Master Fire Alarm
Technical Specifications

Princeton University
Fire Alarm and Emergency Communications Systems Specifications

4/1/2010
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PART 1 GENERAL

1.01 Related Documents

A. Drawings supplied with this specification shall be used by the electrical contractor as a reference for the requirement and location of the system components. It shall be the responsibility of the electrical contractor to visit the site, acquaint themselves with existing conditions, and confirm the required quantities of devices and specific options or locations for same.

B. The requirements of construction permits and authorization to proceed shall become part of this specification. The construction permits shall be obtained and paid for by the electrical contractor as applicable.

C. Prior to commencement and after completion of work, the electrical contractor shall be responsible for securing all permits and scheduling all inspections with the appropriate authority having jurisdiction (AHJ).

D. After the Demonstration Test and before the Acceptance Test, the electrical contractor shall forward a completed and signed “Record of Completion”, as required by National Fire Protection Association (NFPA ) 72, National Fire Alarm and Signaling Code, Chapter 10, to the Owner’s Designated Representative.

E. After submission and acceptance by the Owner or the Owner’s Designated Representative of the “Record of Completion” described in Section 1.01 (D) above, the electrical contractor shall notify the Owner’s Designated Representative, in writing, when the system is ready for the Demonstration Test and the Acceptance Test.

1. The system shall be considered ready for the Demonstration Test only after all preliminary tests have been made by the electrical contractor and the SimplexGrinnell technical representative, and all deficiencies have been found and corrected.

2. For the purposes of this specification “owner’s designated representative” shall mean the General Contractor or the Construction Manager.

1.02 Summary

A. The Architect/Engineer responsible for the design of the fire alarm and emergency communications system for this project shall be known as the engineer of record, and shall be responsible for the complete design of the fire alarm and emergency communications system and any interface requirements from other fire protection systems to the new fire alarm and emergency communications system.

The engineer of record shall also be responsible for submitting signed and sealed drawings by the individual responsible for the design to the appropriate AHJ for all necessary approvals and releases. The work submitted by the engineer of record shall be complete. The engineer of record shall be responsible for ensuring that all documentation submitted will result in the issuance of the permit to proceed by the Authority Having Jurisdiction (AHJ).

B. The electrical contractor shall furnish all work requirements, equipment, and materials, and perform all operations in connection with the installation of the fire alarm and emergency communications system in the facility located at Princeton University.

1. Details of all labor, materials and system performance are indicated and described in this specification.

C. SimplexGrinnell shall be the only acceptable manufacturer of the electronic fire detection, alarm, and control equipment. Equipment that is not manufactured by SimplexGrinnell, but is accept-
able and compatible with SimplexGrinnell and supplied by SimplexGrinnell is acceptable upon review and approval of the Owner’s Designated Representative.

D. The drawings referenced by this specification are for design concepts only, and do not represent installation practices, methods or means. The electrical contractor shall develop shop drawings that reflect details of field installation, and that will become the basis for final “as-built” drawings.

E. This specification extends to all fire alarm and emergency communications systems, including systems established for mass notification systems interconnected with the fire alarm and emergency communications systems, as deemed applicable by Princeton University.

1.03  Electrical contractor Performance Requirements

A. General - The work covered by this Specification shall include the following work to be performed by the electrical contractor at Princeton University. Additional specific requirements follow these General Requirements.

1. Installation of a new and complete networked, non-coded, addressable, microprocessor-based electronic fire alarm and emergency communications system unless otherwise noted, complete with:
   a. Control unit (FACU) and remote annunciator panel (if required and shown on plans.)
   b. Initiating devices
   c. Notification appliances
   d. Monitoring and control devices
   e. Capability to be interfaced with, or operated as a single control unit mass notification system. (Additional specific mass notification requirements are contained later in this specification).

2. The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of storing, and downloading a second set of operating software resident in the control panels as backup while the system is in operation.
   a. In addition, the system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.
   b. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
   c. The system shall provide a means to recall alarm and trouble conditions in chronological order to recreate an event log. Alarm and trouble logs shall be separate.
   d. The FACU shall have the ability to be accessible for diagnostics, maintenance reporting and information access through software that allows a personal laptop computer access.
   e. Fire alarm and emergency communication system control equipment shall have capability to provide third party access through a serial interface connection.

3. Installation of a minimum of one Class B speaker circuit per floor to provide an evenly distributed number of speakers per floor and circuit. Provide additional circuits as necessary to meet the requirements of the design and specifications.

4. Installation of a minimum of one Class B strobe circuit per floor to provide an evenly distributed number of strobes per floor and circuit. Provide additional circuits as necessary to meet the requirements of the design and specifications.
   a. Circuit power load on each circuit shall not exceed 75% of the individual circuit power available from the FACU and the system amplifiers.
5. Installation of a system capable of both pre-recorded and live voice messaging.

6. Installation of photoelectric addressable analog smoke detectors in all common areas and areas specified herein, and as shown on the design drawings.

7. Installation of photoelectric addressable analog smoke detectors with a sounder base in all guest/residential living unit bedrooms and common areas within each guest/residential living unit as shown on the design drawings.

8. Installation of addressable manual pull stations in all common areas and areas specified herein and as shown on the design drawings.

9. Installation of strobe/speaker units in all common spaces and public bathrooms.

10. Installation of additional speakers in each common area as needed to ensure audibility and intelligibility throughout the common areas.

11. Installation and interconnection of the FACU and fire alarm and emergency communications system being installed in the subject building into the existing SimplexGrinnell TSW 4120 token ring campus fire alarm and emergency communications system network. This will require the installation of specific equipment, as applicable and outlined below, to allow the FACU to network into the TSW 4120 token ring:
   a. Installation of a SimplexGrinnell 4100U FACU
   b. 4100U Multiple Signal Fiber Optic Modems

12. Inspection and testing of the complete fire alarm and emergency communications system for alarm and supervisory signal transmission; and correctness to the building FACU upon completion of installation. This includes:
   a. Coordinating and conducting the Demonstration Test.
   b. Coordinating and conducting the Acceptance Test.
   c. Confirmation that proper signal indication of every device is forwarded and displayed at the Public Safety Desk Officer’s monitor. This may be accomplished with the Simplex-Grinnell TSW receiving system or the existing Digitize receiving system.

13. Programming by SimplexGrinnell of device identification information that shall be displayed at the Public Safety Desk Officer’s monitor. The point ID information shall be included on the FACU 40 character display.

14. Providing the documentation (As-built drawings, warranty, maintenance manuals, training materials, etc.) as required in sections 3.06, 3.08 and 3.09.

B. Furnish, install, test, and place into full operating condition a complete 24 VDC closed-circuit, electrically supervised, addressable, analog individual point annunciated fire alarm and emergency communications system/voice communications control panel and Fire Command Center as appropriate and specified herein and indicated on the design drawings. The system shall include, but not be limited to:

1. All control and communication equipment, power supplies, signal initiating devices, audible and visible notification appliances

2. The connection and equipment necessary to connect to the Campus Security monitoring system

3. All conduit, wire, fittings, and all other accessories required to provide a complete and operable fire alarm and emergency communications system/voice communications system.

