

ADDRESSABLE FIRE ALARM SYSTEM – SECTION 283111

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and General Provision of Contract, including General and Special Conditions and Division 1 Specification Section, apply to work of this Section.
- B. Related Sections:
 - 1. General and Special conditions
 - 2. Division 1: Submittals
 - 3. Division 7: Firestopping
 - 4. Division 9: Painting
 - 5. Division 16: Basic Electrical Requirements

1.2 SUMMARY

- A. Scope: This work includes designing and providing a new, complete, addressable fire alarm devices and circuits as described herein and on the contract drawings for Building XXXX at Lehigh University, Bethlehem Pennsylvania. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm and supervisory signals, initiating devices, alarm notification appliances, interfaced equipment, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described.
- B. Existing Equipment: Existing fire alarm panels shall be maintained fully operational while the new equipment is being installed. Once the new system is installed, it shall be tested and accepted by Lehigh University prior to final AHJ acceptance testing. Just prior to demolition and during construction activities (dust producing activities), dust covers should be installed over spot type smoke detectors. The dust covers are to be removed when construction is complete prior to system acceptance testing. Any FACP relocation shall be done such that system downtime does not extend beyond normal working hours of a single day. Contractor shall be responsible for required fire-watch costs should panel transfer extend beyond a single day time work schedule.
- C. Equipment Removal: All existing equipment not connected to the new system shall be removed and all damaged surfaces shall be restored to finishes like surrounding walls/ceiling/floor. Smoke detectors shall remain covered during removal and while in storage. Operational equipment which was removed shall be carefully packaged, labeled, and turned over to the University. Other material, such as conduit, wire and electrical boxes, shall be removed from the site and disposed of by the Contractor.
- D. Existing equipment shall be offered to the University for salvage, all equipment not retained by the University shall be discarded at the contractor's expense. Devices that are removed shall be stored in protective boxes for evaluation by Lehigh University to determine whether the devices will be retained for spare parts. Contractor shall not dispose of devices unless authorized by Lehigh University.

- E. Repair/Service Replacement Parts: Repair services and replacement parts for the system shall be furnished under this contract after the date of final acceptance of work by the University. On-site service during the warranty period shall be provided within 24 hours after notification. All repairs shall be completed within 48 hours after notification.
- F. Conflicts: Nothing stated or shown in Specifications or on Drawings is intended to conflict with the above standards and regulations. Should Contractor find any apparent conflict, it shall be his responsibility to notify Design Professional before any of the work in question is performed or material purchased.

1.3 UNIT PRICES

See section 012700 for Unit price breakdowns.

1.4 DEFINITIONS

- A. FM: FM Global (Factory Mutual)
- B. FPE: Fire Protection Engineer
- C. Furnish: To supply the stated equipment or materials
- D. Install: To set in position and connect or adjust for use
- E. NFPA: National Fire Protection Association
- F. NICET: National Institute for Certification in Engineering Technologies
- G. Provide: To furnish and install the stated equipment or materials
- H. UL: Underwriters Laboratories

1.5 SYSTEM DESCRIPTION

- A. The System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system with [temporal horn/strobe] and [chime/strobe], [voice evacuation], intelligent analog alarm initiation, [residential bedroom sounder detector bases] and complying with all aspects of the applicable documents listed herein.

1.6 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72 and all contract documents and specification requirements.
- B. The system shall be classified as a proprietary protective signaling system.
- C. Interface with Mass Notification System (MNS). Where required by the University, the Emergency Voice Alarm Communication System (EVACS) shall be capable of interfacing with the campus Mass Notification System. Low level audio signals originating from the MNS shall be distributed through the EVACS speaker system via a phone line capture. Coordinate all interfaces and equipment with Campus Police. When this interface is provided, the entire system shall meet the performance requirements for an Emergency Communications System (ECS) in accordance with the requirements of NFPA 72-2013 or later edition.

D. Control features:

1. The system fire alarm control panels are connected to Keltron central monitoring station via a dedicated telephone hardware transmission system. The telephone transmission system shall be maintained as existing to remain.
2. Power extender panels, if required, shall be provided by the fire alarm equipment vendor and shall be installed in the same closet as the existing FACPs, unless an alternative location is approved in advance by Lehigh University and/or the Engineer.
3. Any addressable analog smoke detector shall include a selectable alarm confirmation capability. Alarm conditions on these devices are processed through a confirmation period of 56 seconds. Over the next 60 seconds, a signal justification period is initiated where any subsequent alarms are reported immediately.
4. A subprogram shall be provided to allow environmental compensation for smoke detector sensitivity. Each smoke detector shall be programmed with this capability.
5. The system shall provide a field test function where one person can test the complete system or a specified area at the fire alarm control panel while maintaining full operational function of other areas not under test. Alarms, troubles, device types, and the initiation device addresses shall be logged to the system printer and historical memory.
6. Maintain existing program capability via switches in a locked portion of the fire alarm control panel to bypass the notification appliance circuits, door unlocking features and other bypass functions specific to the building. Operation of these switches shall indicate this action as a trouble signal on the FACP display and printer output.

E. Supervision

1. Class B, two-wire initiating device circuits.
2. Style 4, two-wire signaling line circuits for each floor.
3. Class B, two-wire notification appliance circuits. (Horns, Speakers & Strobes)
4. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
5. Provide electrical supervision of the circuits connected to addressable interface modules for the monitoring of contact type initiation devices (sprinkler system water-flow and tamper switches).

F. Spare capacity:

1. All installed signaling line circuits (SLC) and notification appliance circuits (NAC) shall have 20 percent spare capacity.
2. Battery capacity shall be provided with a minimum of 125% of the calculated requirement.

