -EXECUTION

3.01 EXAMINATION OF THE DRAWINGS AND SPECIFICATIONS

A. Confirm and coordinate voltages and requirements of equipment furnished by other trades, which will be connected to the fire alarm system, such as detectors and dampers. Include the above information on the field-post as-built drawings.

3.02 EXAMINATION OF EXISTING SITE CONDITIONS

A. Cabinets, panels, annunciators, outlets, pull stations, audio / visual devices and other equipment and devices shall be installed in the locations and heights shown on the drawings and/or as specified herein.

1. The location of the equipment and devices shown on the plans are approximate. Before installing, the Contractor shall study adjacent construction, verify all dimensions and sizes of equipment at the job site and perform installation in what is deemed to be the most logical manner.

2. Any changes from the locations shown on the drawings must be approved by the Engineer and shown on the "field-posted as-built" drawings.

3. Any device may be relocated within 10' 0" before installation at the direction of Engineer without additional charge to State.

B. The Contractor shall determine the location of existing cables and record their route on the field-posted as-built drawings.

3.03 INSTALLATION

A. Protect dissimilar metals with approved fittings and treatment.

B. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a single layer of a pressure sensitive plastic tape, half-lapped. Do not use aluminum in contact with the earth.

C. All metallic conduits and boxes shall be grounded with a green wire ground conductor.

D. Equipment Installation: Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with NFPA 70, NFPA 72, and as modified herein.

1. FACP: Locate the FACP where indicated on the drawings. Surface mount the enclosure with the bottom of the cabinet 4 feet above the finished floor. All conductor terminations shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the FACP.

2. Manual Stations: Locate manual stations where shown on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor.

3. Notification Appliance Devices: Locate notification appliance devices where shown on the drawings. Mount visual notification on walls between 80 and 96 inches above the finished floor or 6 inches below the ceiling whichever is lower. Mount audible notification on walls 90" measured to the top of the device.

4. Smoke Sensors: Locate sensors/detectors as shown on the drawings on a 4 inch mounting box. Sensors/detectors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor/detector at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. Install smoke sensors no closer than 3 feet from air handling supply outlets.

E. Cables and Conductors:

1. Below Grade Cable Installation: Cable shall be installed as indicated on the drawings.

a. Conduits shall be sloped as noted on the drawings to provide drainage at handholes and manholes.

b. Cables shall not be installed in the same ducts, conduits, handholes, etc. with non-fire alarm circuits.

2. Above Grade Conductor Installation:

a. Conductors shall not be installed in the same conduits, ducts, junction boxes, etc. with non-fire alarm circuits. 120 volt AC fire alarm circuit conductors shall not be contained within the same multi-conductor cable nor installed with cables and other conductors in the same conduits, ducts, enclosures, junction boxes, etc. with 24 volt DC fire alarm circuits.

b. Conductors shall be installed in continuous lengths. Splices shall be made in above ground junction boxes by terminating wires with terminal blocks.

c. Cable pulling tensions shall not exceed manufacturers' recommended pulling tensions.

d. Wire-nut connectors: Not permitted

3. Conductor Color Code: Conductors shall be provided with color coding. Color coding shall be maintained throughout the circuit and documented on the as-built drawings.

F. Cable and Conductor Terminations and Dress. The following requirements shall apply to terminal cabinets, junction and outlet boxes larger than 12" x 12":

1. Electric equipment shall be installed in a neat and workmanlike manner in accordance with NEC 373 7, Space in Enclosures.

2. Cable conductors or individual conductors shall be bundled, dressed and held together with cable straps, ties or lace and fanned in a manner that equipment terminals are visible and accessible, and allow the connections to be removed and reconnected without moving a large number of wires.

a. Conductors to screw type connectors shall be terminated with wire lugs or with approved cable termination connectors compatible with the specific termination.

b. A minimum of 6 inch excess length shall be provided for conductors from the bundles to the connectors using a vibration loop as described by NEC 300-14.

c. Conductors shall be labeled as specified herein.

3. Cross-connected conductor pairs in junction and device outlet boxes or cabinets will not require bundling and cable straps, ties or lace but shall be neatly installed with a minimum of 6 inches of excess length so conductors can be easily traced between terminals. Label all conductors as

specified herein.

4. Cabinets, junction boxes, outlet boxes, other boxes, shall have sufficient space to accommodate all conductors installed in them without crowding.

5. Completed work shall be uncrowded and uncluttered and shall allow accessibility without cutting and/or removing of any straps, ties, laces, cables, components, devices, brackets, modules, equipment and like items.