4. LCD-type remote annunciator panels, as specified for locations listed in this specification or shown on the drawings.
C. Where applicable, completely remove the existing fire detection and alarm system control equipment, components and equipment that are not specified as being part of the new system. The equipment removed shall be boxed, labeled and delivered to the Princeton University Site Protection Shop Supervisor. All unused, existing fire alarm and emergency communications system wire and cable shall be removed and disposed of properly off-site by the electrical contractor.

D. The work described hereinafter, and as indicated on the drawings, shall consist of all electrical contractor labor, materials, services, software, programming, and testing required to provide a complete and operating system; and complete removal of the existing fire alarm and emergency communications system components not being reused.

1. All cutting, coring and UL Listed fire stopping needed as a result of this work shall be the responsibility of the electrical contractor and shall be coordinated with the Owner’s Designated Representative.

E. All devices shall be installed and wired in accordance with SimplexGrinnell published instructions to achieve the system operation and function as specified herein.

1.04 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 applicable National Fire Protection Association Standards shall take precedence over this specification.

3. Princeton Standards, found in the Princeton University Facilities Design Standards shall take precedence over this specification.

4. This specification shall take precedence over the design drawings referenced by this specification.

1.05 Submittals

A. The electrical contractor shall submit to the Owner and the Owner’s Designated Representative sufficient information to describe the materials to be provided.

B. The electrical contractor shall certify that they have reviewed the documentation to verify dimensions, quantities, installation techniques and procedures; they will provide good workmanship and safety precautions; and they are in conformance and agreement with this specification.

1. These reviews are not the responsibility of the Owner and the Owner’s Designated Representative. The Owner and the Owner’s Designated Representative will only review these documents for the limited purposes of checking for general conformance with the design and not to determine accuracy or completeness of other details such as dimensions and quantities.

2. The Owner and the Owner’s Designated Representative will not approve means, methods or procedures of construction or installation; nor will they review for safety precautions.

C. One set of paper and one set of electronic format submittals are required. Prior to performing any work, all submittals shall be submitted to the Owner’s Designated Representative. The electrical contractor shall certify in writing that the equipment submitted meets all of the requirements of the specifications. No work shall begin until the submittals have been approved, in writing, by the Owner’s Designated Representative, other designated University personnel and state and local officials.

D. SimplexGrinnell shall submit in writing that the equipment to be supplied is not at or near the end of its life cycle. SimplexGrinnell shall also submit in writing that replacement components for Fire Alarm & Emergency Communications Systems
all control equipment shall be available from SimplexGrinnell for a minimum of 15 years from the date of installation.

E. As a minimum, The electrical contractor shall include the following submittals:

1. Original SimplexGrinnell catalog data and descriptive information for all major components of the system.

2. The sequence of operations as supplied by the engineer of record and approved by the owner that describes how the system will operate during alarm, supervisory and trouble conditions. The description shall include FACU indications, initiating devices, notification appliances and auxiliary functions (such as elevator and HVAC functions, etc.).
   a. In addition to the written Sequence of Operations, an Input/Output Matrix, similar in form to that illustrated in NFPA 72-2010, Annex Figure A.14.6.2.4 (9) shall be provided by the engineer of record and approved by the owner and AHJ with the design drawings.

3. Appropriately scaled “shop” drawings shall be submitted. Submittals of installation “shop” drawings shall include original SimplexGrinnell specification and installation instruction sheets.
   a. Copies will not be acceptable. All specific equipment and devices on the shop drawings to be furnished under this contract shall be clearly marked in the specifications sheets. If any equipment and/or devices required in the system are not so marked, the Owner’s Designated Representative shall mark the sheet, and this equipment and/or devices shall be made part of the system and shall be provided.

4. The Owner and the Owner’s Designated Representative, at their sole choice and discretion, may request a demonstration of the proposed equipment.

5. Equipment other than specified will NOT be considered for approval.

6. As a minimum, The electrical contractor shall submit the following prior to performing any work:
   a. A riser diagram of the complete fire alarm and emergency communications system.
   b. A complete point-to-point fire alarm and emergency communications system control equipment installation diagram; typical wiring diagrams are not acceptable.
   c. A complete list of current requirements during normal, supervisory, trouble, and alarm conditions for each component of the system.
   d. Battery calculations showing total standby and total alarm power required to meet the specified system requirements and voltage drop calculations for the notification appliance circuits.

7. Provide catalog sheets of every device and component of the system so that the exact function is known of each component to be installed.

8. The electrical contractor shall not order any equipment nor perform any installations prior to completion of review of the submittals by the Owner and the Owner’s Designated Representative and receipt of a written authority to proceed from the Owner.

1.06 Electrical contractor Coordination Responsibilities

A. The electrical contractor shall coordinate work in this Section with all related trades and ensure work is performed. Where applicable, work and/or equipment provided in other sections and related to the fire alarm and emergency communications system shall include, but not be limited to:
1. Responsibility for all wiring up to and including connection to all existing and new sprinkler waterflow switches and any other sprinkler system supervisory switches. All sprinkler waterflow and supervisory switches shall be monitored for integrity in accordance with the current edition of NFPA 72, National Fire Alarm and Signaling Code.

2. Verification of the quantity and location of all sprinkler waterflow and supervisory switches; additional sprinkler waterflow and supervisory switches shall be monitored accordingly and additional addressable monitor modules shall be installed and programmed, as necessary. Final locations shall be approved by the Owner's Designated Representative.

3. Responsibility for all wiring up to and including connection to a fire alarm relay adjacent to the elevator control unit. The electrical contractor shall provide the fire alarm relay and its enclosure, and shall coordinate the interconnection of the systems.
   a. Elevator recall is to be provided by the elevator contractor. The electrical contractor shall coordinate with the elevator contractor to interface the fire alarm system to the elevator controller.

4. Responsibility for providing addressable modules for the signal connections to the fire pump controller. Fire pump supervision contacts shall be connected to the FACU in accordance with the current edition of NFPA 20, Installation of Stationary Pumps for Fire Protection.

5. Responsibility for all wiring up to and including connection to fire alarm relay adjacent to each HVAC system fan control.
   a. Fan control circuits are to be provided by the HVAC contractor. The electrical contractor shall provide the fire alarm relay and its enclosure. The electrical contractor shall coordinate with the HVAC contractor to interface the fire alarm system to the HVAC controller.
   b. Where smoke dampers are present in the building, they shall be controlled by the FACU and shall be programmed to operate as designed. The electrical contractor shall field verify quantity and location of dampers; additional control relay output modules shall be installed and programmed, as necessary. Final locations shall be approved by the engineer of record. Confirm operation is in accordance with the engineer’s matrix for sequence of operation.

6. Provide circuits for magnetic door hold-open devices such that upon alarm or loss of power, selected magnetic door hold-open devices shall release, allowing the held open door to automatically close.

1.07 Quality Assurance

A. This specification identifies the essential functional requirements of the fire alarm and emergency communications system. SimplexGrinnell’s equipment (hardware and software) and system configuration shall comply with or exceed the functional intent of this specification.

B. Each component of the fire alarm and emergency communications system shall be listed as a product of SimplexGrinnell under the appropriate category by Underwriters’ Laboratories, Inc. (UL), and shall bear the “UL” label. All control equipment shall be listed under the appropriate UL category (such as UOJZ or UUKL) “Control Units System” as a single unit. Partial listings, or multiple listings for various major sections of the control equipment, shall not be acceptable.