G. Alarm Functions: Fire alarm system functions and operations shall be as indicated on the Fire Alarm System Matrix of Operations in the drawings. Operation of an alarm initiating device (other than a bedroom smoke detector) shall cause the functions indicated on the matrix to occur as described below:

1. Sound General Evacuation Alarm: This function shall cause all strobe lights to activate and audible notification appliances in the building to sound.
 2. Notification is maintained until the control panel is silenced or reset by LU.
 3. Illuminate LED on Device in Alarm: This function shall cause an LED, integral to the device, to illuminate, indicating that the device is in alarm. For contact devices, such as non-addressable heat detectors, the LED shall be built into the addressable interface module monitoring the device.
 4. Activate audio/visual signals and display address on the FACP: This function shall illuminate an alarm indicating LED, sound an audible alarm, and display a device address at the FACP when the system is in an alarm condition.
 5. Transmit Event to Campus Police Monitoring Station: This function shall cause the event to be transmitted to the central monitoring station at Campus Police via the Keltron Digital Communication System. Existing hard wired Keltron zone shall also be utilized.
 6. Activate Audio/Visual Signals and Address Display on Remote Annunciator Panel: This function shall cause the event to be transmitted to a remote panel, whose location is shown on the drawings. The message sent shall be the same message displayed on the FACP LCD display board.
- H. Trouble Functions: Provide the following actions and indications at the FACP upon a single break, open condition, or ground fault on all supervised circuits which may prevent the required operation of the system:
1. Annunciate at the FACP: A yellow visual signal, audible alarm, and alphanumeric LCD display of type of trouble, and device address.
 2. The fire alarm system shall be capable of printing a message identical to that shown on the LCD display on the FACP. In addition, the printed hard copy of the event shall indicate the date and time at which it occurred.
 3. Send a signal to central monitoring station. This message shall include the building of origin as well as all information indicated to be displayed on the FACP.
 4. Send a signal to the remote panel shown on the drawings. This message shall include the building of origin as well as all information indicated to be displayed on the FACP. The message sent shall be the same message displayed on the FACP LCD display board.
 5. Each independent fire detection, gas detection, kitchen, and fire suppression system shall be monitored for trouble conditions. Each monitored condition shall be provided with a separate address.
- I. General Building Fire Alarm Signal Initiation shall be by one or more of the following devices:
1. Manual Fire Alarm pull station.
 2. Addressable area heat detector.
 3. Addressable area smoke detector.

4. Addressable area CO detector
 5. Any two smoke detectors in a resident building.
 6. Automatic sprinkler system water-flow switch or sprinkler alarm pressure switch.
 7. Kitchen Suppression system activation (if applicable).
 8. Lab Gas Detection system activation (if applicable).
- J. Supervisory signal initiation shall be by one or more of the following devices or actions:
1. Dwelling unit sleeping room smoke detector activation: Activation of any dwelling unit sleeping room smoke detector will initiate alarm verification mode. It will cause activation of the local sounder base or low frequency horn and the associated ADA room strobe (if applicable) for a 56 second verification period. If within 56 seconds the detector condition clears, the system shall reset. If smoke condition continues past 56 seconds, a sleeping room smoke detector activation shall latch in alarm mode and an alarm signal shall be transmitted to Campus Police monitoring system via the Keltron monitored addressable relay. Latching in alarm shall cause activation of all sounder base(s) in the suite or unit. FACP will receive an alarm signal, but the building general evacuation alarm shall not be initiated.
 2. Residential Living Suite common area smoke detector activation: Activation of any residential living suite/ apartment common area smoke detector shall initiate the same sequence as above. Following alarm verification, all suite/ apartment audible and visual appliances shall annunciate, the FACP will receive an alarm signal.
 3. Activation of an addressable duct detector.
 4. Operation of a fire-protection system valve tamper switch.
 5. Dry-pipe sprinkler system high-low air pressure switch.
- K. System trouble signal initiation shall be by one or more of the following devices or actions:
1. Loss of primary power at the FACP.
 2. Ground or a single break in FACP internal circuits.
 3. Abnormal AC voltage at the FACP.
 4. A break in standby battery circuitry.
 5. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
 6. Failure of battery charging.
 7. Abnormal position of any switch at the FACP or annunciator.
 8. Any internal condition of the FACP requiring Troubleshooting.
- L. Emergency Voice Alarm Communication System (EVACS):

1. When a building is equipped with an EVACS system, alarm notification shall be by one of the following as determined by evacuation protocol planning with the University:
 - a. Temporal-three tone via tone generator.
 - b. Pre-message tone followed by a voice evacuation message.
2. When a residential building is equipped with an EVACS system, all residential living unit common areas and sleeping rooms shall be provided with speakers and with audible bases for the local smoke detectors. Annunciation protocol shall be as described above for alarm and supervisory conditions. Supervisory condition caused by a local residential sleeping room or unit smoke detector activation shall cause annunciation of the local audible bases. All general alarm conditions shall utilize the speakers and shall cause silencing of the local audible bases, if activated in an individual sleeping room or unit.

1.7 SUBMITTALS

- A. General: Refer to Section "SUBMITTALS" for basic information relating to submittal requirements. Submit 6 complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the University. Any work performed by the contractor prior to their approval will be at the contractor's own risk. If such work is contrary to applicable codes and contract documents, the contractor shall bear all costs including, but not limited to, demolition, reconstruction, and all costs and expenses associated with revising the fire alarm system to meet all applicable codes and contract document requirements.
- B. System Description: Submit a detailed description of the fire alarm system as it shall operate for this specific installation. General system descriptions from the catalog cuts and copies of the Systems Design Operation portion of this specification will not be acceptable.
- C. Equipment: Include annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers for all equipment and components of the following:
 1. Fire Alarm Control Panel (FACP)
 2. Strobe Power Extender Panels
 3. Storage Batteries
 4. Battery Charger
 5. Cabinet
 6. Manual Pull Station
 7. Addressable Interface Devices
 8. Terminal Cabinets/Assemblies
 9. Addressable Relays and Interface Modules
 10. Annunciation devices (horns, chimes, strobes, etc.)
 11. Fire Detector (smoke, heat, flame, etc.)