6. Cables shall be secured to junction boxes, equipment cabinet backboards, console members or to other system components using cable clamps and wraps. Provide cable support posts as required to facilitate system installation.

G. Cable and Conductor Identification System

1. Underground Cable Markers:

a. Provide markers at both ends of the cables and at all intermediate locations where the cables are accessible and visible.

b. Each marker shall be secured with two (2) nylon ties.

2. Conductor Markers:

a. Provide markers at ends of each conductor connected to the control panels and terminal cabinets at each building.

b. Attach markers a minimum of four (4) inches from the ends of conductors in a manner that will not permit accidental detachment.

3. Signaling Line Circuits: Signaling line circuits shall be labeled by circuit number as shown on the drawings. Conductors shall be labeled in the fire alarm panel(s), the building's main fire alarm junction box and termination cabinet.

4. Audible and Visual Notification Circuits: Notification circuits shall be labeled by signaling circuit number as shown on the drawings. Conductors shall be labeled in the fire alarm panel(s) and in the building's fire alarm termination cabinet.

H. Framed Map: When a system services multiple buildings, a framed map drawn at a minimum scale of 1"=40', showing buildings, panels, and the location of initiating devices shall be printed on a white background, and permanently mounted adjacent to the main fire alarm annunciator-control panel.

I. Framed Operating Instructions: A framed set of operating instruction printed on a white background Main Fire Alarm Panel Operating Instructions shall be provided. The framed instructions shall be permanently mounted adjacent to the main fire alarm annunciator-control panel.

J. Field Touch-up Painting: Touch-up painted surfaces and fire alarm system components damaged during installation to match the existing or specified paint and color.

K. Disconnection and Removal of Existing System: Fire alarm control panels and fire alarm devices not connected to the new system shall be disconnected and removed. Contact the Engineer to determine if any of the existing equipment shall be salvaged.

1. The existing fire alarm and smoke detection system shall remain in operation at all times during the installation and commissioning of the new system. The Contractor shall take precautions to avoid any accidental activation of the existing fire alarm system. When making modifications to the existing systems, the Contractor shall minimize the time the existing system is out of service. Prior to any impairment of the existing system the Contractor shall notify the State and County Fire Department. The Contractor shall comply with 29 CFR 1910.36 and 29 CFR 1910.37. No impairment shall exceed 4 hours. The Contractor shall establish a fire watch to monitor the impaired area until the entire fire alarm system is returned to full operation. The Contractor shall schedule outages in advance. Once this new system is on-line and accepted by the State, remove the old system. As new equipment is installed, label it "NOT IN SERVICE". Upon acceptance, remove labels.

2. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and in the specification.

L. Connection of New System: The following new system connections shall be made during the last phase of construction, at the beginning of the preliminary tests. New system connections shall include:

1. Connection of new control modules to existing magnetically held smoke door (hold-open) devices.

2. Connection of new elevator recall smoke sensors to existing wiring and conduit.

3. Connection of new system monitoring to existing fire alarm monitoring service.

Once these connections are made, system shall be left energized and new audio/visual devices activated. Report immediately to the State, coordination and field problems resulting from the connection of the above components.

M. Firestopping: Provide UL listed firestopping for all holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with IBC.

3.04 TESTING

A. Testing Of The New Fire Alarm System:

1. After completion of the fire alarm system's installation, turn on and leave the system on for a minimum of three (3) consecutive weeks to demonstrate that the new work done by the contractor operates, meets the requirements of the specifications and does not affect the operation of the entire fire alarm system.

2. Upon successful completion of the three (3) week operational period, arrange with the Engineer for a pre-final fire alarm system test and inspection. The test and inspection shall demonstrate that all the Contractor installed fire alarm system equipment, devices cables and conductors are operating acceptably and have been installed in accordance with this specification.

Accordingly, the test demonstrates that the system is ready for a final test of the overall fire alarm system.

Representatives at the prefinal test shall include the Contractor, fire alarm system manufacturer’s representative, user, the user's facility maintenance agency personnel, F.A. system design consultant, and the Engineer. Representatives at the Final test shall include all the foregoing representatives and the County Fire Department Inspector.

3. Preliminary Test Results: Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include a hard copy of printer output information from preliminary testing, i.e. download historical file so that all test data is available for State review.
   a. Tests:

      1) Dielectric Strength and Insulation Resistance Tests: Test the dielectric strength and the insulation resistance of the system interconnecting wiring by means of an instrument

capable of generating 500 volts dc and equipped to indicate leakage current in 1000 megohms. For the purpose of this test, the instrument shall be connected between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open circuited and all series-connected devices in place. The system shall withstand the test without breakdown and shall indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100 volts nor more than 550 volts. The tests shall be witnessed by the Inspector and test results recorded for use at the final acceptance test.