C. SimplexGrinnell shall have a service organization which is capable of providing a factory-trained NICET level 3 certified service technician at the University's facility, within 4 hours of a request for on-site service.

D. All control equipment shall have transient protection devices to comply with UL864 requirements.

E. All materials and equipment shall be new and unused.
F. All equipment supplied shall be SimplexGrinnell’s first quality, best type and latest model, 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. Technician Qualifications:

1. The SimplexGrinnell individual technician that will be assigned to this project shall have at least five (5) years experience in the area of installing fire detection, alarm, and control systems. The supervisor and his/her qualifications shall be presented, and be acceptable to the Owner’s Designated Representative. Once assigned, SimplexGrinnell’s supervisor and the fire alarm and emergency communications system technicians shall not be changed without the approval of the owner or the Owner’s Designated Representative.

2. SimplexGrinnell shall be the only acceptable manufacturer of the electronic fire detection, alarm, and control equipment. Equipment that is not manufactured by SimplexGrinnell, but is acceptable and compatible with SimplexGrinnell and supplied by SimplexGrinnell is acceptable upon review and approval of the Owner’s Designated Representative.

H. All equipment, devices, cables, etc., shall be listed by Underwriters Laboratories, Inc., for use in Fire Protection Signaling Systems (fire alarm and emergency communications systems) under the following standards as applicable:

- UL 864 Control Units for Fire Protective Signaling Systems
- UL 268 Smoke Detectors for Fire Protective Signaling Systems
- UL 268A Smoke Detectors for Duct Applications
- UL2034 Single and Multiple Station Carbon Monoxide Alarms
- UL 521 Heat Detectors for Fire Protective Signaling Systems
- UL 228 Door Closer-Holders for Fire Protective Signaling Systems
- UL 464 Audible Signaling Appliances
- UL 1971 Standard for Safety Devices for the Hearing Impaired
- UL 38 Manually Actuated Signaling Boxes
- UL 346 Waterflow Indicators for Fire Protective Signaling Systems
- UL 1481 Power Supplies for Fire Protective Signaling Systems
- UL 2572 Control Units for Mass Notification Systems

I. If a UL listing for a specific device is unavailable, equipment approved by Factory Mutual Global (FM) will be acceptable. Specific FM Approvals Guide information shall be presented to the Owner’s Designated Representative.

J. The system shall comply with all state and local codes, including the New Jersey State Uniform Fire Code and the most recently adopted version of the State of New Jersey Uniform Construction Code.

K. General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this project section.

L. The work covered by this specification is to be coordinated with related work as specified elsewhere in this specification, and the requirements, as applicable, listed in the following specification sections apply:

1. Division 16: Electrical
2. Division 15330: Automatic Sprinklers Fire Suppression
3. Division 15850: HVAC Systems

M. Installation shall be made in accordance with the applicable provisions of the NJUCC adopted edition of the following:

2. NFPA 72, National Fire Alarm and Signaling Code.
3. *International Mechanical Code.*
4. SimplexGrinnell equipment and installation guidelines.

N. The system shall be tested in accordance with the latest edition of the following:
   1. NFPA 72, *National Fire Alarm and Signaling Code* – specifically the chapter on *Inspection, Testing and Maintenance*
   2. SimplexGrinnell guidelines.

1.08 Scheduling
A. The electrical contractor shall provide a schedule to the Owner's Designated Representative indicating the installation sequence and time frame prior to beginning work. Where an existing system is being upgraded, this schedule shall include a detailed description indicating how the new FACU switchover is to occur to ensure that the fire alarm and emergency communications system will be out of service for not more than 12 hours. The electrical contractor shall provide weekly updates to the Owner's Designated Representative.

PART 2 PRODUCTS AND SYSTEM FUNCTIONS

2.01 Manufacturer
A. Fire alarm and emergency communications system control equipment shall be manufactured by SimplexGrinnell, (A Division of Tyco International, LTD.)

2.02 Functional Description of the System
A. The electrical contractor shall provide new control equipment which is UL Listed or FM approved to operate with the submitted manual fire alarm boxes, water flow switches, supervisory switches, heat detectors and smoke detectors, and will
   1. transmit the appropriate signal to the Public Safety Fire Alarm Monitoring System
   2. indicate the condition on the local building FACU, as applicable
   3. alert building occupants using audible (speakers and horns) and visual (strobos) notification appliances, as applicable and indicated in this specification and on the design drawings
   4. supervise each system for conditions which would impair proper system operation and annunciate such abnormal conditions
   5. upon activation of a supervisory device, the system shall activate the supervisory audible and visible signal indicators on the FACU
   6. where applicable, control related equipment as indicated on contract documents such as elevator recall, air handling units and electronic door lock release.

B. FACU shall include basic functions as follows: (see also 2.10)
   1. Power limited circuit design, with 120 VAC input power.
   2. 2000 point capacity where one input or control module, or device equals one (1) point.
   3. Battery voltage and ammeter readouts from the unit LCD.
   4. One auxiliary electronically resettable fused two (2) ampere @ 24 VDC output programmable disconnect operation for auxiliary release.
   5. One auxiliary relay, SPDT two (2) ampere @ 32 VDC output programmable as normally energized or de-energized, or as an auxiliary control.
6. Three (3) class A notification appliance circuits, rated three (3) amperes @ 24 VDC.

7. The FACU shall be support six (6) RS-232-C ports and one (1) service port.

8. Remote Unit Interface shall be a supervised serial communications channel for controlling and monitoring remotely located annunciators and input/output control units.

9. FACU cabinet door shall be with a lockable steel enclosure. FACU shall be arranged so that all operations required for testing and normal care can be performed from the front of the enclosure. If more than one enclosure is required, exactly matching modular units shall be provided.

10. FACU shall include 80-character Liquid Crystal Display to indicate alarm, supervisory and trouble status messages.

C. FACU shall include a keypad for use in entering and executing control commands. A green POWER ON LED shall normally be lit, indicating that the system is receiving normal 120 VAC electrical power. A failure of normal control panel power shall cause this LED to extinguish, and a trouble signal shall be displayed on the FACU.

D. Upon the activation of any alarm initiating device, such as a heat detector or sprinkler water flow switch activation, the system shall transfer to the “Alarm” state and shall operate as outlined in Section 2.03 of this Specification.

E. Upon the occurrence of an abnormal condition of a monitored component or point, such as the closing of a sprinkler system control valve, the system shall transfer to the “Supervisory” state and shall operate as outlined in Section 2.04 of this Specification.

F. Upon the occurrence of an abnormal condition, such as a fault in circuit wiring, on the system, equipment, Initiating Device Circuits (IDC), Signaling Line Circuits (SLC) or Notification Appliance Circuits (NAC), the system shall transfer to the “Trouble” state and shall operate as outlined in Section 2.05 of this Specification.

2.03 System Alarm Condition

A. 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.

B. The system alarm operation subsequent to the alarm activation of any manual pull station, automatic detection device, or sprinkler waterflow switch shall automatically perform the functions contained in this section and operate as follows:

1. **Within a residential/guest living unit:** Upon activation of any residential/guest living unit smoke detector all smoke detector audible bases for the smoke detectors in the rooms of the residential/guest living unit, or the audible appliance in the smoke detector base in a single residential/guest room suite, shall sound.