12. Wire
 13. Boxes
 14. Terminal strips
 15. Relays
 16. Transient Voltage Surge Suppressors
 17. Conduit
 18. Support
- D. Shop Drawings: Provide 4 sets of working drawings on sheets not smaller than 24 inches by 36 inches. Shop drawings shall be prepared in CAD. As a minimum, the shop drawing submittal shall include the following:
1. Interior wiring diagram for FACP.
 2. Provide point-to-point wiring diagrams on floor plans at a scale of not less than 1/8" = 1'-0" or 1/4" = 1'-0", showing all field devices (indicating and initiating devices, relays, switches, etc.), field interconnections, the routing of conduit and circuits between devices, electrical boxes, terminal cabinets, risers, and the FACP. All device circuit numbers and addresses shall be indicated.
 3. Field wiring color code scheme and wiring labeling numbers. Labels for all devices shall comply with LU standards with identification of where the wire originates and where it terminates. If terminated at a junction box, the junction box termination shall be identified as to where the cable is connected. Color scheme for circuits shall be as follows:
 - a. Red (Dashed) for SLC
 - b. Blue (Dashed-dot-dot) for Speaker (NAC) Circuits
 - c. Green (Dashed-dot-dashed) for Strobe Circuits
 - d. Black (Solid) for Normal Power (120Vac)
 - e. Yellow (Solid) Circuit(s) as noted
 4. Locations for all ceiling mounted equipment shall be coordinated with lighting fixtures, air outlets, ductwork and other fixtures. All detectors shall be centered and aligned with ceiling tiles and/or other ceiling mounted devices.
 5. Provide complete riser diagrams indicating the wiring sequence of all devices and their connections to the control equipment. Provide a color code schedule for the wiring. Provide floor plans showing the location of all devices and equipment.
 6. Detailed sequence of operations and matrix.

Note: All wiring shall be approved by Eastern Time Inc. for type and configuration prior to installation.

- E. As-Built (Record) Working Drawings: Daily the contractor's superintendent shall record as-built conditions on a set of Shop Drawings maintained at the job site. Two sets of Shop Drawings reflecting as-built conditions shall be available prior to and for use in the final acceptance test. Two weeks after the acceptance test and before final acceptance of the work, furnish four complete sets of as-built drawings. The drawings shall be prepared on uniform sized sheets not less than 24 inches by 36 inches. The drawings shall include:
1. As-built location of all devices and equipment. Device addresses shall be listed next to each device, with wire identification if not the same as the device identification.
 2. 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, with nomenclature of "FROM DEVICE X, or TO Device X at the wire termination.
 3. Riser diagram.
 4. All deviations from the project drawings and approved shop drawings.
- F. Record Drawing Software: Provide one (1) compact disc containing CAD based drawings of all as-built drawings and schematics.
- G. Device Addresses: Prior to fire system installation provide for approval a complete list of device addresses with corresponding commands, controls, and sequence of operation.
- H. Qualification Data: For Designer and Installer.
- I. NAC Evacuation Circuit Labels: Prior to fire alarm system installation, provide a complete list of descriptions for NAC circuits to be labeled on the fire alarm panel circuit selector switches.
- J. Operation and Maintenance Manuals (Equipment Descriptions): Thirty days prior to the final acceptance test and after the preliminary testing has been completed submit the following:
1. Three (3) bound copies of complete Operation and Maintenance manuals to include: EST device/circuit maps, Addressable device List and user descriptions, device and board specifications, operation, installation, manufacturers installation instructions for all aspects of the installation; Walk test Operating Instructions; manufacturers wiring specifications for the system; training manual and all AHJ Inspection Reports, and contractor testing reports with Record of Completion (ROC).
 2. Inspection, Testing and Maintenance checklists for all equipment.
 3. As-built circuit diagrams, complete with color-code scheme, and device descriptions. (See Above)
 4. Complete parts list by make model number and manufacturer.
 5. List of smoke detector addresses and corresponding sensitivity readings.
 6. Copies of approved submittal materials.

- K. Calculations: Submit substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system device and each panel component shall be submitted with the calculations. Calculations shall include:
 - 1. Battery capacity calculations.
 - 2. Supervisory power requirements for all equipment.
 - 3. Alarm power requirements for all equipment.
 - 4. Power supply rating justification showing power requirements for each of the system power supplies.
 - 5. Voltage drop calculations for NAC wiring runs demonstrating worst-case condition. Show capability of circuits for wire runs.
 - 6. Provide complete battery calculations for both the alarm and supervisory power requirements. Ampere hour requirements for each system component shall be submitted with the calculations.
- L. FACP Wire Chart: Prepare a system wire chart. Chart every wire showing the wire number, color, size, type of circuit, designation, origination point and termination point. The chart shall be typewritten with minimum 12-point lettering on paper that is 8.5 inches by 11 inches. The format of the wire chart shall be as shown on the contract drawings. Provide one copy of the wire chart in a sealed plastic envelop inside the fire alarm control panel.
- M. Terminal Cabinet Wire Chart: Prepare a wire chart of the wires in each terminal cabinet. Chart every wire showing the wire number, color, size, type of circuit, designation, origination point and termination point. The chart shall be typewritten with minimum 12-point lettering. The format of the wire chart shall be as shown on the contract drawings. The chart must be protected with a clear laminate and mounted in each cabinet so that it does not interfere with the wiring or terminals.
- N. Work Schedule: All work must be coordinated with the University. A work schedule must be submitted for approval prior to initial work. See Section 01100, Summary for additional information.
- O. Record of Completion (ROC): Within two weeks after passing the acceptance test submit a Record of Completion to the University in accordance with NFPA 72, National Fire Alarm and Signaling Code.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications

- 1. Testing Services or Laboratories: Provide all fire alarm and fire detection equipment in accordance with the latest edition of the following publications from Underwriters Laboratories (UL) and Factory Mutual Global (FM):
 - a. UL Fire Protection Equipment Directory
 - b. UL Electrical Construction Materials Directory
 - c. UL 38 – Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems

- d. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
 - e. UL 268A - Smoke Detectors for Duct Application
 - f. UL 464 - Audible Signal Appliances
 - g. UL 497A – Secondary Protectors for Communications Circuits
 - h. UL 521 - Heat Detectors for Fire Protective Signaling Systems
 - i. UL 864 - Control Units for Fire Protective Signaling Systems
 - j. UL 1283 – Electromagnetic Interference Filters
 - k. UL 1449 - Transient Voltage Surge Suppressors
 - l. UL 1480 – Speakers for fire Protective Signaling Systems
 - m. UL 1971 - Signaling Devices for the Hearing Impaired
 - n. FM Approval Guide
2. Codes and Standards
- a. International Building Code, 2009 Edition as adopted by the Commonwealth of PA (Pennsylvania Uniform Construction Code)
 - b. NFPA 70, National Electrical Code
 - c. NFPA 72, National Fire Alarm and Signaling Code, 2007 Edition
 - d. Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - e. ASME/ANSI A 17.1, Safety Code for Elevators and Escalators.
 - f. LEHIGH UNIVERSITY STANDARDS
- B. Qualifications of Installer: Installer shall have an office, which has been in existence for at least 3 years. Installation shall be accomplished by an electrical contractor with a minimum of five years experience in the installation of fire alarm systems of similar size and capacity. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system.
- C. Distributor/ Service Organization/ Designer Qualifications: Design shall be by a NICET Level III or IV Technician or a Registered Fire Protection Engineer. The manufacturer's equipment distributor shall show evidence of certification by the manufacturer in the technical support of the system installed under this contract.
- 1. The distributor shall show evidence of certification of at least one employee by the National Institute for Certification in Engineering Technologies (NICET) at Level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology. If such a certified individual is not employed, adequate documentation shall be provided to show comparable

training and experience of an existing employee. At a minimum, comparable training and experience shall consist of ten years of progressive experience in the installation and design of fire alarm systems of similar size and complexity to that specified herein.

2. In lieu of an employee with NICET Level III or IV certification, the distributor shall show evidence of at least one employee with a minimum of ten years of progressive experience in the design of fire alarm systems and, in addition, the distributor shall show evidence of technical support in the design, installation, and testing of the systems from a manufacturer-affiliated company, which shall show evidence of certification of at least one employee by the National Institute for Certification in Engineering Technologies (NICET) at level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology.
 3. The contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization, which carries a stock of repair parts for the system being furnished. Should the Contractor fail to comply with the service requirements of this section, Lehigh University will then have the option to make the necessary repairs and back-charge contractor without any loss of warranty as provided by the contract documents.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 DELIVERY STORAGE AND HANDLING

- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.10 PROJECT CONDITIONS

- A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by The University or others unless permitted under the following conditions, and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify University no fewer than two days in advance of proposed interruption of fire alarm service.
 2. Do not proceed with interruption of fire alarm service without The University's written permission.
 3. Apartment area work should be scheduled through the University during daytime hours.

1.11 WARRANTY:

- A. The contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by Lehigh University and after the receipt of as-built drawings and schematics of all equipment.

1.12 SERVICE AGREEMENT

Confirm with University.

1.13 EXTRA MATERIALS

- A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping or tagging.
- B. Furnish the following spare parts. Quantity shall be five percent of the installed number of devices, but not less than the quantities listed:
 - 1. Smoke Detectors of each type installed: 5
 - 2. Heat detectors: 2
 - 3. Speakers: 3
 - 4. Speaker/Strobe Combination Units: 2
 - 5. Manual pull stations: 2
 - 6. Horn/Strobe devices: 3
 - 7. Strobe: 2
 - 8. Fuses for each fused circuit: 5
 - 9. Wrenches or special tools required to gain access to all lockable equipment: 5

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. FACP, cabinets, and peripheral devices:

- 1. EST, No substitutions.

B. Conduit

- 1. Allied Tube & Conduit
- 2. Carlon
- 3. Wheatland Tube Company
- 4. FRE Composites Inc.

C. Fittings, Couplings

- 1. Appleton Electric Co.
- 2. Crouse-Hinds Co.
- 3. Pyle-National Co.

D. Surface Metal Raceway and Wireway

- 1. Square D Co.
- 2. Walker Parkersburg, Textron
- 3. Wiremold Company
- 4. Isoduct

E. Wires and Cables

1. 600V Insulated Copper Building Wire
 - a. Rome Cable Company
 - b. General Cable Co.
 - c. Triangle PWC, Inc.
 - d. BICC Cables
 - e. West Penn Wire
2. Mineral Insulated Cable (MI)
 - a. BICC Cables
3. Nonmetallic Sheathed and Armored Cable
 - a. AFC Cable
 - b. Anaconda by Cablec
 - c. Rome Cable Corp.

F. Pull and Junction Boxes

1. Hoffman Engineering Co.
2. Penn Panel & Box Co.
3. Keystone

G. Cabinets

1. Hoffman Engineering Co.
2. Penn Panel & Box Co.
3. Keystone

H. Supporting Devices

1. Kindorf, Midland Ross Corp.
2. Power-Strut, Inc.
3. Unistrut Building Systems

I. Air and Liquid Sealant

1. Solar Compound Corp.
2. Thunderline Corp.

J. Substitutions: Items of same quality and performance are acceptable. Contractor shall provide proof of equivalency.

2.2 FIRE ALARM CONTROL PANEL (FACP):

- A. The Fire Alarm Control panels shall be new EST-3 Fire Alarm Control Panels. The new FACP shall replace the existing FACP in each building. The existing FACP shall be temporarily wired and supported to accept inputs from all existing field devices and provide outputs to existing notification appliances, while the new system is being installed.

