

## **SECTION 28 31 00 – EMERGENCY VOICE / ALARM COMMUNICATION FIRE ALARM SYSTEM**

### **1.0 GENERAL**

#### **1.1 Related Documents**

- A. Drawings and general provisions of the Contract and Agreement apply to this section.

#### **1.2 Summary**

- A. Drawings supplied with this specification shall be used as a reference for the requirement and location of system components. Work includes visiting the site to observe the existing conditions, and confirmation of the required quantities of devices and specific options for locations of the same.
- B. At the time of bid, all exceptions taken to these specifications, variances from these specifications and all substitutions of equipment specified shall be listed in writing and forwarded to JENSEN HUGHES (Engineer) and the Building Owner. Any such exceptions, variances, or substitutions which were not listed at the time of bid shall not be approved or considered.
- C. The Work includes all labor, materials, services, software, programming, tools, transportation, and temporary construction necessary to fabricate, install, program and test a fully operational and code compliant UL Listed addressable emergency voice / alarm communication fire alarm system (hereafter referred to as “the fire alarm system”) in the Hennessey Elementary School in East Providence, Rhode Island:
  - 1. Install new total, complete coverage fire alarm system in accordance with the Rhode Island Life Safety Code (RILSC) Section 15.3.4.4.1, RILSC Section 9.6.2.9 and NFPA 72 (2010) Section 17.5.3.1.
  - 2. New, addressable fire alarm control unit to be installed. Demolition of existing fire alarm control unit will be completed after acceptance of new fire alarm system.
  - 3. The Contractor shall be responsible for providing all personnel, trades and/or contractors necessary to provide all fire alarm system and building service functionality, as described herein and on provided drawings.
  - 4. All existing valve supervisory switches and waterflow switches are to be monitored with new addressable monitor modules.
  - 5. Reuse existing radio energy master box.
  - 6. All existing notification appliances are to be demolished. New notification appliances shall be provided throughout the building, as indicated on provided drawings. The Contractor is responsible for determining the number of additional remote power supplies to support all notification appliances shown on the drawings. The Contractor is to locate the additional remote power supplies and provide a photoelectric smoke detector in the immediate vicinity of each remote power supply. All remote power supplies are required to be tripped via a signaling line circuit.
  - 7. Provide fire alarm control modules for shutdown of all HVAC supply fans greater than 2,000 cfm. Provide duct smoke detectors in all HVAC supply fans greater than 2,000 cfm.
  - 8. Demolish and remove all existing equipment, conduit and wiring of the existing system.
  - 9. Install linear heat detection above acoustical ceiling tile ceilings as shown on the design drawings. All linear heat detection zones are required to be monitored with an addressable monitor module. All linear heat detection zones are required to be provided with a remote test switch located below the ceiling.
  - 10. New splices or junctions are not to be created by the deletion or addition of initiating devices or notification appliances.
  - 11. Coordination with other Contractors shall be required, as necessary, to interface HVAC shutdown and partial fire sprinkler system.
  - 12. Provide painting and patching associated with all fire alarm work.

13. Provide as-built cabinet adjacent to fire alarm control unit. Provide as-built graphical map for buildings.
  14. Provide fire drill key switch.
  15. Remove, protect and re-install all existing lay-in acoustical tile ceilings where work is required above the ceiling. Any tiles broken are to be replaced by the Contractor at no cost to the Owner.
- D. The Work includes all labor, materials, services, tools, transportation, and temporary construction necessary to remove the existing building fire alarm system equipment in the manner and to the extent indicated herein upon final acceptance of the new fire alarm system.
  - E. The Work includes all fees and activities required to secure approvals for necessary State and Local permits.
  - F. The Work includes submitting detailed Shop Drawing Plans, Wiring Diagrams, Calculations and Product Data to the Engineer for review prior to submitting same to local officials (as required) for approval and permit.
  - G. The Work includes performing field quality control activities.
  - H. The Work includes documenting and submitting the results of integrity and functional testing.
  - I. The Work includes performing an overall, full-day pre-test of the system prior to the “Pre-Acceptance” test.
  - J. The Work includes performing overall system, full-day “Pre-Acceptance” test(s) for the Owner’s and Engineer’s approval.
  - K. The Work includes performing overall system, full-day “Final Acceptance” test(s) for Authority Having Jurisdiction (AHJ) approval.
  - L. The Work includes submitting As-built Plans and closeout documentation to the Engineer for review prior to scheduling Owner demonstration training.
  - M. The Work includes training Owner’s personnel on the operation of the system, required maintenance tasks and frequencies, and the locations of all equipment necessary to maintain and operate the fire alarm system.

### **1.3 Performance Requirements**

- A. 24 VDC closed-circuit, electrically supervised, addressable, automatic emergency voice / alarm communication fire alarm system. The system shall include, but not be limited to:
  1. Fire alarm control unit (FACU), emergency voice evacuation communication equipment, including supervised amplifiers, back-up amplifiers, distributed amplification (where applicable), a digitized voice evacuation message and low frequency temporal pattern evacuation tone, and power supplies.
  2. Addressable double-action manual fire alarm boxes at all stair entrances and building exits as shown on the drawings.
  3. Photoelectric, addressable analog automatic smoke detectors (in those environments suitable for proper smoke detector operation), as indicated in this section and where shown on the drawings.

- a. In addition to where devices are shown on the drawings system type, analog, addressable, photoelectric smoke detectors with standard bases shall be installed in the immediate vicinity of all fire alarm control equipment.
  - b. Where an area is environmentally unstable such that a smoke detector could experience high levels of dust or temperature variations above 100 degrees F or below 32 degrees F and the area in question is protected by an automatic sprinkler system, smoke detectors shall be omitted. If an automatic sprinkler does not protect the area, an addressable heat detector shall be installed.
4. Audible and visible notification appliances (speaker/strobe, stand-alone speaker, and stand-alone strobe notification appliances) in common (public) spaces and public bathrooms, as shown on the drawings.
  5. Addressable monitor modules and addressable control relay modules, as shown on the drawings and described in this specification.
  6. Connection to the existing building master box in building to transmit all alarm, supervisory and trouble signals to the East Providence Fire Department.

#### **1.4 Order of Precedence**

- A. Should conflicts arise out of discrepancies between documents referenced in this specification, the most stringent requirement shall apply; however, should a level of stringency be indeterminable, the discrepancies shall be resolved as follows:
  1. State and local codes shall take precedence over this specification.
  2. The National Fire Protection Association Standards shall take precedence over this specification.
  3. This specification shall take precedence over the drawings.

#### **1.5 Submittals**

- A. Pre-Installation Documentation:
  1. Product Data: For each product specified in Part 2. Submittal shall indicate listing and approvals, selected options and electrical characteristics.
  2. Equipment List: Identify type, quantity, make and model number of each piece of equipment (including spare components) included in submittal. Types and quantities of equipment indicated shall coincide with the types and quantities of equipment used in the battery calculations and those shown on the shop drawings.
  3. Shop Drawing Plans: Corresponding riser diagram inclusive of information required by NFPA 72 requirements.
  4. Wiring Diagrams: Point-to-point fire alarm control equipment installation diagrams inclusive of information required by NFPA 72 requirements.
  5. Battery Calculations: Prepared in accordance with NFPA 72 requirements and showing total standby power and total alarm power required to meet the specified system requirements. Include a complete list of current requirements during normal, supervisory, trouble, and alarm conditions for each component of the system.