   Each on-campus residential/guest living unit detector shall be programmed to transmit the residential/guest living unit alarm signal through the FACU to Public Safety Fire Alarm Monitoring System and to the LCD-type annunciator located at the entrance or the Guest check-in area. Off-campus residential living units will not report to the Public Fire Safety Monitoring system.

   These guest living unit smoke detectors shall operate similar to single- or multiple-station smoke alarms in that only the audible appliances within the residential/guest living unit, or the audible appliance in the smoke detector base within the residential/guest living unit, shall sound when any single smoke detector within the residential/guest living unit activates. **This residential/guest living unit alarm shall not activate a general alarm.**

2. There shall be 5% of the total number of rooms in the building that will be designated “Handicapped Accessible” residential/guest living units. In those rooms designated
“Handicapped Accessible” residential/guest living units: In addition to the operation of audible signals as described above, the visible (strobe) notification appliance within the hearing-impaired living unit shall operate.

3. Non-high rise office building common areas: When any waterflow device, heat detector or manual fire alarm box, or a common area smoke detector is activated, a general alarm shall be initiated. Upon activation of these devices, all building common spaces notification appliances shall operate in a general alarm mode throughout the building or the alarm zone as designated on the drawings. The general alarm shall consist of an alert tone for a period of five (5) seconds, a digitized recorded voice message providing the occupants with emergency instructions and, at the end of the message sequence, the activation of a temporal code 3 National Evacuation Signal throughout the building and all residential/guest living units in the building. All strobes shall operate. The general alarm shall be transmitted to the Public Safety Fire Alarm Monitoring System.

4. High rise building common areas: When any waterflow device, heat detector or manual fire alarm box, or a common area smoke detector is activated, a general alarm shall be initiated throughout the building. The general alarm shall consist of an alert tone for a period of five (5) seconds, a digitized recorded voice message providing the occupants with emergency instructions and, at the end of the message sequence, the activation of a temporal code 3 National Evacuation Signal throughout the building notification. All strobe lights in the building shall operate.

The general alarm shall be transmitted immediately to the Public Safety Fire Alarm Monitoring System. When any smoke detector is activated, the fire alarm and emergency communications system shall initiate an alarm immediately.

C. FACU alarm indication
1. Alarm conditions shall be immediately displayed on the control panel alphanumeric display and on the remote graphic annunciator (if required and shown on plans), and alphanumeric display indicating all information associated with the fire alarm and emergency communications system condition including type of device, its location (address) and the time and date of activation. Alarm LED’s shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on.

A subsequent alarm received from another address after acknowledgment shall flash the alarm LED on the control panel and the panel display shall show the new alarm information.

2. If any serially connected annunciation equipment is being used, each of the connected peripherals shall display/print the information associated with the FACU condition, including the time/date stamping of the change of status event. 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.

3. During an alarm condition, a pulsing signal tone shall sound within the control panel until the alarm is acknowledged.

4. If the audible alarm signals are silenced for any reason, they shall automatically resound if another initiating device is activated.

5. When the alarm signals are silenced by pressing the Alarm Silence pushbutton on the display module, the FACU Alarm Silenced LED indicating that an alarm is present and silenced shall remain lit until the alarm is reset at the control panel.

6. The alarm sequence shall be recorded with the time and date of all occurrences.

D. Actuation of Notification Appliances upon Alarm Indication
1. Operate audible notification appliances as specified in sections 2.03 B and 2.06.
2. Operate visible notification appliances as specified in sections 2.03 B and 2.06.
3. All alarm signals shall be automatically “locked in” at the control panel until the operated device is returned to its normal condition and the control panel is manually reset.

E. Auxiliary Functions upon Alarm Indication
1. Where applicable, all auxiliary functions shall be connected to and operated by the FACU.
2. Elevator Recall - The alarm activation of any smoke detector in the elevator lobbies, elevator pit, at the top of the elevator shaft or the elevator machine room shall initiate as a common area smoke detector, and issue notifications as listed above in section 2.03B. Additionally, these smoke detectors shall cause the elevator cabs to be recalled according to the following sequence:
   a. If the activated detector is on any floor other than the designated level of exit discharge, the elevator cabs shall be recalled to the designated level of exit discharge.
   b. If the activated detector is on the designated level of exit discharge, the elevator cabs shall be recalled to the alternate floor as determined by the Owner and local fire official.

   Note: Automatic detectors shall be listed and approved for the ambient conditions present in the areas that these devices are installed. If smoke detectors cannot be provided to meet the ambient conditions of the space, alternate detection is acceptable. Alternate detection methods shall be approved by the Owner's Designated Representative, in writing. Refer to the current editions of NFPA 72 and Underwriters Laboratories Fire Equipment Directory for guidance.
3. Elevator Power Shut Down
   a. The electrical contractor shall install a heat detector within 2 feet of the sprinkler head located at the top of the elevator shaft and within 2 feet of each sprinkler installed in the elevator machine room. These heat detectors shall be connected to the elevator power system and arranged to shut down elevator power upon activation. The heat detectors shall have an RTI less than the sprinkler heads.
4. HVAC
   a. The operation of a duct smoke detector shall cause the appropriate existing fan control relays to activate to cause the shutdown of the associated fan(s), or initiate the site specific smoke control sequence, as appropriate. Refer to the engineer’s matrix of sequence of operation and override conditions. Duct detector shall cause a supervisory signal at the FACU except in high rise applications where they will actuate an alarm condition.
5. Smoke Damper Controls
   a. Where smoke dampers are present in the building, they shall be controlled by the fire alarm and emergency communications system. Upon activation of area smoke detectors or duct smoke detectors in the space being served by the HVAC duct, the fire alarm and emergency communications system shall cause the appropriate smoke damper control relays to activate causing associated damper(s) to close.

   An override control switch shall be installed in the FACU to allow the fire department to return the smoke dampers to their normal condition.

   On an alarm condition every damper in the building shall not be closed; only the dampers serving the area where the smoke detector or duct smoke detector is in alarm shall be closed.
6. Laboratory Hood/Fan Exhaust Systems (Where Applicable)
   a. The fire detection and alarm system operation shall not be interconnected to automatically shut down laboratory hood exhaust fans. All associated air handling and control equip-
ment connected to laboratory hood exhaust fans shall conform to the latest editions of NFPA 45 and 91.

7. Electronic Door-Lock Release
   a. Where exit doors are locked with magnetic locking devices for occupant safety, they shall have an automatic door lock electric release feature. The operation of any general fire alarm and emergency communications system initiating device shall cause all electronic door lock release relays to activate to allow secured doors to unlock. All non-magnetic locking devices shall fail secure.

8. Magnetic Door Hold-Open Device
   a. Where smoke or fire doors are held in the open position by a magnetically controlled hold-open device, they shall automatically release as shown on the matrix of sequence operation. All door hold-open devices shall also release upon loss of operating power. The door hold-open devices shall have approximately 35 lb. holding power and offer fail safe operation. All door hold-open circuits shall be separately fused.

2.04 System Supervisory Condition

A. The FACU shall have a system supervisory LED and a supervisory signal acknowledge switch.

B. When a supervisory condition is detected, the following functions shall immediately occur:
   1. The System Supervisory LED shall flash.
   2. A steady signal tone in the control panel shall sound.
   3. The display shall indicate all information associated with the supervisory condition, including: device, its location within the protected premises, and the time and date of the activation.
   4. If more supervisory signals are in the system, the operator shall be able to scroll the display to view all signals.
   5. If any serially connected equipment is being used, then each of the connected peripherals shall display/print the information associated with the condition, including the time/date stamping of the change of status event.
   6. If applicable, 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 (Supervisory Indicating Appliance and/or relays) shall be activated.