- B. Buildings with existing EST-3 Fire Alarm Control Panels already installed, shall be modified so all existing devices are replaced with new addressable detection devices and new Notification Appliances.
- C. Cabinet: Install control panel components in cabinets sized to accommodate all components and to allow ample gutter space for interconnection of all panels as well as all field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say Fire Alarm Control Panel and shall not be less than 1-inch high. If multiple panels are provided, additional identification shall be provided on each nameplate to distinguish the panels. Provide prominent rigid plastic or metal identification plates for all lamps, circuits, meters, fuses and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.
- D. Control/Display Modules: Provide power and control modules in the FACP to perform all functions described in this specification.
 - 1. On an interim basis, maintain and provide communication between the new FACP and existing field devices. Provide addressable input cards as necessary to re-connect existing circuits to retain existing system functionality in all respects while new fire alarm field devices are installed.
 - 2. Initiation circuitry is required to communicate with, and receive alarms from a minimum of sixty intelligent analog alarm initiating and sixty intelligent controllable output devices.
 - 3. Non-volatile memory for system data base, 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.
 - 4. Visual indication of alarm, supervisory or trouble initiation on the fire alarm control panel shall be by liquid crystal display or similar means with a minimum of 80 characters of which at least 32 are field changeable.
 - 5. LED display for "ALARM", "AUDIBLE SILENCED", "SUPERVISORY", "TROUBLE", "POWER ON" and "PARTIAL SYSTEM DISABLED".
 - 6. Touch activated membrane switches for "ALARM ACKNOWLEDGE", "AUDIBLE SILENCE", "SUPERVISORY ACKNOWLEDGE", "TROUBLE ACKNOWLEDGE", "RESET", "DISPLAY HOLD" and "DISPLAY NEXT".
 - 7. Touch activated membrane switches, programmable to perform custom functions such as drill, disable, activate, bypass automatic control commands or other special functions as required by the system user.
 - 8. Ten-digit keypad for the passcode entry to perform programming and maintenance functions.
 - 9. Programmable panel mounted relays to be software programmed to perform control functions required for system operation, including:
 - a. Silencing alarm notification circuits during testing of fire suppression system alarm points.
 - 10. Notification appliance circuits as required to supervise and operate all connected notification appliances. Operation of NACs shall be fully integrated with the FACP. Switches shall be used to activate or deactivate horns and strobe circuits.

11. Locate diodes and relays, if any, on screw terminals in the FACP.
12. Additional Requirements: The FACP shall have the following additional features:
 - a. System shall be UL 864 listed, 9th edition or later
 - b. Field programmable.
 - c. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions as required.
 - d. Provide TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE switch.
 - e. Control panel shall have minimum 25% capacity for addition of future signaling line circuits and notification appliance circuits. Each installed circuit shall have 20% spare capacity.
 - f. Analog Loop Driver to allow for continuous interrogation of each addressable device in the building.
 - g. Communication with auxiliary devices, including waterflow switches, valve supervisory switches, door controls, etc. using appropriate interface modules as indicated on the riser diagram and interface schematics.
 - h. The FACP shall have drift compensation technology and shall be UL listed as a calibrated smoke test instrument.
 - i. Device history shall be stored at the FACP. At a minimum, the following information for each sensor shall be maintained: device history, sensitivity levels, alarm verification status, drift compensation data.
 - j. The FACP shall provide a minimum 500 event history log.
 - k. The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 - l. All function keys shall be programmed in accordance with the University's specific requirements.

2.3 SMOKE DETECTORS

A. Photoelectric light scattering type smoke detectors shall be provided as follows:

1. The detector shall be suitable for two wire 24VDC operation and two way communications on the addressable signaling line circuit. Smoke detectors shall be UL listed for use with the FACP and environmental conditions as installed.
2. Detectors shall be provided as indicated on drawings, and shall be in all common areas of the building, all class rooms, mechanical rooms, electrical rooms, telephone rooms, elevator lobbies, elevator machine rooms, rooms with FACPs/NAC Power Supplies and at the top of all stairs.

3. Smoke detectors shall be ceiling mounted only unless authorized by Lehigh University in special cases.
 4. In cases where the smoke detectors are mounted on a clouded ceiling, and smoke detectors are required above the clouded ceiling by code and not “easily” accessible, then no smoke detectors shall be installed unless required by code.
 5. Smoke detectors installed in duct work for the purpose of duct smoke detection shall not be mounted to the bottom of the duct work.
 6. Detectors shall be self-compensating for ambient temperature and humidity.
 7. Detector bases shall be installed on an industry standard, 4 inch (101 mm) square or octagonal electrical outlet box. Bases shall be universal for ionization, heat, photoelectric (light scattering type) and flame detection. Detector bases shall have a trim ring installed.
 8. Detectors shall be twist lock type on to the base with self-wiping contacts.
 9. Screw clamp terminals shall be provided for all conductor terminations
 10. The detector shall be addressed, tested and programmed prior to installation. The detector readout shall yield a discreet electrical value for status tracking and logging for determining maintenance and cleaning requirements. An address to identify each detector, type, its location within the system, and its sensitivity setting. The control panel shall provide a sensitivity readout from the detector without removal from the pluggable base.
 11. All detectors shall be identified with a label adhered to the base of the detector. The label shall be compliant with the University’s standard and include the Panel number, the loop number and the device on that loop. Label shall be visible on the device viewed from the floor.
 12. All components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or air born materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 13. The detector shall display a flashing green LED when in a normal state and a flashing red LED when in the alarm state while the system is operating from normal or standby power.
 14. Bedroom smoke detection devices shall be mounted on EST sounder baseplate model and provided with supervised 24 VDC power from the fire alarm control panel.
- B. Heat Detectors: Heat detectors as indicated intelligent, low temperature (135°F-140°F), unless indicated otherwise, rate-compensating detectors.
1. The detectors furnished shall be UL listed for use in the FACP and environment conditions as installed.
 2. The detector shall be addressed, tested and programmed prior to installation.
 3. The detector shall display a flashing green LED when in a normal state and a flashing red LED when in the alarm state while the system is operating from normal or standby power.
 4. Detector bases shall be installed on an industry standard, 4 inch (101 mm) square or octagonal electrical outlet box. Bases shall be universal for ionization, heat, photoelectric (light scattering type) and flame detection. Detector bases shall have a trim ring installed.

5. Detectors shall be twist lock type on to the base with self-wiping contacts.
6. Detectors shall be equipped with screw terminals for each conductor.
7. Detectors shall be hermetically sealed and of the automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.
8. Detectors shall be provided as indicated on drawings, and shall be located in all bathrooms of the building, elevator machine rooms and areas not suitable for smoke detectors.
9. All detectors shall be identified with a label adhered to the base of the detector. The label shall be compliant with the University's standard and include the Panel number, the loop number and the device on that loop. Label shall be visible on the device viewed from the floor.

C. Carbon Monoxide Detectors: Shall be an integrated electrochemical sensor combined with addressable smoke/heat detector.

1. Combination smoke/CO detectors shall be located in all boiler rooms and rooms directly adjacent to Boiler Rooms. Heat/CO shall be used in dirty areas.