2) 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 Inspector and test results recorded for use at the final acceptance test. 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 Inspector and test results recorded for use at the final acceptance test.

3) Ground Resistance Tests: Measure the resistance of each connection to ground. Ground resistance shall not exceed 5 ohms. The tests shall be witnessed by the Inspector and test results recorded for use at the final acceptance test.

4) Smoke Sensor Tests: Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke sensor. Clean the smoke sensors in accordance with the manufacturer's recommended procedures.

5) Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests" of this section. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable to the State a minimum of 7 calendar days before the formal acceptance test date required in the paragraph below. Without the submission of this report, the final acceptance test is automatically canceled.

b. Formal Acceptance Testing: Notify the State in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the O&M Manuals are submitted and the following are provided at the job site:

1) Marked-up red line drawings of the system as actually installed

2) Dielectric strength and insulation resistance test results

3) Loop resistance test results

4) Complete program printout including all input/output addresses

5) An electronic copy of the entire software program for the system

6) A list of passwords permitting access by designated State employees to all levels of the software programs(s).

The final tests shall be witnessed by the County Fire Department or the Authority Having Jurisdiction (AHJ). At this time, any and all required tests shall be repeated according to the AHJ. Following acceptance of the system, as-built drawings and Operation and Maintenance (O&M) Manuals shall be submitted for review and acceptance. In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M Manuals are received.

c. Minimum System Tests: Test the system in accordance with the procedures outlined in NFPA 72, Chapter 14. The required tests are as follows:

1) Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.

2) Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

3) Test each initiating and indicating device and circuit for proper operation and response at the control unit.

4) Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.

5) Test both primary power and secondary power. Verify, by test, that the secondary power system is capable of operating the system for the time period and in the manner specified.

6) Determine that the system is operable under trouble conditions as specified.

7) Visually inspect all wiring.

8) Test the battery charger and batteries.

9) Verify that all software control and data files have been entered or programmed into the FACP. Hard copy records and two identical diskette copies of the software and data files shall be provided to the Engineer.

10) Verify that red-line drawings are accurate.

11) Measure the current in circuits to assure there is the calculated spare capacity for the circuits.

12) Measure voltage readings for circuits to assure that voltage drop is not excessive.

13) Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke or test gas needed to activate the sensor.

14) Measure the voltage drop at the most remote appliance on each notification appliance circuit.

15) Measure and record the ambient sound pressure level and the alarm sound pressure levels in each area or room. Tests shall be conducted with the door closed.

4. Contractor shall be responsible for notifying the AHJ and Fire Department of formal acceptance testing

5. In addition to satisfactory acceptance tests of the contractor's new work, the entire fire alarm system must be accepted and certified by the County Fire Department or AHJ before commencement of the specified system warranty period with full maintenance responsibility.

   The tests must demonstrate that the entire facility fire alarm system is operating in order to receive the Fire Department Certification.

6. If requested by the Engineer, isolate the contractor's new work from the overall system and demonstrate that the new work does not affect the operation of the overall fire alarm system and shall repeat tests at no additional cost to the State.

B. Concealed Work: Concealed work re-opened and re-closed at random during the formal inspection as requested by the Engineer shall be done at no additional cost to the State.

C. Testing Tools and Equipment: The Contractor shall provide the tools and equipment, including handheld radios, etc. necessary to accomplish the testing.

3.05 TRAINING

A. Conduct training and instruction for the operating and maintenance staff, as designated by the Engineer, on the operation of the fire alarm panel and system.

B. The training session shall be conducted during normal business hours, and shall last as long as necessary to properly instruct the staff, but not less than 1-hour.

C. Instruction shall include hands-on training in routine operations and queries (reading of normal status and trouble status) of the fire alarm system.

D. Training shall be provided for the new fire alarm system and additional circuits and devices.

E. Instruction shall include operations and query of system status, etc.; and hands-on training in the procedures and process for operations and obtaining system status, trouble and other functional information to determine when to call for repairs and how to report the type of trouble encountered.

PART 4 - MEASUREMENT AND PAYMENT

4.01 BASIS OF MEASUREMENT AND PAYMENT

A. Work under this section will not be measured nor paid for separately but shall be considered incidental to and included in the price bid for the various items of work in this project.

END OF SECTION