6. Voltage-drop Calculations: Prepared in accordance with NFPA 72 requirements to demonstrate that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
  7. Sequence of Operation: A sequence of operation that describes how the system responds during an alarm, supervisory and trouble condition. The description shall include fire alarm control unit LEDs, audible and visible indications, initiating devices, notification appliances, and auxiliary functions. The description shall provide sufficient information so that the exact function of each installed device and appliance is known.
  8. Statement of Equipment Lifecycle: A written statement, signed by a representative of the equipment manufacturer stating that the equipment to be supplied is not at or near the end of its life cycle and that replacement components for all control equipment shall be available from the manufacturer for a minimum of 15 years from the date of installation.
- B. Pre-Programming Documentation:
1. Device Address List: Indicating proposed label verbiage for each address.
- C. Pre-Acceptance Documentation:
1. As-Built Drawings: Showing all field changes from original Shop Drawing Plan submittal. Drawings shall include:
    - a. The exact locations and installation details of all equipment installed including the FACU(s), remote amplifiers, all initiating devices, monitor modules, control modules and fault isolator modules with the address of each addressed device and all notification appliances.
    - b. The installed wiring and color-coding and wire tag notifications for the exact locations of all installed junction boxes and terminal cabinets.
    - c. Specific point-to-point interconnections between all equipment and internal wiring of the equipment. Typical point-to-point wiring diagrams are not acceptable.
  2. Preliminary test report indicating that all devices and appliances within the building have been tested in accordance with NFPA 72 guidelines.
  3. Preliminary Record of Completion: Prepared in accordance with NFPA 72.
  4. Statement of Completion; to indicate that system installation, field quality control and commissioning is complete, a signed written statement, substantially in the form as follows:

*“The undersigned, having been engaged as the Fire Alarm Contractor for the Hennessey Elementary School in East Providence, RI, confirms that the fire alarm system equipment has been installed in accordance with the system manufacturer’s wiring diagrams, installation instructions and technical specifications provided to us by the manufacturer and the Building Owner. Field quality control procedures are complete, system indicators are normal, and the system is suitable for demonstration testing.”*
- D. Final Acceptance Documentation:
1. As-Built Drawings: With final revisions per Engineer’s comments.
  2. Final Record of Completion: Prepared in accordance with NFPA 72.
  3. Test Reports: From Pre-Acceptance testing; substantially in the format and inclusive of information required by NFPA 72.

E. Closeout Documentation:

1. Maintenance Data: Operating and Maintenance Manual to include the following:
  - a. Final Equipment List identifying the quantities and types of equipment listed by manufacturer's part number.
  - b. Detailed narrative description of the system inputs, evacuation signaling, ancillary functions, annunciation, sequence of operations, expansion capability, application considerations and limitations.
  - c. Product datasheet (or specification sheet) for each piece of fire alarm system equipment installed.
  - d. Operator instructions for basic system operations, including alarm acknowledgement, system reset, interpretation of system output, operation of manual evacuation signaling and ancillary function controls.
  - e. Standby power calculations and voltage drop calculations that coincide with the equipment that has been installed in the building.
  - f. Point ID list referencing the signaling line circuit loops and the devices on those loops.
  - g. Sensitivity report for all smoke detectors at the time of acceptance.
  - h. Testing results of all wiring free from faults, as specified in this specification.
  - i. Detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including testing and maintenance instructions for each type of device installed.
    - 1) This information shall include manuals that outline inspection, testing and cleaning procedures for all detectors and control equipment, as well as any other special maintenance procedures for any other pieces of fire alarm system equipment installed in the buildings.
  - j. Detailed troubleshooting instructions for each trouble condition generated from the monitored field wiring, including opens, grounds, and loop failures.
    - 1) These instructions shall include a list of all trouble signals annunciated by the system, a description of the condition(s) that causes such trouble signals, and step-by-step instructions describing how to isolate such problems and correct them (or how to call for service, as appropriate).
  - k. A service directory, including a list of names and telephone numbers of those who provide service for the system.
2. Documentation of programming with the disks containing the programming information. Include necessary non-disclosure agreement or licensing agreement.
3. Electronic As-Built Drawings: Submit electronic AutoCAD files on compact disk. Coordinate AutoCAD version with Owner at time of submittal.
4. Statement of Warranty.

**1.6 Coordination**

- A. Coordinate the installation of the fire alarm system and testing of associated equipment and circuits with all related trades, contractors, equipment maintenance and testing representatives, the Engineer, the Owner and the authorities having jurisdiction.
- B. Coordinate with the installation of sprinkler waterflow switches and valve supervisory switches, including wiring up to and connections to all new sprinkler waterflow switches, valve supervisory switches, and pre-action solenoid valves. The Fire Alarm Contractor shall be responsible for all wiring connections to all sprinkler waterflow switches, valve supervisory switches and pre-action solenoid valves. The Fire Sprinkler Contractor shall furnish and install all sprinkler waterflow and valve supervisory switches. The Fire Sprinkler Contractor shall be responsible for adjusting the sprinkler waterflow switches and the valve supervisory switches to report a change in status. All sprinkler waterflow and supervisory switches shall be monitored for integrity in accordance with NFPA 72. Fire Alarm Contractor shall verify the quantity and location of all new sprinkler waterflow and supervisory switches.
- C. Coordinate with the installation of new acoustic ceiling tile (ACT) ceilings. Where it is feasible, all fire alarm system equipment, including notification appliances and photoelectric smoke detectors, shall be installed as ceiling-mounted and in the center of ACT.
- D. Contractor is responsible for coordination and documentation of existing light fixtures.

### 1.7 Quality Assurance

- A. Fire alarm system equipment shall be manufactured and distributed by the following:
  - 1. Gamewell FCI, a division of Honeywell Fire & Life Safety Solutions,
  - 2. Notifier, a division of Honeywell Fire & Life Safety Solutions, or
  - 3. Non-proprietary engineer-approved equivalent.
- B. Each component of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer under the appropriate category for the intended use in Underwriters Laboratories, Inc. (UL), *UL FPED Fire Protection Equipment Directory*, 2013 Edition.
  - 1. All control equipment shall be listed under UL category UOJZ Control Units System as a single unit.
  - 2. Partial listings, or multiple listings for various major sections of the control equipment, shall not be acceptable.
  - 3. If a UL listing for a specific device is unavailable, approval by FM Global (FM) or other nationally recognized testing laboratory (NRTL) acceptable to the Owner and the Engineer shall be acceptable.
- C. Electrical components, devices, and accessories shall be Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- D. All control equipment shall have transient protection devices that comply with the requirements outlined in UL 864, *Standard for Control Units for Fire-Protective Signaling Systems*.
- E. All materials and equipment (initiating devices, notification appliances, etc.) shall be new and unused.
- F. All equipment supplied shall be first quality and the manufacturer's best type and latest model capable of complying with all requirements of this specification and shall have been in continuous production and in continuous service in commercial applications for at least one year. Obsolete equipment shall not be used.

- G. Distributor Qualifications: Distributors of the fire alarm system equipment shall provide proof that they are authorized to distribute, supervise installation of such equipment, and / or program the fire alarm system equipment to be installed.
- H. Installer Qualifications:
  - 1. Licensed in the State of Rhode Island and be experienced in the installation of fire alarm systems in buildings similar to the Work described herein and has obtained design and inspection approvals for similar projects from Authorities Having Jurisdiction (AHJ).
  - 2. Foreman: Provide proof of competence of both their company and the individual foreman that will be assigned to this project, in the area of installing fire detection, alarm, and control systems for at least five (5) years and acceptable to the Owner. Once assigned, the Contractor's foreman shall not be changed without the approval of the Owner.
- I. The fire alarm system shall comply with all applicable state and local codes including:
  - 1. NFPA 1, *Fire Code*, 2012 Edition, as amended by the State of Rhode Island.
  - 2. NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2013 Edition.
  - 3. NFPA 70, *National Electrical Code*, 2011 Edition.
  - 4. NFPA 72, *National Fire Alarm Code*, 2010 Edition.
  - 5. NFPA 101, *Life Safety Code*, 2012 Edition, as amended.
- J. Buildings accessible to the disabled or impaired shall comply with the provisions of the *Americans with Disabilities Act Accessibility Guidelines (ADAAG)*.
- K. The requirements and recommendations of the latest published edition of the equipment manufacturers' product datasheets, technical specifications, installation instructions and wiring guidelines shall be followed.