C. Unacknowledged alarm messages shall have priority over supervisory messages, and if an alarm signal is initiated during a supervisory sequence, the alarm condition shall have display priority.

D. 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.

E. Restoring the device or supervisory contact to the normal position shall cause the supervisory LED to extinguish indicating restoration to normal position.

F. The activation of any fire protection control valve supervisory switch shall activate an audible supervisory signal and illuminate the supervisory LED at the control unit.

G. Fire pump system supervisory conditions shall be individually monitored. Monitoring points shall include the following:
   1. Fire Pump Running
   2. Fire Pump Power Failure
   3. Fire Pump System Control Valves
4. Fire Pump Phase Reversal
5. Engine Driven fire pump driver or controller trouble (low oil pressure, bad batteries, etc.)
6. Engine driven controller switch not in “automatic”

H. Activation of the duct smoke detectors in air handling units shall produce a supervisory condition at the FACU when activated for all buildings except high rise applications. In high rise buildings activation of the duct smoke detectors shall produce an alarm condition.

2.05 System Trouble Condition

A. When a trouble condition is detected, the following functions shall immediately occur:

1. 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 system circuits, disarrangements in system wiring, failure of the microprocessor or any identification module, or system ground faults shall activate this trouble circuit.

2. A trouble signal may be acknowledged by actuating the “ACKNOWLEDGE” switch. This shall silence the panel trouble signal. If additional trouble conditions occur, the trouble signal shall resound.

3. The 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.

4. If any serially connected equipment is being used, then each of the connected peripherals shall display/print the information associated with the condition, including the time/date stamping of the change of status event.

5. If applicable, 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 Indicating Appliances and/or relays) shall be activated.

B. Unacknowledged alarm messages shall have priority over trouble messages, and if such an alarm occurs during a trouble sequence, the alarm condition will have display priority.

2.06 Occupant Notification

A. Occupant Notification

1. Audible Notification – within a residential/guest unit – see 2.03 B 1 above:

2. Audible notification in all building common areas shall be by speakers, as indicated on the design drawings.

3. Audible Notification – Non-high rise residential/guest living unit building common areas; High-rise and non-high rise office building common areas – see 2.03 B 1, 3, and 4 above:

   a. Audible notification shall be by speakers, as shown on the Design Drawings, capable of delivering a digitized recorded voice message providing the occupants with emergency instructions and, at the end of the message sequence, the activation of the temporal code 3 National Evacuation Signal in the building notification zones receiving the alarm.

   b. Failure of the pre-recorded message sequence shall cause the system to default to a standard evacuation, temporal code 3 pattern.

   c. The FACU shall be equipped with an emergency voice alarm communication module that will take precedence over the pre-recorded message when the module microphone is activated.
4. Manual silencing of the fire alarm and emergency communications system notification signal shall be permitted. An Alarm Silence LED shall be lit at the control panel indicating audible silencing. When the alarm signals are silenced by pressing the Alarm Silence pushbutton on the display module, the FACU Alarm Silenced LED indicating that an alarm is present and silenced shall remain lit until the alarm is reset at the control panel.

5. Visible Notification - within a residential/guest unit established for hearing impaired occupants – see 2.03 B 2 above:
   a. Visible Notification shall be by strobe lights set with the candela rating as shown on the design drawings.

6. Visible notification - Non-high rise residential/guest living unit building common areas; High-rise and non-high rise office building common areas – see 2.03 B 1, 3, and 4 above.
   a. Visible Notification shall be by strobe lights, sized and located as indicated on the design drawings.

7. Visible fire alarm and emergency communications system notification appliances shall continue to flash until they are “Silenced” or the “RESET” switch has been actuated.

8. All visible fire alarm and emergency communications system notification appliances that can be viewed in the same space shall flash in synchronization.

9. The occurrence of any subsequent alarm after actuation of the “ALARM SILENCE” switch shall re-actuate the audible and visible notification appliances.

10. All alarm signals shall be automatically “locked in” at the FACU until the operated device is returned to its normal condition and the control panel is manually reset.

2.07 System Supervision

A. All wiring extending from the FACU enclosure to system components shall be supervised for opens, shorts and grounds. Systems containing unsupervised wiring of any type shall not be acceptable.

B. 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.

C. Incoming 120 VAC line power shall be supervised so that any power failure shall be audibly and visually indicated at the control panel.

D. Batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel.

E. Loss of incoming 120 VAC line power or battery power in any building shall be indicated as a trouble condition through the SimplexGrinnell TSW 4120 token ring campus fire alarm and emergency communications system network.

F. Interconnected Fire Safety Systems shall be monitored for alarm, supervisory and trouble conditions. The supervisory signal will activate any time the monitored system indicates an off-normal condition.

2.08 System Reset

A. 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.

B. Should an alarm condition continue to exist, the system shall remain in an abnormal state. System control relays shall not reset. The panel alarm LED shall remain on. These points shall not require acknowledgment if they were previously acknowledged.
2.09 Minimum Components

A. The automatic fire detection and alarm system shall consist of, but not be limited to:

1. Addressable fire alarm and emergency communications system control unit, containing a Central Processing Unit (CPU) power supply, LED indicators, control switches and relays. This fire alarm and emergency communications system control unit shall be integrated with the voice/communications control equipment, as applicable.

2. Input Devices (waterflow switches, tamper switches, emergency generator and fire pump supervisory switches).

3. Addressable, analog photoelectric, with standard bases.
   a. Addressable, analog photoelectric, with bases with integral horn in residential/guest living units.

4. Addressable spot-type heat detectors.

5. Addressable manual pull stations.

6. Addressable Relay Output Modules

7. Fault Isolator Modules.

8. Annunciation.

9. Remote Annunciator (if required and shown on drawings).

10. Audible and visual notification appliances


12. Fire Pump supervision, if required and shown on the design drawings.

13. Battery backup supervision.

2.10 Fire Alarm and Emergency Communications System control unit (FACU)

A. The FACU shall provide power, English display status, supervision, control, and programming capability for the fire detection and alarm system.

B. FACU shall include the following:

1. Power limited circuit design, with 120 VAC input power.

2. The FACU 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, where one input or control module, or device equals one (1) point, with time and date of each event. The history file shall remain intact in the event of a loss of AC and battery power.

3. Battery voltage and ammeter readouts from the unit LCD.

4. One auxiliary electronically resettable fused two (2) ampere @ 24 VDC output with programmable disconnect operation for 4-wire smoke detector reset.

5. One auxiliary relay, SPDT two (2) ampere @ 32 VDC output programmable as normally energized or de-energized, or as an auxiliary control.

6. Three (3) class B notification appliance circuits, rated three (3) amperes @ 24 VDC.

7. The FACU shall be contained in a single cabinet, lockable steel enclosure. FACU shall be arranged so that all operations required for testing and normal care can be performed from the front of the enclosure. If more than one enclosure is required, exactly matching modular units shall be provided.
8. FACU shall include 80-character Liquid Crystal Display to indicate alarm, supervisory and trouble status messages.