2.4 MANUAL FIRE ALARM PULL STATIONS:

- A. Provide double action intelligent manual fire alarm pull stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall be addressable type.
- B. Stations shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Stations which require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire-engine red with molded raised lettering operating instructions of contrasting color. The use of a key or wrench shall be required to reset the station.
- C. Stations shall be mounted 4'-0" to the top of the device, and located within 5'-0" of the door where they are installed. Locations shall comply with maximum travel distance of NFPA 72.
- D. Stations shall be identified with labels on the back box to which they are installed.

2.5 NOTIFICATION APPLIANCES

- A. Horns, chimes and strobes shall be 24 VDC and shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Devices shall be mounted to an outlet box. Surface mounted devices shall be mounted in a wire-mold type box or manufacturer's equivalent.
- B. Speakers, where required, shall be in all common areas of the building, all class rooms, offices, mechanical rooms, electrical rooms and shall be field selectable for 25 or 70V RMS as required by the system configuration.
 1. Speakers shall have multiple taps that are field adjustable from 1/4watt to 2 watts' minimum.
 2. Where combined with strobes, they may be located per the criteria for strobes, with individual speakers provided where strobes may not be required.
 3. Speakers shall be wired so that each individual floor, stairwell or zoned area determined by Lehigh University can be bypassed for inspection, testing and paging purposes.

4. Speakers in the vicinity of any paging microphone shall be muted during microphone activation to prevent audio feedback.
- C. Horns: Provide fire alarm horns conforming to UL 464.
1. Horns shall be provided with two output settings: Low, High.
 2. Horn or horn/strobe devices shall produce Temporal 3 or Steady output tones, minimum 95 dB per UL 464.
 3. Horns shall be wired so that each individual floor or zoned area determined by Lehigh University can be bypassed for inspection, testing purposes.
- D. Chimes: Provide fire alarm chimes conforming to UL 464.
1. Chimes shall be provided with two output settings: Low, High.
 2. Chime or Chime/strobe devices shall produce Temporal or 60 strokes per minute output tones, minimum 55 dB per UL 464.
 3. Chimes shall be wired so that each individual floor or zoned area determined by Lehigh University can be bypassed for inspection, testing purposes.
- E. Strobes
1. Provide with red finish plate and with the word "FIRE" horizontally printed for ceiling mounting, or vertically for sidewall mounting. The wording on the devices shall be confirmed with the University prior to providing devices for the project.
 2. Xenon strobe with a minimum repetition rate of 1 HZ, not exceeding 3 HZ and a maximum duty cycle of 40% with a pulse duration of 0.2 seconds.
 3. Visual alarm signals shall be furnished with minimum light intensity as required, and meet the requirements of ADA and UL 1971. In large rooms with ceilings over 10 feet, 110 candela models shall be provided. All devices shall have field adjustable candela settings.
 4. Provide strobes which operate on 24 VDC. Each strobe shall be field selectable for candela outputs ranging from 15 to 177 candelas.
 5. Synchronization shall be provided for devices as required by NFPA 72. As a minimum, each floor shall be synchronized.
- F. Audio-Visual Combination Assemblies shall be provided where strobes and speakers are identified at the same locations. Separate audible devices may be provided as required.

2.6 POWER SUPPLIES

- A. Primary power for the FACP shall be 120VAC service obtained from the emergency power panel board. Red colored breaker locks shall be provided for all fire alarm circuit breakers.
- B. Secondary power for the FACP shall be provided by sealed gelled electrolyte batteries. Batteries shall be housed in the FACP cabinet or a separate cabinet with adequate cell separation to prevent accidental discharge.

- C. Battery Capacity: Battery supply shall be calculated to operate its load in a supervisory mode for twenty-four hours with no primary power applied, and after that time, operate its alarm mode for five minutes for horns and 15 minutes for speakers/voice evacuation. (In addition, an alarm reserve correction of 1.2 shall be included.)
- D. Battery Charger: Secondary power battery chargers shall be obtained from the emergency power panel board. Provide battery charging circuitry for each standby battery bank in the system low voltage power supply or as a separate circuit. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries

2.7 ADDRESSABLE INTERFACE MODULES:

- A. Furnish addressable interface modules for the monitoring of contact type initiation devices, control or shutdown of electrical equipment, and monitoring of each independent fire suppression system where required. Unless a dedicated releasing control panel is provided as part of a turn-key package, provide Agent Releasing module to interface with the associated pre-action sprinkler system for the activation of the control solenoid and monitoring all flow and tamper switches. The modules shall be capable of monitoring for alarm, trouble and supervisory conditions, depending on the application.
- B. Where addressable control modules are provided to control or shutdown equipment, they shall be located with 3'-0" of the device or the power source of the equipment. Where control functions require loads greater than the rating of the module contacts, an interposing relay shall be provided, and rated a minimum of 10 Amps @ 120Vac.
- C. Each module shall be addressed, tested and programmed prior to installation using a UL listed programmer/ tester.
- D. Each module shall display a flashing red LED for each circuit, in the normal power or standby power condition, when in the alarm state or during control circuit is activation.

PART 3 - EXECUTION

3.1 PRIMARY POWER:

- A. Make the service connection for the FACP at the emergency distribution panel where shown. Provide a separate NEMA 1 "General Purpose Enclosure" for the circuit breaker. The circuit breaker enclosure shall be painted red, marked "FACP", and provided with a lockable handle or cover.

3.2 SYSTEM FIELD WIRING AND CONDUIT

- A. Wiring within Cabinets and Junction Boxes: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any junction box or cabinet.
- B. Conductor Type and Size: Wire size shall be sufficient to prevent excessive voltage drop issues, and to prevent communication problems where applicable. Wire type and sizing of conductors shall be in accordance with the manufacturers wiring specifications for the system, except for minimum wire size shall be as follows. Follow EST requirements and recommendations for shielding of circuits.