## 1.8 Scheduling

- A. The Contractor's Foreman shall act as primary point of contact and responsible-in-charge for coordinating the Pre-Acceptance Test with the other portions of the Work, Owner and the Engineer.
- B. The Contractor's Foreman shall act as primary point of contact and responsible-in-charge for coordinating the Final-Acceptance Test with the other portions of the Work, Owner, Engineer and the AHJs.
- C. Upon award, the Contractor shall provide a schedule to the Owner and Engineer for the milestones and construction progress.

## 1.9 Extra Materials

- A. The manufacturer shall provide a suggested spare parts list with firm unit prices maintained for the duration of the manufacturer's warranty period as specified herein, for items such as power supplies, central processor units, fault isolator modules, monitor addressable modules, addressable control relay output modules and other modules that may be long lead replacement items. Firm costs for programming

changes shall also be included. Firm prices shall be maintained for one year beyond the duration of the manufacturer's warranty period as specified herein.

### **1.10 Warranty**

- A. The Contractor shall guarantee all new equipment installed and new raceways, new wiring and connections to existing wiring from defects in workmanship and inherent mechanical and electrical defects for a period of one (1) year from the date of substantial completion of the project. See Part 1 "Submittals".
- B. The Manufacturer or the authorized representative shall guarantee all new system equipment for a period of two (2) years from the date of substantial completion of the project. See Part 1 "Submittals".

## **2.0 PRODUCTS**

### **2.1 Manufacturers**

- A. The fire alarm system control unit (FACU), fire alarm system control equipment and remote power supplies shall be manufactured by:
  - 1. Gamewell-FCI,
  - 2. Notifier, or
  - 3. Non-Proprietary Engineer-approved equivalent
- B. Distributors of acceptable manufacturer's equipment shall provide documentation indicating that they are authorized by the manufacturer to distribute and service the equipment and that the manufacturer has stated that they have satisfactorily completed all training courses offered by the manufacturer in relation to the equipment provided.

### **2.2 Functional Description of the System**

- A. The system shall include new fire alarm control and emergency voice communications equipment which is UL Listed to operate with the submitted manual fire alarm boxes, smoke detectors and monitor modules located for sprinkler valve supervision. The fire alarm system shall transmit a signal to the East Providence Fire Department via existing radio master box and alert building occupants using audible and visible notification appliances; supervise each system for conditions which would impair proper system operation; annunciate such abnormal conditions; and where applicable, control related equipment as indicated on the contract documents.
- B. Alarm Condition
  - 1. The system operation shall be such that the alarm operation of any alarm initiating device shall not prevent the subsequent alarm operation of any other initiating device due to wiring or power limitations.
  - 2. The fire alarm system shall be programmed such that when the FACU receives an alarm signal from actuation of any automatic or manual fire alarm system initiating device the "evacuation sequence" shall start.
  - 3. The system evacuation sequence as identified above in this section shall operate as follows:

- a. Broadcast an alert (pre-signal) tone throughout the building.
  - b. Broadcast the pre-recorded message regarding the evacuation procedure throughout the building.
    - 1) The exact wording of the message shall be approved by the East Providence Fire Department.
    - 2) The message shall repeat three times.
  - c. At the conclusion of the message, the temporal 3 evacuation tone shall be broadcast throughout the building.
  - d. Additionally at the conclusion of the message, all strobes throughout the building should operate.
  - e. The evacuation sequence shall be repeated until the system is reset.
4. The general alarm shall immediately be transmitted to the East Providence Fire Department via the existing radio master box.
5. Fire Alarm Control Unit Indication
- a. Alarm conditions shall be immediately displayed on the control unit and remote LCD annunciator alphanumeric display, indicating all information associated with the fire alarm condition including type of device, its location and the time and date of activation. The red “ALARM” LED shall flash on the control unit until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another initiating device after acknowledgment shall flash the alarm LED on the control unit and the display shall show the new alarm information.
  - b. During an alarm condition, a pulsing alarm tone shall sound within the control until the alarm is acknowledged.
  - c. If the audible alarm signals are silenced for any reason, they shall automatically resound if another initiating device is actuated.
  - d. When the alarm signals are silenced by pressing the “ACKNOWLEDGE” pushbutton on the control module, the control unit LED’s shall continue to flash until the alarm is reset at the control unit.
  - e. The alarm sequence shall be recorded with the time and date of all occurrences in the fire alarm system History Log.
6. Auxiliary Functions
- a. Where applicable, all auxiliary functions shall be connected to and operated by the control unit.
- C. Supervisory Condition
1. The control unit shall have a “SYSTEM SUPERVISORY” LED and a supervisory signal “ACKNOWLEDGE” switch.
  2. When a supervisory condition is detected, the following functions shall immediately occur:
    - a. The “SYSTEM SUPERVISORY” LED shall flash.
    - b. A pulsing alarm tone in the control unit shall sound.

- c. The FACU and remote LCD annunciator display shall indicate all information associated with the supervisory condition, including device, its location within the protected premises, and the time and date of that activation.
    - d. If more supervisory signals are in the system, the operator shall be able to scroll the display to view new signals.
    - e. All system output programs assigned via control-by-event equations to be activated by the particular point monitored shall be executed, and the associated system outputs (Supervisory Notification Appliances and/or relays) shall be activated.
  3. Unacknowledged alarm messages shall have priority over supervisory messages, and if an Alarm occurs during a supervisory sequence, the Alarm condition shall have display priority.
  4. Activating the supervisory “ACKNOWLEDGE” switch shall silence the audible signal while maintaining an LED on, indicating the supervisory condition is still in the off-normal state.
  5. Restoring the valve or supervisory contact to the normal position shall cause the supervisory service audible signal to pulse thus indicating restoration to normal position. Activating the “ACKNOWLEDGE” switch shall silence the audible signal and restore the system to normal.
  6. The activation of duct smoke detectors shall activate an audible supervisory signal and illuminate the supervisory LED at the control unit.
    - a. In addition, the air-handling unit where the duct smoke detector is associated shall be shut down.
  7. The activation of any standpipe or sprinkler tamper switch shall activate an audible supervisory signal and illuminate the supervisory LED at the control unit.
  8. The activation of any stairway smoke detector shall activate an audible supervisory signal and illuminate the supervisory LED at the control unit.
  9. The detection of the running condition of the emergency generator shall activate an audible supervisory signal and illuminate the supervisory LED at the control unit.
- D. Trouble Condition
1. When a trouble condition is detected, the following functions shall immediately occur:
    - a. An amber “SYSTEM TROUBLE” LED shall light and the system audible signal shall steadily sound when any trouble is detected in the system. Failure of normal power, opens or short circuits on the signaling line circuits or the notification appliance circuits, disarrangements in system wiring, failure of the microprocessor or any identification module, or system ground faults shall activate this trouble circuit.
    - b. A trouble signal may be acknowledged by actuating the “ACKNOWLEDGE” switch. This shall silence the control unit trouble buzzer. If additional trouble conditions occur, the trouble circuitry shall resound.
    - c. During an “alarm” condition, all “trouble” signals shall be suppressed with the exception of lighting the amber “COMMON TROUBLE” LED steadily.
    - d. The FACU and remote LCD annunciator display shall indicate all information associated with the trouble condition, including type of trouble point, its location within the protected premises, and the time and date of that activation.