9. The FACU shall be located in the individual building fire command center, where applicable.

C. FACU shall include a keypad for use in entering and executing control commands. A green “POWER ON” LED shall normally be lit, indicating that the system is receiving normal 120 VAC electrical power. A failure of normal control panel power shall cause this LED to extinguish, and a trouble signal shall be displayed on the FACU.

D. A 24 hour clock shall be provided to continually provide the time of day in English AM/PM format and day of the week information. During normal standby conditions, the FACU shall display time and date.

E. The FACU shall be provided with the following function switches and LED’s:

1. **Power-On LED**: Shall indicate AC power-on under normal, supervisory, and alarm conditions.

2. **Alarm LED**: Shall indicate the existence of an alarm condition. It shall be redundant to the display.

3. **Alarm Acknowledge Switch**: A switch shall be provided to allow acknowledgment of each alarm before the system is silenced and reset.

4. **Alarm Silence**: Actuation of the switch shall silence alarm outputs and illuminate an LED. Any subsequent alarms shall resound the signals. The switch shall not be operable unless the alarm has been acknowledged.

5. **Trouble LED**: Shall indicate when the system is in off normal condition, but not in alarm. It shall be redundant to the display.

6. **Trouble Acknowledge**: Switch actuation shall silence the control unit trouble buzzer and illuminate an LED. Subsequent trouble conditions shall resound the buzzer.

7. **Supervisory LED**: Shall indicate when the system is in off normal condition, but not in alarm. It shall be redundant to the display.

8. **Supervisory Acknowledge**: Switch actuation shall silence the control unit trouble buzzer and illuminate an LED. Subsequent trouble conditions shall resound the buzzer.

9. **Lamp Test**: Shall illuminate all control unit LED’s and all segments of the display.

10. **System Reset**: Restoration of the system to normal standby supervisory condition shall require the actuation of a switch. The switch shall be inoperable if all alarms are not properly restored.

11. **Ground Fault**: Shall indicate low resistance between positive or negative and ground in field wiring or devices. For ease of troubleshooting, separate indications shall be provided for grounds on positive and negative wiring.

12. **Battery Failure**: Indication shall indicate battery voltage decay or disconnected batteries.

13. **Battery Test**: Shall load test battery capacity with display of battery voltage and current.

14. 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.

15. Multiple alarm conditions shall be sequentially displayed automatically at not more than a five (5) second interval until manually acknowledged by priority.
F. Upon the activation of any alarm initiating device, such as a heat detector or sprinkler water flow switch activation, the system shall transfer to the “Alarm” state and shall operate as outlined in Section 2.03 of this Specification.

G. Upon the occurrence of an abnormal condition of a monitored component or point, such as the closing of a sprinkler system control valve, the system shall transfer to the “Supervisory” state and shall operate as outlined in Section 2.04 of this Specification.

H. Upon the occurrence of an abnormal condition, such as a fault in circuit wiring, on the system, equipment, Initiating Device Circuits (IDC), Signaling Line Circuits (SLC) or Notification Appliance Circuits (NAC), the system shall transfer to the “Trouble” state and shall operate as outlined in Section 2.05 of this Specification.

I. The system shall have a “walk-test” capacity of eight (8) programmable pass code protected, single-person testing groups so that the entire system does not require disabling during testing. Activation of this feature initiates:

1. Control relay function bypassing
2. Initiation of a FACU trouble condition and signal
3. Alarm activation that allows the activated initiating device to cause an audible signal to sound and identify the initiating device
4. Automatic reset after signaling is complete
5. Opening of a device or appliance circuit shall cause a 4-second trouble signal to sound.

J. The FACU 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.

K. The FACU 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.

L. The FACU shall support a minimum of one (1) signaling line circuit. The signaling line circuit shall be loaded to no more than 75% of its specified capacity.

M. Fault isolator modules shall be used on each signaling line circuit or a minimum of one fault isolator module per floor or entry. In all cases, no more than 25 devices shall be installed on a circuit between fault isolators.

N. The FACU 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. Signaling line circuits shall be Class B operation.

O. The FACU shall support the design required number of speaker and strobe circuits. Each circuit's power load shall not exceed 75% of the individual circuit power available from the FACU and shall be Class B circuits.

P. Power for all notification appliances shall come from integral power supplies in the FACU. Remote power supplies, if needed, shall be of the same manufacturer as the FACU. The location of all remote control equipment, such as remote power supplies (extenders) shall be approved prior to installation by the Owner's Designated Representative. All locations containing remote control equipment (such as a power supply extender) shall be protected with a smoke detector.

Q. Distributed voice amplifier panels shall be of the same manufacturer as the FACU. The location of all distributed voice amplifier panels shall be approved prior to installation by the Owner's Designated Representative. All locations containing remote distributed voice amplifier panels shall be protected with a smoke detector.
R. The FACU shall accommodate all addressable input devices in alarm simultaneously and shall be capable of operating all output relays while all inputs are in alarm.

S. The functional operation of the FACU 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 standard terminal or standard laptop computer. Laptop computers shall utilize standard SimplexGrinnell's communications software.

T. Access and control of the FACU operating program shall be restricted to proper personnel designated by the University.

U. The channel modules shall be field programmable to report wire-to-wire short conditions as a trouble condition.

V. The FACU 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 FACU 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 24 hours of backup power for the system and enough remaining power to operate all notification appliances for 15 minutes at the end of the 24 hour period. Standby battery calculations shall include a 20% additional capacity.

2. Transfer from AC to battery power shall be instantaneous when AC voltage drops below 85 percent input.

3. 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. 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.

5. The FACU 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.

6. 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.

Y. Output Function Modules. The FACU shall use output function modules to control output functions. The modules shall plug into the control unit motherboard. The functions and presence of each module shall be supervised. All modules shall be individually programmable by circuit as hereinafter specified.

1. The FACU shall be programmable for any of the following auxiliary functions:
   a. Electronic door lock release
   b. Magnetic door hold-open device release
   c. HVAC shutdown
   d. Elevator recall (Where applicable)
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2. The FACU shall have a "silent" walk test capability.

2.11 Voice/Communications System

A. Voice/Communications System

1. Where applicable and as indicated on the design drawings, a Voice Communications System and associated system components shall be provided.

2. The voice/communications panel shall contain all of the equipment required for all audio control, firefighter’s telephone system control (when required), signaling and supervisory functions. The voice/communications panel shall perform the following functions:

   a. Operate as a dual channel emergency voice/communication system.
   b. Operate as a two-way firefighter’s emergency telephone system control center (when required).
   c. Operate as a mass notification system.
   d. Audibly and visually indicate the active or trouble condition of each speaker circuit and telephone circuit.
   e. Audibly and visually indicate any trouble condition of tone generators and digital voice units required for normal operation of the system.
   f. Provide automatic, digitally recorded voice messages and tones.
   g. Supervision of all speaker and telephone circuits for opens and shorts.
   h. Audio amplifiers to provide audio power for distribution to speaker circuits.
   i. Audio input and amplified output supervision, back-up input and automatic switch over function.
   j. Amplifiers shall be backed up in groups. Failure of any one amplifier in the system shall not degrade system performance in any way.
   k. Actuation of any alarm indicating device shall cause an alert tone to sound and cause a prerecorded message to sound over the speakers as described under section 2.03 of this specification.
   l. A built-in microphone shall be provided to allow paging through speaker circuits.
   m. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
   n. The firefighter’s telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.
   o. The voice/communications panel shall be UL listed and integrated into the building’s SimplexGrinnell FACU.