1. Signaling Line Circuits: 18AWG, Type FPLR, solid copper

2. Notification Appliance Circuits: 14AWG, Type FPLR, solid copper

3. 120VAC Circuits: 12AWG, Type THHN, solid copper
 4. Interfaced Circuits: 16AWG, Type FPLR, solid copper
 5. Battery Cable: 14 AWG, stranded
- C. Connectors: All conductors shall be terminated at a screwed connector on a securely mounted approved pressure type terminal block. The use of wire nuts or similar devices are prohibited.
- D. Terminal Cabinets: Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Cabinet size shall be appropriate for the size of the wiring to be connected. Each cabinet shall provide terminal strips of sufficient quantity for the terminations required, with a spare capacity of 20% for future use.
- E. Conductor Numbering: All conductors installed in the system shall be identified and labeled at every junction point. Use a shrink-wrap label designed specifically for this purpose. Wire identification shall be the same as those designated on the as-built drawings. Mark each terminal in accordance with the wiring chart and diagrams for the system. Each label shall identify the origin of the conductor and the termination point with device ID. Label shall indicate "FROM and TO" on each end with appropriate device ID.
- F. Conductor Color Coding: Color coded conductors shall be consistent for each type of circuit. When renovating or adding to an existing system, color coding shall match the existing system. Conductor color shall match the Shop drawing color to the extent possible. Where a specific color is not available, red FLP or NFPL cable with a different color stripe may be provided. The color scheme shall be submitted and approved prior to use on the project.
- G. Signaling Line and Notification Appliance Circuits
1. Direct connection of signaling line circuits to the FACP mother board (board containing CPU) shall not be done prior to testing of the circuits. All circuits shall be tested with the TITAN EST Map Fault Finder (SIGA-MFT).
 2. The SIGA-MFT (Map Fault Finder Tool) shall pinpoint mapping issues on the Signature Series signaling line circuit (SLC). The SIGA-MFT shall be connected between the SLC and a laptop computer through a standard USB port and shall report onscreen, via Windows 7 compatible software.
 3. A copy of the fault finder report shall be incorporated within the O&M manuals.
 4. A copy of the SLC Map shall be incorporated within the O&M manuals.
 5. The SIGA-MFT shall run a variety of tests and diagnostic routines including:
 - a. The identification of all programmed devices attached to the SLC;
 - b. The identification of end-of-line devices;
 - c. A thorough connection integrity analysis on detectors and modules;
 - d. A comprehensive map consistency analysis on detectors and modules;

- e. The identification of the detectors and modules that fail connection integrity analysis; and,
 - f. The identification of the detectors and modules that fail map consistency;
 - g. Device related issues that commonly cause map faults and map mismatch faults;
 - h. SIGA-MFT shall also analyzes SLC communications to uncover wiring problems including:
 - 1) Reversed IN/OUT wiring
 - 2) Wiring loops within loops (nested loop wiring)
 - 3) Short circuits in the SLC
 - 4) Reversed polarity connection to the SIGA-MFT
 - 5) False EOL devices or T-taps
6. All Notification Appliance Circuits connecting to strobes and speakers shall be tested as required by NFPA and manufacturer prior to connecting to the NAC power supply or the Amplifier Module in the EST3 FACP. Tests shall include conditions for:
- a. Open circuits
 - b. Shorts
 - c. Grounds
 - d. Continuity
 - e. Impedance

H. Circuit Arrangement and Loading:

- 1. Signaling line circuits may be routed throughout all building sections and between floors. Device addresses shall be assigned per floor with a block of addresses anticipated for each floor.
- 2. Notification appliance circuits shall be zoned by floor or fire/smoke zone so that servicing one building section does not require taking multiple building sections or floors off-line.
- 3. Spare capacity shall be in accordance with 1.6.
- 4. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10% of nominal voltage.

Note: All wiring configurations shall be reviewed by the fire alarm contractor for proper quantity of devices, circuits, amplifiers and all other system devices for compliance with Lehigh University standards.

- I. Spare Circuits: Provide one spare signaling line and notification appliance circuit for each terminal box placed at each floor on each riser. Spare capacity shall also be provided in the FACP for these

circuits. FACP control boards shall be provided to permit 2 spare initiation circuits and 2 spare indicating circuits. Spare circuits are not to include those provided on the mother board.

J. Wiring to Central Station: Maintain existing telephone connections to central monitoring panel.

K. Provide modules and cable as required to transmit status from the EST3 FACP to the EST central Network monitoring location. LU will provide the data drop/Ethernet connection for this function.

L. Conduit:

1. All conductors shall be in grounded metal conduit. Conduit shall be:

- a. Rigid metal or IMC, where conduit may be subject to impact, and for all exposed risers.
- b. Liquid-tight metallic conduit with liquid-tight fittings, for installation below the concrete slab and in the backflow preventer pit.
- c. Red Fire Alarm EMT, for all panel and device connections. Provide flexible connections at all sprinkler system interface modules between the sprinkler switches and the modules.
- d. Flexible metallic conduit and/or Fire alarm MC cable, where run above plaster ceilings, within architectural soffits, for connections between fire alarm devices and other system equipment (e.g., valve tamper switches and waterflow switches) and for drops within walls to devices.
- e. Surface-mounted raceway (Wiremold®) for installation in units where raceway will be exposed. Use of surface mounted raceway shall be minimized and all locations identified and approved by the University prior to installation.

2. Flexible metal conduit shall use only insulated throat connectors.

3. Run conduit and MC cable concealed wherever possible. Surface-mounted raceway shall be used only where raceway cannot be concealed behind wall or ceiling construction within residential units.

4. Minimum conduit size shall be 3/4-inch, unless smaller conduit is approved in advance by the Engineer or University.

M. Load Control Relays:

1. All relays shall be supervised as required by NFPA 72 and mounted within three feet of the device controlled.

3.3 FIRESTOPPING:

A. Seal all holes created by penetrating conduit, piping, or other penetrations which pass through floors, walls or ceilings. Firestop penetrations through floor slabs, fire-rated walls, shafts, or any fire-rated assembly in accordance with Section 07841, Penetration Firestopping.

3.4 NOISE LEVELS

A. Select equipment with minimum standard noise levels satisfactory for each type of application. Noise levels shall be subject to approval of Project Manager for type and time they are generated.