- e. All system output programs assigned via control-by-event equations to be activated by the particular point in trouble shall be executed, and the associated System Outputs (Trouble Notification Appliances and/or relays) shall be activated.
  2. Unacknowledged alarm messages shall have priority over trouble messages, and if such an Alarm occurs during a Trouble sequence, the Alarm condition shall have display priority.
- E. System Supervision
1. All wiring extending from the FACU enclosure to fire alarm system components shall be supervised for opens, shorts and grounds. Systems containing unsupervised wiring of any type shall not be acceptable.
  2. The occurrence of any fault shall activate the system trouble circuitry, but shall not interfere with the proper operation of any circuit that does not have a fault condition.
  3. Incoming 120 VAC line power shall be supervised so that any power failure shall be audibly and visually indicated at the control unit.
  4. Batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control unit.
  5. The generator shall be monitored by the fire alarm system for a “running” condition.
- F. System Reset
1. A “SYSTEM RESET” button shall be used to return the system to its normal state after an alarm condition has been remedied. Printed messages shall provide operator assurance of the sequential steps (i.e.: “IN PROGRESS”, “RESET COMPLETED”) as they occur, should all alarm conditions be cleared.
  2. Should an alarm condition continue to exist, the system shall remain in an abnormal state. System control relays shall not reset. The control unit “ALARM” LED shall remain on. These points shall not require acknowledgment if they were previously acknowledged.

### **2.3 Minimum Components**

- A. The automatic fire detection and alarm system shall consist of, but not be limited to:
1. Fire Alarm Control Unit (FACU).
  2. Input Devices (waterflow switches, tamper switches, emergency generator supervision).
  3. Addressable, analog photoelectric smoke detectors, with standard bases.
  4. Addressable spot-type heat detectors.
  5. Conventional-type heat detectors, where environment is not appropriate for addressable devices.
  6. Addressable double-action manual fire alarm boxes.
  7. Addressable monitor modules and control relay output modules.
  8. Fault Isolator Modules.

9. Primary and back-up amplifiers for speaker circuits.
10. Annunciation at the FACU and remote LCD annunciator.
11. A permanent record of the alarm signal, time, and date.
12. Audible and visible notification appliances.
13. Battery backup supervision.
14. Automatic supervision of alarm initiating circuits and notification appliance circuits.
15. Transmission of alarm signals to East Providence Fire Department.
16. Emergency generator supervision.
17. As-built drawings cabinet.
18. Signage.

#### **2.4 Fire Alarm Control Unit (FACU)**

- A. The system shall be programmed with pre-recorded evacuation sequence tones and a voice message, as follows:
  1. Pre-signal tone shall be a low frequency 520-hertz tone pulsed to produce one round of Code 4 at approximately one second intervals.
  2. Pre-recorded message regarding the evacuation procedure shall contain the following verbiage: "Attention please. The signal tone you have just heard indicated a report of an emergency in this building. Please walk to the nearest stairway and leave the floor."
    - a. The message shall be repeated three times.
    - b. A female voice shall be used for the message.
  3. Evacuation tone shall be the temporal 3 tone, as required by NFPA 72. The frequency of the temporal 3 tone shall be a low frequency of 520-hertz plus or minus 10%.
- B. The FACU shall provide power, English display status, supervision, control, and programming capability for the fire detection and alarm system.
- C. The control unit shall be in a location approved by the Engineer, the Owner and the AHJ as shown on the drawings.
- D. The color, trim and construction of all fire alarm system control units shall be red.
- E. The control unit shall store a record of alarm and trouble events in a nonvolatile history file. This file shall contain, at least, the most recent 500 events, with time and date of each event. It shall be possible to select the number of events to be viewed in the history file so that the entire file does not have to be downloaded. The history file shall remain intact in the event of a loss of AC and battery power.
- F. The control unit shall be modular in construction and receive supervised plug-in component boards to provide system functions as hereinafter specified and/or to accommodate future system expansions.

- G. The control unit shall be capable of being expanded and field reprogrammed at any time up to the predetermined maximum capacity of the system, without the requirement to return the operating system to the factory for program changes. All field programming shall be done by an authorized manufacturer's representative.
- H. The control unit shall contain a minimum of two (2) signaling line circuits. Each signaling line circuit shall support a minimum of 100 addressable input devices or addressable monitor modules and a minimum of 10 output devices. All addressable input and output devices shall be capable of being intermixed on the same signaling line circuit.
- I. The control unit shall accommodate all addressable input devices in alarm simultaneously and shall be capable of operating all output relays while all inputs are in alarm.
- J. A minimum of one (1) signaling line circuits shall be provided per floor of the building with devices equally distributed on each circuit. Each signaling line circuit shall be loaded to no more than 75% of its manufacturer specified capacity. Additional SLCs shall be furnished and installed as necessary to comply with this requirement.
- K. The control unit shall supply power and communication protocol signals to the addressable input devices over a single pair of wires per signaling line circuit from the control unit.
- L. The fire alarm system shall provide a minimum of two (2) visible (strobe) notification appliance circuits (NAC) per floor.
  - 1. Each circuit's power load shall not exceed 50% of the individual circuit power available from the FACU. Installed circuit risers shall be Class A circuits.
  - 2. Additional NACs shall be furnished and installed as necessary to comply with this requirement.
  - 3. Visible notification appliances shall operate on a floor by floor basis and shall be able to be controlled from the main FACU similar to the floor by floor speaker circuits.
- M. The control unit shall be capable of being networked with additional remote control units using a Class X signaling line circuit, consistent with the survivability requirements of NFPA 72.
- N. The fire alarm system shall provide a minimum of two (2) speaker notification appliance circuits (NAC) per floor.
  - 1. Installed circuit risers shall be Class A circuits.
  - 2. Each circuit's power load shall not exceed 50% of the individual circuit power available from the FACU.
  - 3. Speaker circuits shall not be installed in the same raceway with strobe notification appliance circuits or signaling line circuits unless approved in writing by the supplier of the fire alarm / voice communication system.
  - 4. No more than half of the speakers serving any floor or evacuation zone shall be connected to the same riser circuit.
  - 5. If additional control units are required in order to accommodate two (2) speaker circuits per floor, the control units shall be networked using a Class X signaling line circuit.
- O. All fire alarm / voice communication circuits shall be provided with standby amplifiers equal to the amount of amplification required for complete system operation.

- P. Power for all notification appliances shall come from integral power supplies in the control unit. Remote power supplies or amplifiers shall be provided as needed and shall be of the same manufacturer as the FACU. All locations containing remote control equipment (such as a power supply extender) shall be protected with a smoke detector, in accordance with NFPA 72.
- Q. At a minimum, the FACU shall contain the following:
1. Display. A minimum 80 character, highly readable, display. Upon input activation, the display shall provide the following indication:
    - a. A device address display.
    - b. A field programmed English label indicating the location of the device.
    - c. An English description of the type of device activated, such as smoke detector, manual fire alarm box, water flow switch, etc.
    - d. The status of the input: alarm, supervisory or trouble.
    - e. Multiple alarm conditions shall be sequentially displayed automatically at not more than a five (5) second interval until manually acknowledged by priority.
  2. Annunciation. Annunciation shall be an integral part of the control system and shall indicate alarm, supervisory and trouble conditions and the corresponding address. The following initiating devices shall be annunciated individually:
    - a. Smoke detectors
    - b. Sprinkler waterflow devices
    - c. Manual fire alarm boxes
    - d. Other approved types of automatic fire detection devices or suppression systems
  3. Battery voltage and ammeter readouts shall be available from the LCD display.
  4. Once acknowledged, individual alarms shall be viewed by operating a "next-alarm" switch.
  5. Communication Ports. Two supervised RS232C communication ports shall be provided to support a printer or MODEM. Each RS232C port output shall be programmable for printer or display output and shall be programmable to provide access to the control unit's EEPROM operating system to perform the following functions:
    - a. Listing and indicating status of all field devices.
    - b. Capability of performing alarm tests on any or all addressable smoke detectors and contact input devices.
    - c. Monitoring of the system from remote locations via printer, terminal, or computer.
  6. The control unit shall be provided with a "silent" walk test feature. This feature shall allow for testing of the fire alarm system without activating the notification appliances.
  7. Clock. A 24 hour clock shall be provided to continually provide the time of day and day of the week information. During normal standby conditions, the control unit shall display time and date.
  8. Any operation of an alarm silence, supervisory silence, trouble silence, acknowledge, lamp test, relay switches, or system reset switch shall cause a display indication of operation with time and date. These operations shall also be recorded in the system's history file.