B. Signal priority shall be such that signals generated from the mass notification system shall have highest priority when determined appropriate from a risk analysis. Fire alarm signals shall have priority over non-emergency MNS messages/signals, supervisory signals and trouble condition signals.

C. The activation of an addressable device shall not prevent the receipt of signals from subsequent addressable devices.
2.12 Network Communications

A. Network node communication shall be through a token ring.

B. A single open, ground or short on the network communication loop shall not degrade network communications. Token shall be passed in opposite direction to maintain communications throughout all network nodes. At the same time the status of the communication link shall be reported.

C. If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.

D. Fiber optics communication shall be provided via a multiple signal fiber optic modems. Modem shall multiplex audio signals and digital communication via full duplex transmission over a single fiber optic cable, single mode.

E. The communication method shall be NFPA 72, Class X.

F. Wiring

1. All modem wiring shall be power-limited and monitored for integrity.

2. The following modem wiring shall be within a system box or close nippled to a system box:
   a. Digital Audio Riser (DAR)
   b. 24-volt card power
   c. 4120 network left port
   d. Analog audio risers
   e. Remote unit interface (RUI)

3. The following modem wiring may be routed external to a system box:
   a. 4120 network right port
   b. Analog audio riser X-link
   c. Remote unit interface X-link

4. Ferrite beads shall be used where the DAR, 4120 network and RUI enter or exit a system box.

5. Right port wiring specifications
   a. Surge suppressors shall be installed where the wiring leaves the building.
   b. For 57.6 Kbits per second:
      1. maximum length of transmission: using fire rated shielded twisted pair cable, 18AWG- 10,000 feet; using twisted telephone cable, 24 AWG- 7,000 feet,
   c. For 9600 bits per second:
      1. Maximum length of transmission: using fire rated shielded twisted pair cable, 18AWG- 17,000 feet; using twisted telephone cable, 24 AWG- 12,000 feet.
   d. Shield shall be connected to earth ground.

6. Wiring to the Modem's Analog Audio Riser (AAR) shall be as follows:
   a. Wiring to and from the modem shall connect to either an AAR or an AAR interface card.
   b. All wiring shall be 18 AWG to 14 AWG, twisted shielded pair.
c. Audio wiring shall not be in the same jacket with any other wiring, including other audio wiring.

d. AC voltage rating shall be 10 VRMS maximum.

e. DC voltage rating shall be 1 VDC maximum.

f. All wiring that enters and exits the building shall have the 2081-9044 overvoltage protector.

g. Wiring shall test free of all grounds.

h. All wiring shall be power-limited and monitored for integrity.

i. There shall be no T-taps in the wiring from the modem.

7. Wiring to the Modem's Digital Audio Riser (DAR) shall be as follows:

a. Wiring shall always be in a system box, or close-nippled to a system box.

b. The DAR shall always connect to either a DAR interface card or digital audio controller.

c. All riser wiring shall be power limited and monitored for integrity.

d. Audio wiring shall not be in the same jacket with any other wiring, including other audio wiring.

8. Wiring to the modems remote unit interface (RUI) shall be as follows:

a. RUI wiring shall connect to either a CPU/RUI card or a transponder interface card.

b. Wiring shall be between 18 AWG and 14 AWG.

c. There shall be no T-taps in the wiring from the modem.

d. Correct polarity shall be maintained on all terminal connections.

e. All RUI wiring shall be power-limited and monitored for integrity.

f. All wiring that enters and exits the building shall have the 2081-9044 overvoltage protector.

g. There shall be a maximum of eight (8) pairs of modems for the RUI if wired class A or X.

2.13 Fire Command Center

A. A fire command center for fire department use shall be provided in all high-rise buildings and Atriums in a location approved by the fire department. The fire command center shall contain the following:

1. All necessary equipment and controls for the fire alarm and emergency communications system/voice communications system.

2. All fire department telephone communication controls as required by the NJ Construction Codes.

3. A standard voice grade telephone to allow direct dial access to the local telephone network. This phone shall be housed in a locked cabinet with the lock keyed the same as the fire alarm and emergency communications system control cabinet. A raceway shall be installed from the telephone cabinet to the telephone NID block connection.

4. All fire alarm and emergency communications system, supervisory and trouble conditions will be annunciated at the fire command center. The indications shall be first floor by floor, then by device, shown on the LCD readout.
5. An annunciator that visually indicates the operational status and floor location of all elevators in a high rise building.

6. Status indicators and controls for air-handling systems that are used for smoke control.

7. Status indication for all sprinkler valve supervisory switches, sprinkler水流 supervision switches and fire pump operation supervisory switches.

8. Controls to manually transmit an evacuation signal and voice instructions on a selective and all-call basis to each Elevator.

9. A two way fire department communication system shall be provided for fire department use. The communication system shall operate between the fire command center and every elevator, elevator lobby and every entrance to an exit stairway.
   a. Install a firefighter’s telephone jack in each elevator cab and one in the fire pump room.
   b. Install a firefighter’s telephone jack at each elevator lobby and at each entrance to an exit stairwell on each floor.
   c. Firefighter’s telephone circuits shall be arranged so as to allow communications between the fire command center and up to six (6) remote telephone locations simultaneously.
   d. Means shall be provided to connect the firefighter’s telephone circuits to the speaker circuits to allow voice communication over the speaker circuit from a telephone handset.
   e. Provide and install 6 firefighter telephones in a cabinet located in the fire command center.

2.14 Wiring

A. All new wiring shall comply with this section.

B. The electrical contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets, and similar devices necessary for the complete installation. All wiring shall be of the type as specified herein and as recommended by the manufacturer and shall be installed in conduit throughout.

C. Where penetrations of floor or walls are made, they shall be fire-stopped with approved or UL-listed fire stopping material acceptable to the Authority Having Jurisdiction.

D. The entire wiring system for the new fire detection and alarm system shall be in full accordance with Article 210, "Wiring," of the current NFPA 70, National Electric Code.

E. All wiring shall test free from grounds and short circuit faults. No connections to the FACU shall be made until the system wiring has been accepted by the Owner’s Designated Representative and the equipment supplier.

F. Local and/or state codes that require that the conductors for the fire detection and alarm system, and the means and methods of their installation be more stringent than those of the National Electric Code and NFPA, shall be followed.

G. All new wiring shall be installed to requirements listed in the current edition of NFPA 70, National Electric Code. Color coding shall be approved by Owner’s Designated Representative.

H. All new wiring for the initiating devices, notification appliances and remote 80-character display shall be stranded copper and shall comply with the appropriate sections of the current edition of NFPA 70, National Electrical Code. All system wiring size shall be as determined suitable by the manufacturer and in compliance with the current edition of NFPA 70, National Electric Code, yet they shall not be any smaller than as specified herein.