- B. Installation shall operate under all conditions of load without sound or vibration which is objectionable in the opinion of Design Professional and University. In addition, if sound or vibration is noticeable outside of room in which it occurs, or annoyingly noticeable inside, it will be considered objectionable. Correct sound or vibration conditions considered objectionable by University at Contractor's expense, and without cost to University.

3.5 MARKING:

- A. All metal surfaces shall be painted. Metal conduit in finished areas shall be painted the color to match adjacent surfaces. Junction boxes in unfinished areas shall be painted a full gloss enamel red. Painting shall be in accordance with Section 09900.
- B. Red bands with white lettering indicating "Fire Alarm" shall be applied every 10 feet (3.05m) when not using red-colored conduit, or connection to and between fire alarm devices is evident.
- C. All conductors shall be identified at each end with the device it is connected to, and or the panel origin of the cable connection.
- D. All devices shall be identified with a label to match the University's standard for size and location. Labels for detectors shall be on the base, and not the detector.
- E. All Notification Appliances shall be identified as to their panel, circuit and number of device on that circuit.

3.6 DEVICE INSTALLATION:

- A. FACP: Install new FACP where indicated on the drawings. Surface mount the enclosure with the top of the cabinet 6'-0" above the finished floor or center the cabinet at 5'-6", whichever is lower.
- B. Remote Annunciators: Install new remote annunciator panels where indicated on the plans. Surface mount the enclosure with the top of the cabinet 6 feet (1829 mm) above the finished floor or center the cabinet at 5 ½ feet, whichever is lower. Where installation of a new annunciator is in an existing location, the annunciator may be mounted at the height of the existing annunciator if recessed in the wall. Otherwise, mount at height described herein.
- C. Manual Fire Alarm Pull Stations: Extend existing raceway systems where applicable, and mount manual pull stations so that the pull handle is 45 inches above the finished floor, and the top of the station does not exceed 4'-0". (48")
- D. Strobes: Location in accordance with the contract drawings. Sidewall mounting shall be that the bottom of the strobe lens is 80" above the finished floor. On ceilings, located in center of tile to the extent possible. Candela rating/output and location shall be in accordance with NFPA 72.
- E. Horns: Horns shall be Temporal 3 pattern devices with average dB output of as required by the project and location.
- F. Speakers: Speakers shall match the voltage of the system configuration at 25 or 70 VRMS. Field selectable taps shall be provided for outputs of ¼ watt to 2 watts. Speakers in offices shall be tapped at the lowest wattage, with other taps to meet the ambient noise level where they are installed.
- G. Chimes: Chimes should typically be 60 beats per minute pattern devices with average low dB output of 55 dB per UL 464.

- H. Sprinkler Input Modules: Modules shall be mounted away from the sprinkler riser to ensure the module won't get wet during sprinkler activation.
- I. Post-indicator valve monitoring: Provide addressable input module to monitor position of the fire protection water supply post-indicator valve. The addressable input module shall be located inside the building at the service entrance. An initiating device circuit shall be routed in watertight conduit from inside the building to the post-indicator valve.
- J. Addressable Smoke Detectors:
1. Photoelectric type smoke detectors shall be installed throughout. Smoke detectors shall be provided as indicated on drawings, and shall be located in all common areas of the building, class rooms, conference rooms, mechanical rooms, electrical rooms, telephone rooms, elevator lobbies, elevator machine rooms, rooms with FACPs/NAC Power Supplies and at the top of all stairs.
 2. Smoke detectors within room suite/apartments shall be provided with sounder bases and programmed in such that activation of one detector within a room suite/apartment shall activate all detector sounder bases within the room suite/apartment. Refer to drawings for exact sequence of operation.
 3. Detectors in Boiler rooms shall be combination Smoke/CO or Heat/CO type. Combination type shall be provided as indicated on drawings.
 4. Install smoke detectors a minimum of 3 feet (914 mm) away from supply air vents.
 5. Smoke detectors shall be ceiling mounted only unless authorized by Lehigh University in special cases.
 6. Smoke detectors shall be easily accessible.
 7. Wall mounted smoke detectors are not authorized without prior approval from Lehigh University.
 8. In cases where the smoke detectors are mounted on a clouded ceiling, and smoke detectors are required above the clouded ceiling by code and not "**easily**" accessible, then no smoke detectors shall be installed unless required by code.
 9. Smoke detectors installed in duct work for the purpose of duct smoke detection shall not be mounted to the bottom of the duct work.
 10. Smoke detectors installed in duct work for the purpose of duct smoke detection shall not be mounted to the bottom of the duct work.
 11. New smoke detectors shall be installed with dust covers. The dust covers shall be removed just prior to acceptance testing.
 12. The indicating LED on the smoke detector shall be visible from the floor. Where ceiling conditions prevent easy viewing of the LED from the floor, a remote indicating lamp must be installed.

Note: Requirements for location of smoke detectors shall be regardless of whether the building has automatic sprinklers.

3.7 TESTS

- A. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall attend the preliminary testing to make necessary adjustments.
- B. University Certification AND Final AHJ Acceptance Tests: Notify the University in writing when the system is ready for University certification testing. Submit request for test at least 14 calendar days prior to the test date and prior to Final AHJ Acceptance Test. No testing will be scheduled until the submittals required in Part 1 are provided to the University. University and AHJ tests shall be in accordance with the procedures outlined in NFPA 72. The required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 3. Complete operational tests under emergency generator power
 - 4. Complete operational tests under battery power and as described above under battery power. Test the battery charger.
 - 5. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
 - 6. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 - 7. Visually inspect all wiring.
 - 8. Verify that all software control and data files have been entered or programmed into the FACP.
 - 9. Verify that Shop Drawings reflecting as-built conditions are accurate.
 - 10. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.
 - 11. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 - 12. Measure the voltage drop at the most remote appliance on each notification appliance circuit.
- C. Test Equipment: The contractor shall supply personnel, communication devices, and all equipment necessary for performance of the final test.

3.8 TRAINING

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the Lehigh University employees

designated by the University, in the care, adjustment, maintenance, and operation of the fire alarm system.

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

3.9 KEYS

- A. Keys and locks for all equipment shall be identical where possible. Provide not less than six keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in each operation and maintenance manual furnished.

END OF SECTION 283111