- R. The functional operation of the control unit shall be established by programmable software.
1. The operating program shall be contained in nonvolatile EEPROM memory and shall be configurable in any of the following ways:
    - a. At the factory;
    - b. At the job site via modem; or
    - c. At the job site via standard terminal or standard laptop computer.
- S. Access and control of the operating program shall be restricted to proper personnel designated by the Owner.
1. The control unit shall have a minimum of three (3) security levels, and they shall be designated: "ELECTRICIAN", "ALARM SYSTEM SERVICE TECHNICIAN", and "MANUFACTURER." Each level shall have individual passwords. Illegal access attempts shall be rejected by the system and shall be displayed and recorded in the history file with time and date.
  2. The "ELECTRICIAN" security level shall be the lowest security level and shall only allow access to the system status levels and lists and shall not impair system operation.
  3. The "MANUFACTURER" and "ALARM SYSTEM SERVICE TECHNICIAN" security levels shall allow access to the operating system.
  4. Accessing a programming function that disables normal system operation shall initiate a trouble sequence.
- T. Failure of the CPU(s) in the control unit module or a channel shall light the CPU Error LED and sound the control unit trouble buzzer. Alarms received while the control unit is in this state shall bypass the software and sound the general alarm signals and light the alarm LED.
- U. The channel modules shall be field programmable to report wire-to-wire short conditions as either an alarm or trouble condition.
- V. The control unit shall be capable of locating input circuit openings by the associated address and initiate the proper display and trouble sequence.
- W. The system response to alarms shall be 2.5 seconds maximum for the first alarm.
- X. The main control unit, all remote control units, and remote amplifier/speaker circuit transponders shall contain an integral standby battery to provide continuous power in the event of AC power failure.
1. The batteries shall be capable of providing 60 hours of backup power for the system and enough remaining power to operate all notification appliances for 15 minutes at the end of the 60 hour period.
  2. The calculations for battery standby shall include a "safety factor" (reserve power estimate) of a minimum 15%.
  3. Transfer from AC to battery power shall be instantaneous when AC voltage drops below 85 percent input. Transfer to battery standby shall be indicated by display and recorded in the history file with time and date. The indication shall be "AC OFF".
  4. Loss of building power for the system shall automatically and immediately cause transfer of the system to battery power and cause all audible trouble signals to sound. Upon return of building

- power, the system shall automatically retransfer thereto, and the batteries shall automatically recharge.
5. During battery operation, the control unit shall process all inputs. However, the display shall provide five (5) seconds of indication for each new input condition, then turn off to conserve battery power.
  6. The control unit shall have a dual rate battery charger that shall maintain the batteries in a fully charged condition and shall provide recharge of the batteries to full capacity in forty-eight (48) hours.
- Y. The control unit shall provide a nonprogrammable DPDT common alarm relay and common trouble relay both with contacts rated 2 AMP at 24 VDC.
- Z. Bypass switches. The system shall include bypass switches for the following:
1. HVAC shutdown.
  2. Notification appliance bypass.
  3. Magnetic door holder bypass.
- AA. Output Function Modules. The control unit shall utilize output function modules to control output functions.
1. The modules shall plug into the control unit motherboard.
  2. The functions and presence of each module shall be supervised, and “ELECTRICIAN” password shall enable the user to request a list that locates the module by panel and slot within system.
  3. All modules shall be individually programmable by circuit as hereinafter specified.
  4. Addressable control relays shall be provided for each of the auxiliary functions; field verify quantities and locations.

## **2.5 Remote LCD Annunciator**

- A. A remote LCD Annunciator shall be installed as indicated on the drawings.
- B. Display. A minimum 80 character, highly readable, display. Upon input activation, the display shall provide the following indication:
- a. A device address display.
  - b. A field programmed English label indicating the location of the device.
  - c. An English description of the type of device activated, such as smoke detector, manual fire alarm box, water flow switch, etc.
  - d. The status of the input: alarm, supervisory or trouble.
  - e. Multiple alarm conditions shall be sequentially displayed automatically at not more than a five (5) second interval until manually acknowledged by priority.

## **2.6 Wiring**

- A. All wiring shall be solid copper and shall comply with the appropriate sections of NFPA 70, *National Electrical Code*, 2011 Edition. All system wiring size shall be as determined suitable by the manufacturer and in compliance with NFPA 70, *National Electrical Code*, 2011 Edition, yet they shall not be any smaller than as specified herein.
- B. Shielded wire shall be used only as directed by the FACU manufacturer.
- C. The minimum separation between the outgoing and return circuits shall be a minimum of 1-foot vertically and 4-foot horizontally where practical.

## **2.7 System Field Devices - General**

- A. Addressable devices shall operate under the following ranges of environmental conditions:
  - 1. Ambient Temperature: 32-100 degrees Fahrenheit.
  - 2. Relative humidity: 0-93 percent, non-condensing.
  - 3. Air velocity: 300 feet per minute.
- B. Each addressable device shall include a means to assign a unique address code to the device in the field. This address code shall serve as the means by which the system program recognizes the device.
- C. Failure of any single device shall not hinder the operation of any other devices connected to the signaling line circuit.
- D. Failure of the control unit to properly communicate with any addressable device shall initiate the proper trouble sequence. While in this trouble condition, the control unit shall cause actual alarm input from devices to override trouble alarm.

## **2.8 Automatic Detectors – General**

- A. All automatic smoke detectors shall be of the addressable, analog photoelectric type and shall be interchangeably mounted into a common twist-lock base.
- B. The control unit shall recognize changes of detector type in each location and provide proper indication that reprogramming for the affected address is required.

## **2.9 Addressable Photoelectric Smoke Detectors**

- A. Addressable analog photoelectric smoke detectors with standard base shall be installed, as shown on the drawings.
  - 1. Unless otherwise shown on the drawings, these common area detectors shall be spaced at thirty (30) foot centers, and spaced in accordance with NFPA 72 and the manufacturer's installation instructions.
  - 2. Smoke detectors shall only be installed in those environments suitable for proper smoke detector operation.
- B. UL 268, photoelectric smoke detector with general alarm setting in all common spaces of 3.0% - 4.0% per foot obscuration.

- C. The detectors shall provide a combination alarm / power LED. The LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control unit. The LED shall be placed into steady illumination under an alarm condition. An output connection shall also be provided in the base to connect an external remote alarm LED. The mounting location of every device shall be approved by the Owner.

#### **2.10 Detector Bases**

- A. Automatic detectors shall utilize a common, plug-in, twist-lock, tamper-resistant type base that accommodates photoelectric and thermal detectors. Detectors shall be interchangeable to simplify field conversion.
- B. Provide bases constructed of white, high impact polycarbonate designed for mounting on a standard 3-1/2 inch or 4 inch octagonal or 4-inch square outlet box. Provide screw terminal connections for No. 14 AWG wire.
- C. Removal of the detector from the base shall cause a trouble indication at the FACU. Removal of the detector shall not disrupt the alarm circuit wiring or prevent the receipt of alarms from other devices operating in the circuit.
- D. Insertion of an incorrect detector type into the base shall cause a "Wrong Device" trouble condition at the FACU until the proper type of detector is installed, or the system is re-programmed. The system program shall recognize the insertion of a wrong device and shall automatically default to the setpoint values corresponding to the inserted device, and shall monitor alarm and trouble conditions according to the default parameters.

#### **2.11 Addressable Manual Fire Alarm Boxes**

- A. Manual fire alarm boxes shall be UL 38 non-coded, double-action type, surface or semi-flush mounted, with integral contact monitor module to provide addressable operation.
- B. Faceplates shall be red with raised white identification lettering.
- C. Stations shall mechanically latch after operation, with a key operated reset feature, keyed the same as FACU.

#### **2.12 Addressable Monitor Modules**

- A. Each addressable monitor module shall be able to support any number of normally open (N/O) devices (including but not limited to sprinkler waterflow switches, sprinkler valve supervisory switches, etc). Wiring to the device(s) being monitored shall be supervised.
- B. Module status (normal, alarm, supervisory, trouble) shall be transmitted to the FACU.
- C. Addressable monitor modules shall include a mounting plate for installation in a junction box or shall be mounted in a locked cabinet or approved box, as shown on the manufacturer's recommended specifications.
- D. The addressable monitor modules shall provide address-setting means.
- E. An LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control unit.

### **2.13 Addressable Control Relay Output Modules**

- A. Each relay shall operate according to the control program resident in the FACU.
- B. Relays shall be supervised for trouble conditions (open, short, device missing/failed) at the FACU.
- C. Relay output modules shall include a mounting plate for installation in a junction box.
- D. The relay output module shall provide address-setting means and shall also store an internal identifying code which the control unit shall use to identify the type of device.
- E. An LED shall be provided which shall flash under normal conditions, indicating that the Relay Output Module is operational and is in regular communication with the control unit.
- F. Provide transient suppressors for inductive loads.

### **2.14 Fault Isolator Modules**

- A. Fault isolator modules shall provide short circuit isolation for signaling line circuit wiring. Fault isolator modules shall be listed to UL 864, *Standard for Control Units for Fire-Protective Signaling Systems*.
- B. The isolator module shall mount directly to a minimum 2-1/8 inch deep, standard 4-inch square electrical box, without the use of special adapters or trim rings.
- C. Power and communications shall be supplied by the signaling line circuit.
- D. Fault isolator modules shall report faults to the satellite and master FACU.
- E. After the wiring fault is repaired, the fault isolator modules shall test the lines and automatically restore the connection.
- F. At minimum at least one fault isolator module shall be installed where the signaling line circuit spans multiple floors.

### **2.15 Audible and Visible Notification Appliances**

- A. General
  - 1. All notification appliances shall be rated at 24 VDC and shall be powered by supervised notification appliance circuits originating from the remote FACU's (strobes) and amplifier / speaker circuit transponders (speakers).
  - 2. The notification appliances shall be installed in accordance with the required audibility and intelligibility levels and the required illumination levels as described in NFPA 72.
  - 3. All notification appliances shall be installed in environmental conditions in accordance with their listing and manufacturer's specifications and installation instructions.
  - 4. Where required, notification appliances that are to be installed in outdoor areas or in areas with harsh environmental conditions shall be tested and listed for outdoor use or for weatherproof applications.
- B. Audible (speaker) notification appliances

1. Fire alarm speakers shall be listed in accordance with UL 1480, *Standard for Speakers for Fire Protective Signaling Systems* and amplifiers shall be listed in accordance with UL 1711, *Standard for Amplifiers for Fire Protective Signaling Systems*.
  2. Speaker notification appliances and/or combination Speaker/Strobe notification appliances shall be multi-tap units.
    - a. Low-range speaker units shall have adjustable output power taps rated for 1/8 to 2 W. All corridors, lobbies, gymnasium, mechanical rooms and boiler rooms and other common rooms shall be set to 1 W unless there is the presence of excessive ambient sound. All classrooms, conference rooms and bathrooms shall be set to 1/2 W unless there is the presence of excessive ambient sound.
    - b. Matching Transformers: Tap range shall be matched to the acoustical environment of the speaker location.
  3. Speakers shall operate on a standard 25VRMS audio notification appliance circuit.
  4. The speaker shall be tapped such that it has a minimum sound-pressure level of 85 dBA measured 10 feet (3m) from the speaker at its minimum tapped output providing 15 dBA above ambient sound levels. In no case shall speakers produce a sound output on alarm more than 120 dBA.
  5. The speaker shall have a frequency response of 400 to 4000 Hz for fire alarm notification and 125 Hz to 12 kHz for general signaling.
  6. Speakers shall be either flush-mounted or ceiling mounted as indicated on the drawings.
- C. Visible (strobe) notification appliances
1. All strobes shall conform to the requirements of NFPA 72, UFAS and the ADA and shall be listed to UL 1971, *Standard for Signaling Devices for the Hearing Impaired*.
  2. All visible notification appliance circuits shall be synchronized and have a rated light output as indicated on the design drawings.
  3. Visible notification appliances installed for the notification of carbon monoxide detection in an area shall not have the word "FIRE" visible on the exterior of the appliance.
  4. Visible notification appliances installed for the notification of carbon monoxide detection in an area shall be synchronized throughout the protected area and have a rated light output as indicated on the design drawings.

## 2.16 Linear Heat Detection

- A. Protectowire Universal Series Heat Detector model PLR linear heat detection shall be installed above suspended ceilings, hard ceilings and in attics as indicated on the drawings.
- B. The linear heat detection shall be installed in accordance with the manufacturer's recommendations.
- C. The linear heat detection shall be connected to an addressable monitor module on the fire alarm control unit.
- D. The linear heat detection shall be model PLR-155 above suspended ceilings and hard ceilings. The linear heat detection shall be model PLR-190 in all attics.
- E. The linear heat detection shall be wired in a Class A arrangement.

- F. The total resistance and distance of each circuit shall not exceed 85% of the manufacturer's recommendations.
- G. The routing of the linear heat detection shall be documented on the as-built fire alarm documents.
- H. The maximum listed spacing for the Protectowire Model PLR-155 and model PLR-190 linear heat detection is fifty-feet (50').

#### **2.17 Transmission of Signals**

- A. All alarm signals shall be transmitted to the East Providence Fire Department via the existing radio master box.

#### **2.18 As-built Drawings Cabinet**

- A. As-built drawing cabinet shall be red in color with a durable, baked on, textured powder coat finish.
- B. It shall be constructed of rigid 16 gauge steel.
- C. Cabinet shall contain a full-length, stainless steel piano hinge.
- D. Cabinet shall be marked with white 1" high lettering stating "As-Built Drawings" or approved equal.

#### **2.19 Signage and Markings**

- A. The fire alarm control unit shall be marked "Fire Alarm Control" with two (2) inch high letters white on red or red on white.
- B. All raceway containing fire alarm system conductors and/or cables shall have all connector / pull boxes painted red and marked "Fire Alarm Circuits".
- C. Junction box covers shall be painted red and marked "Fire Alarm Circuits".

### **3.0 EXECUTION**

#### **3.1 Examination**

- A. Coordinate examinations with the Owner.
- B. Examine and verify actual location of equipment, initiating devices, notification appliances, monitor modules, output modules, fault isolation modules, remote power supplies and other components.
- C. Examine and verify actual locations of vertical and horizontal raceway including existing raceway that may be reused.
- D. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing and other conditions where equipment is to be installed prior to preparing pre-installation submittal.
- E. Promptly report conflicts with proposed solutions.

### **3.2 Preparation**

- A. Prepare and submit a minimum of three (3) complete “Pre-Installation Documentation” submittal packages to the Engineer for review prior to submitting same to local officials (as required) for approval and permit. Resubmit portions or entirety of submittal to address Engineer comments prior to submitting package to local officials (as required) for approval and permit. See Part 1 “Submittals” for submittal content.
- B. Obtain Owner approval to deliver materials and begin installation once “Pre-Installation Documentation” review process is complete and necessary local approvals and permits have been secured.

### **3.3 General Equipment Installation**

- A. Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance with NFPA 72.

### **3.4 Remote Control Unit, Amplifier Transponder, and Module Installation**

- A. Install remote control units and amplifier transponders in accordance with manufacturer’s recommendations and as indicated on Pre Installation Documentation submittal. Obtain Engineer approval for locations not previously identified (and approved) in submittal.
- B. Install addressable isolator modules as indicated on Pre Installation Documentation submittal. Obtain Engineer approval for locations not previously identified (and approved) in submittal.
- C. Install addressable monitor modules as indicated on Pre Installation Documentation submittal to supervise and monitor the status of each non-addressable device, such as sprinkler waterflow alarm switch and valve supervisory switch contacts.
  - 1. Addressable monitor modules shall be installed to monitor the existing fire alarm control units for alarm and off-normal conditions.
  - 2. Obtain Engineer approval for locations not previously identified (and approved) in submittal.
- D. Install addressable control relay output modules as indicated on Pre Installation Documentation submittal. Obtain Engineer approval for locations not previously identified (and approved) in submittal.

### **3.5 Initiating Device Installation**

- A. In general, automatic detectors shall be mounted on the structural ceiling, finished ceiling, or finished wall; as shown on the drawing.
  - 1. Automatic detectors shall be installed as indicated on the plans and in conformance with all codes and Regulations and these specifications.
  - 2. The detectors shall be installed within five (5) feet of the location shown on the drawings to accommodate construction.
- B. Automatic detectors shall be located near points where air currents normally intersect.
  - 1. Detectors shall not be located in the direct path of the draft from an HVAC air supply grille, a door, window, or hallway.

2. Detectors shall be installed a minimum of three (3) feet from an HVAC air supply diffuser, in accordance with NFPA 72.
- C. Addressable analog photoelectric smoke detectors shall be installed in accordance with this specification, and as shown on the drawings.
1. Unless otherwise shown on the drawings, these detectors shall be spaced at thirty (30) foot centers, and in accordance with NFPA 72 and the manufacturer's installation instructions.
  2. Smoke detectors shall only be installed in those environments suitable for proper smoke detector operation.
- D. Addressable heat detectors shall be installed in environments appropriate for proper detection in accordance with NFPA 72 and the manufacturer's installation instructions.
- E. In unsprinklered areas where the environment is not suitable for proper operation of addressable heat detectors, conventional spot-type heat detectors shall be furnished and installed.
1. Conventional heat detectors shall be monitored and supervised by addressable monitor modules.
  2. Addressable monitor modules shall be installed in an area where the environmental conditions are suitable and the monitor modules' initiating circuits extended to the conventional heat detectors alarm contacts.
- F. Manual fire alarm boxes shall be installed at every exit and in common areas in accordance with NFPA 72, as shown on the drawings.
- G. Manual fire alarm boxes shall be mounted at a maximum height of 48 inches measured to the activating handle, above the finished floor, in accordance with NFPA 72 and the ADA Guidelines.

### **3.6 Notification Appliance Installation**

- A. All wall-mounted visible notification appliances shall be mounted such that that the entire strobe lens is not less than eighty (80) inches and not greater than ninety-six (96) inches above the finished floor, or six (6) inches below the finished ceiling, whichever is lower.
- B. All visible notification appliances shall be synchronized in accordance with NFPA 72.
- C. All audible notification appliances shall be synchronized in accordance with NFPA 72.

### **3.7 Wiring Installation**

- A. The wiring and raceway system for the fire alarm system shall be in accordance with NFPA 70, *National Electrical Code*. Device and appliance boxes shall be new and low-profile.
- B. Furnish metal raceway, wiring, outlet boxes, junction boxes, cabinets, labels and similar devices necessary for the complete installation of the fire alarm system. Wiring shall be of the type as specified herein and recommended by the manufacturer.
- C. All raceway for fire alarm system risers shall be minimum 1-inch in diameter. All fire alarm risers are to be provided in conduit.
- D. All wiring shall be installed continuous from device to device.

- E. All wiring (excluding risers) is permitted to be approved, listed MC-cable.
- F. Terminal cabinets with hinged, lockable red covers, by Space Age Electronics, Marlboro, MA, or approved equal shall be provided at all junction points where risers convert to circuits for each floor.
  - 1. All conductor splices shall be made on screw-type terminal blocks – wire nuts, butt, crimp or screw type connectors shall not be used.
  - 2. All terminals within a terminal cabinet shall be properly and permanently labeled.
  - 3. All junction box covers shall be painted red.
- G. Raceways containing conductors identified as "Fire Alarm System" conductors shall not contain other conductors, and no AC carrying conductors shall be allowed in the same raceway with the DC fire alarm detection and signaling conductors.
- H. The conductors for the notification appliance circuits shall not be installed in the same raceway as the conductors for signaling line circuits unless written certification from the manufacturer is supplied to the Engineer indicating that the inclusion of these circuits in the same raceway is acceptable and that no additional consideration is needed for these circuits.
- I. Conductors for the speaker circuits and strobe circuits shall not be installed in the same raceway unless written certification from the manufacturer is supplied to the Engineer indicating that the inclusion of these circuits in the same raceway is acceptable and that no additional consideration is needed for these circuits.
- J. Notification appliance circuits and control equipment shall be arranged and installed so that loss of any one (1) notification appliance circuit shall not cause the loss of any other notification appliance circuit in the system.
- K. Color coding of conductors shall be approved by the Engineer and the Owner. Contractor shall submit proposed color codes for fire alarm system wiring prior to installation of circuits.
- L. Exposed raceways shall be run parallel and perpendicular to the walls and ceilings only in permitted areas.
  - 1. Raceway shall not be exposed in common corridors or common spaces.
  - 2. Raceway shall only be exposed in mechanical spaces, electrical rooms, any storage spaces. MC cable is not permitted to be installed in exposed areas.
  - 3. Wherever practical, exposed raceways shall be run on the ceiling as close as possible to a wall or as high as possible on a wall.
  - 4. Where exposed raceways shall cross under a structural beam or rib, they shall be run down on one side of the beam or rib, across its bottom, and up to the ceiling on the other side of the beam or rib.
  - 5. No spanning from beam to beam or rib to rib shall be permitted.
  - 6. The use of a raceway body on one side of a beam or rib shall be permitted provided it shall be readily accessible.
- M. Fault isolator modules shall be furnished as required and shall be mounted as directed by the manufacture. The field location of the fault circuit isolators shall be labeled so that the devices may be easily located, and that location shall be noted on the point-to-point and as-built drawings.

- N. The power employed to operate the fire alarm system shall have a high degree of reliability and capacity for the intended service. Connections to this power service shall be made on a dedicated branch circuit(s). The circuit shall be mechanically protected.
- O. The electrical supply to the FACU shall be equipped with a dedicated fused disconnect with a handle that can be locked in the “power on” position.
  - 1. This disconnect is to be provided at the connection to the normal power supply serving the FACU.
  - 2. Circuit disconnecting means shall have a red marking, shall be accessible to authorized personnel, and shall be identified as “FIRE ALARM CIRCUIT CONTROL.”
  - 3. The location of the circuit disconnecting means shall be permanently identified on a nameplate installed on the inside of the FACU.
- P. All wiring within the control unit shall be neatly served in the panel gutters and be secured by means of Thomas & Betts "Ty-Raps" or by other approved means.
- Q. Where penetrations of floor slabs, fire-resistance rated walls and/or smoke barrier walls are made, the wiring shall be sleeved in metal raceway and the penetrations shall be fire-stopped with UL Listed through-penetration firestop assembly.
- R. All signaling line circuits connecting remote control units and amplifier transponders on the network shall be wired Class A.

### **3.8 Identification**

- A. Provide “P-Touch”, or approved equal, adhesive markers indicating the device address with minimum 12-point font lettering in the following locations:
  - 1. Outside of addressable smoke detector bases.
  - 2. Outside of addressable spot-type heat detector bases.
  - 3. Outside of addressable manual fire alarm boxes.
  - 4. Outside of addressable monitor modules.
  - 5. Outside of addressable relay output modules.
  - 6. Outside of addressable fault isolator modules.
- B. See Part 3 “Wiring Installation” for identification of conductors.

### **3.9 Field Quality Control**

- A. Work shall be performed in accordance with the best and the most modern practices of the trade. The entire system shall be installed in a neat and workmanlike manner, in accordance with the standard instructions and recommendations of the manufacturer and in accordance with the approved manufacturer's wiring diagrams unless otherwise specifically permitted by the Owner and the Engineer.

- B. The system shall be installed under the supervision of a qualified and trained manufacturer's representative.
  - 1. The technical representative is expected to be on site with the Contractor during the installation of wiring and during the entire time of final connections and testing of the fire alarm system.
  - 2. The system shall be demonstrated to perform all of the functions as specified.
- C. The supervisory work of the qualified manufacturer's technical representative shall include, but not necessarily be limited to, checking all the system wiring connections; advising the Contractor regarding technical details of the installation; and the adjustment and testing of all components of the system in order to ensure a complete and satisfactorily operable system.
  - 1. The manufacturer's technical representative shall be on site, as required by the Owner and the Engineer, during the entire installation and connection of the new control equipment.
  - 2. The technical representative shall monitor all wiring changes and assist the Contractor to ensure a smooth transition to the new control equipment.
  - 3. The cost of the technical representative shall be paid by the Contractor and shall be included in the bid price.
  - 4. The minimum amount of man-hours for this technical representative to be carried is 40 hours.
  - 5. The Contractor shall identify the amount of manufacturer's technical representative's man-hours that shall be provided and the per-hour cost (including the cost for possible overtime [premium] hours) for the technical representative's time.
- D. Perform Test to verify wiring is free from grounds and short circuit faults. Document and endorse results, and forward to the supplier, the Owner and the Engineer. No connections to the FACU shall be made until the system wiring has been accepted by the equipment supplier.
- E. Perform inspections and tests required by NFPA 72-2010, "Inspection Testing and Maintenance" for control equipment, batteries, conductors, remote transmission, annunciation of system signals, initiating devices, notification appliances and auxiliary functions.
  - 1. Replace system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained. Replace detectors that are outside their marked sensitivity range.
  - 2. Use the NFPA 72-2010 "Record of Completion" to document the inspection and test results.

### **3.10 Cleaning and Protection**

- A. Do not install smoke detectors prior to substantial completion by other portions of the Work.
- B. Remove paint splatters and other spots, dirt, and debris.
  - 1. Touch up scratches and marred finish to match original finish.
  - 2. Clean unit(s) internally using methods and materials recommended by manufacturer.

### **3.11 Equipment Removal**

- A. Completely remove any unused existing fire detection, alarm system control equipment, wiring and components and equipment that are not specified as being part of the new system.
  - 1. The equipment removed shall be boxed, labeled and delivered to the Owner.
  - 2. All unused, fire alarm system wire and cable shall be removed and disposed of properly off-site.
- B. Perform all removal work efforts in accordance with the best and most modern practices. Removal of existing equipment shall include all cutting, patching and painting of existing walls, hard ceilings and/or replacement of suspended ceiling tiles.

### **3.12 Engineer Pre-Acceptance**

- A. Prepare and submit one (1) complete “Pre-Acceptance Documentation” submittal package to the Engineer a minimum of five (5) business days prior to proposed pre-acceptance test date.
  - 1. See Part 1 “Submittals” for submittal content.
  - 2. Resubmit portions or entirety of submittal to address Engineer comments prior to scheduling test date.
- B. Schedule Pre-Acceptance Test with Owner, Engineer and related trades once submittal package was been reviewed to the satisfaction of the Engineer. Tests shall not be scheduled or conducted prior to satisfactory review of “Pre-Acceptance Documentation” submittal package.
- C. Demonstrate system functional performance. Document testing results in the format specified by NFPA 72-2010; at a minimum, perform the following:
  - 1. Functionally operate each building fire alarm initiating device to ensure proper operation, correct annunciation at the fire alarm control unit and proper operation of all alarms and auxiliary functions.
    - a. “Magnet” testing of smoke detectors will not be accepted as a functional test.
    - b. A “wick/punk” source must be used in accordance with manufacturers’ recommendations.
  - 2. All manual fire alarm boxes shall be tested.
  - 3. All auxiliary functions shall be tested including AHU shutdown, door hold deactivation, and remote key unlock functions.
  - 4. All automatic extinguishing system switches shall be activated by flow of water.
  - 5. All valves shall be mechanically operated.
  - 6. The signaling line circuits and the notification appliance circuits shall be opened in at least two locations per floor to check for the presence of correct supervisory circuitry.
  - 7. The notification appliances shall be tested to automatically sound the voice evacuation sequence and activate the audible and visible notification appliances throughout the building.
  - 8. The voice communication system shall be tested to verify the manual operation of the system throughout the building.

9. One-half of all tests shall be performed on battery standby power.
- D. A 24-hour battery test shall be performed followed by a 15 minute alarm test period.
- E. Reschedule testing where unsatisfactory results cannot be resolved such that testing can be completed during business hours on the scheduled day. See Owner “General Agreement” for possible additional costs and penalties.
- F. Upon satisfactory completion of the Pre-Acceptance Test, leave the system operating for a minimum of one week prior to the Final Acceptance Test.

### **3.13 Authority Having Jurisdiction Final Acceptance**

- A. Prepare and submit a minimum of three (3) complete “Final Acceptance Documentation” submittal packages to the Engineer for review prior to submitting same to local officials for final system approval.
  1. Resubmit portions or entirety of submittal to address Engineer comments prior to submitting package to local officials.
  2. See Part 1 “Submittals” for submittal content.
- B. Submit reviewed “Final Acceptance Documentation” submittal package to authority and coordinate scheduling (minimum ten (10) business days notice) of common fire sprinkler and fire alarm system acceptance testing. If acceptable to the authority, the reviewed “Approval Documentation” submittal may be submitted to the authority at the time of the final acceptance tests.
- C. Coordinate with fire sprinkler portion of final acceptance tests. Operate as required.
- D. Demonstrate system operations to authority having jurisdiction as necessary. The following systems and their sequences, components and functions shall be demonstrated to the authority having jurisdiction as necessary.
  1. Fire Alarm System
- E. Reschedule testing where unsatisfactory results cannot be resolved such that testing can be completed to the satisfaction of the authorities. See Owner “General Agreement” for possible additional costs and penalties.
- F. Upon satisfactory completion of the tests, leave the fire alarm system in proper working order.

### **3.14 Project Closeout Procedures**

- A. Prepare and submit a minimum of three (3) closeout documentation packages to the Engineer for review prior to scheduling Owner demonstration and training.
  1. Resubmit portions or entirety of submittal to address Engineer comments prior to scheduling demonstration and training.
  2. See Part 1 “Submittals” for submittal content.
- B. Schedule Owner demonstration and training with the Owner for each building. Provide at least five (5) working days notice.

- C. Demonstrate equipment, specialties, and accessories with the Owner. Review operating and maintenance information with the Owner.
1. Alarm Service Company & Building Manager: Prior to final acceptance of the fire alarm system, provide operation training to each shift of the Owner's designated Building Manager.
    - a. Each training session shall be a minimum of 1 hour and shall be conducted on shift or at a time acceptable to the Owner.
    - b. Each session shall include an overview of the system and the devices connected to it, emergency procedures (including alarm, trouble and supervisory condition procedures), control panel operation, and safety requirements.
    - c. Each session shall include a complete demonstration of the system.
  2. The manufacturer's technical representative shall also be required to instruct designated building and management personnel in the general operation of the system and to give the designated personnel an overview of the system functions when the system is in normal, supervisory mode, alarm mode, and trouble mode, as specified in this specification.

**END OF SPECIFICATION**