I. Unless otherwise indicated on the design drawings, the following minimum sizes of conductors shall be used for all new wiring:
1. AC Power Supply Conductors  
   No. 12 AWG
2. DC Power Supply Conductors  
   No. 14 AWG
3. Signaling Line Circuit Conductors  
   No. 18 AWG – twisted shielded cable
4. Remote Annunciators  
   No. 18 AWG – twisted shielded cable
5. Remote Pilot Lamp Units  
   No. 18 AWG
6. Notification Appliance Units  
   No. 14 AWG
7. Speakers  
   No. 18 AWG – twisted shielded cable
8. Firefighter’s Telephone Units  
   No. 18 AWG – twisted shielded cable

J. All wiring shall be arranged and installed using the following color code:
1. THHN – Red (+) & Black (-) – Visual Notification Appliance Circuits
2. THHN – Orange (+) & Brown (-) – Audible Notification Appliance Circuits (non-voice)
3. THHN – Yellow (+) & Blue (-) – Sounder Base and Duct Smoke Detector Power
4. THHN – White (+) & purple (-) – Door Holder Power
5. Twisted Shielded Cable – Blue outer jacket – Audible Notification Appliance Circuits (voice)
6. Twisted Shielded Cable – Red outer jacket – MAP/NET Signaling Line Circuits

K. Raceways containing conductors identified as "Fire alarm and emergency communications system" conductors shall not contain any other conductors, and no AC carrying conductors will be allowed in the same raceway with the DC fire alarm and emergency communications system detection and signaling conductors.

L. Raceways shall be run parallel and perpendicular to the walls and ceilings. 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. Where concealed, provide access panels for all junction boxes, pull boxes and conduit bodies per NFPA 70 (NEC).

Where exposed raceways must 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. No spanning from beam to beam or rib to rib will be permitted. The use of a conduit body on one side of a beam or rib will be permitted provided it will be readily accessible.

The method and location of all exposed conduit and raceways shall be approved by the Owner’s Designated Representative prior to start of any installation work.

M. End-of-Line Resistors (for non-addressable switches and devices) and fault circuit isolators shall be furnished as required and shall be mounted as directed by SimplexGrinnell and listed in this specification, unless the design drawings indicate specific locations.

N. The field location of the End-of-Line Resistors (for non-addressable switches and devices) and 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.

O. The system FACU, amplifiers and all power extender panels shall be arranged to receive power from a dedicated two-wire, 20 amp, 120 VAC supply fed from an emergency circuit.

P. The FACU shall have an adhesive label, “P – Touch” or equal, on the inside, which shall indicate the electric panel board and circuit breakers which protect the feeders to the control panel.

Q. All wiring within the control panel shall be neatly served in the panel gutters and be secured by means of Thomas & Betts “Ty-Raps” or by other approved means.
R. Connection of initiating devices and notification appliances to appropriate signaling line circuits and notification appliance circuits from each floor shall be as indicated on the approved installation drawing from SimplexGrinnell.

2.15 System Field Device – 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. The address of each addressable device shall be clearly and permanently indicated, using an adhesive label, “P – Touch” or equal, on the base of each detector or on the face of addressable modules, relay output modules and manual pull stations.

D. Failure of any single device shall not hinder the operation of any other devices connected to the signaling line circuit.

E. Failure of the FACU to properly communicate with any addressable device shall initiate the proper trouble sequence. While in this trouble condition, the FACU shall cause actual alarm input from devices to override trouble alarm.

2.16 Annunciation

A. Annunciation shall be an integral part of the control system and shall indicate alarm, supervisory and trouble conditions and the corresponding address.

B. High-rise building annunciation shall be as follows:
   1. Each initiating device shall transmit a signal separately to the FACU. This includes:
      a. Smoke detectors.
      b. Sprinkler waterflow devices.
      d. Other approved types of automatic fire detection devices or suppression systems.

2.17 Automatic Detectors - General

A. All automatic detectors shall be of the addressable, analog type.

B. Photoelectric smoke detectors shall be interchangeably mounted into a common twist-lock base.

C. The FACU shall recognize changes of detector type in each location and provide proper indication that reprogramming for the affected address is required.

D. Every automatic detector shall be so located as to be readily visible from the floor. Detector bases shall have an adhesive label, “P – Touch” or equal, attached to them indicating the address of the detector. Markers shall be installed on the base and lettering shall be a minimum of 12 point.

E. In general, automatic detectors shall be mounted on the structural ceiling or finished ceiling and not on the bottom or side of any type of construction or structure which extends down from the ceiling. The mounting location of every device shall be as shown on the drawings, and as approved by the owner.
F. Automatic detectors shall be located near points where air currents normally intersect. However, no detectors shall be located in the direct path of the draft from an HVAC air supply grille, a door, window, or hallway.

G. Automatic detectors shall be located out of the direct stream of air currents.

H. All automatic detectors shall be installed as indicated on the plans and in conformance with the current edition of NFPA 72, *National Fire Alarm and Signaling Code* and these Specifications. The mounting location of every device shall be approved by the Owner’s Designated Representative.

### 2.18 Addressable Photoelectric Smoke Detectors

A. Addressable, analog photoelectric smoke detectors shall be provided and installed where shown on the drawings.

B. Smoke Detectors shall comply with UL Standard 268, “Smoke Detectors for Fire Protective Signaling Systems”. They shall:
   1. Include a serial number and type identification on the factory nameplate.
   2. Operate at a nominal 24-volts DC.
   4. Plug into fixed base with twist lock feature – no special tools shall be required to remove a detector head from its base.
   5. Include communications equipment to achieve addressability.

C. Common area smoke detectors shall be spaced at thirty foot centers, or less based on the geometry of the space.

D. Smoke detectors shall only be installed in those environments suitable for proper smoke detector operation.

E. Photoelectric, analog smoke detectors shall have a general alarm setting in all common spaces of 3.7% per foot obscuration.

F. Photoelectric smoke detectors shall be addressable, analog and shall connect using a Class B wiring configuration to the FACU.

G. The detectors shall be ceiling- or sidewall-mount and shall include a twist-lock base.

H. 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 FACU. 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.

### 2.19 Addressable Spot-type Heat Detectors

A. Addressable heat detectors may be of the analog or digital type, provided each individual detector is assigned an address.

B. The detectors shall be ceiling- or sidewall-mount and shall include a twist-lock base.

C. Spot-type heat detectors shall have a general alarm setting of 135-degrees-F.

D. The detectors shall provide an alarm and power LED. The LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. 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.
2.20 Detector Bases

A. Automatic detectors shall use a common, plug-in, twist-lock, tamper-resistant type base which accommodates ionization, photoelectric and thermal detectors. Detectors shall be interchangeable to simplify field conversion.

B. 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.

C. 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 set point values corresponding to the inserted device, and shall monitor alarm and trouble conditions according to the default parameters.

D. 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.

E. Provide bases with integral audible devices for all residential living unit smoke detectors.

F. Provide decorative collars or trim rings, as required by the Owner, for all surface back boxes that contain the smoke detector base with the integral horn assembly. A physical mock-up of the decorative collar or trim ring shall be supplied to the Owner's Designated Representative and be approved in writing, prior to commencement of work.

2.21 Addressable Photoelectric Duct Smoke Detectors

A. Duct smoke detectors shall be photoelectric, addressable analog type, with sampling tube of design and dimensions as required for the specific duct size and installation conditions where applicable. Duct smoke detector housing shall have a supervised output for a remote form C relay (rated for 7A @ 120 VAC) as required for HVAC fan shutdown and/or smoke damper closure. This auxiliary relay output shall be fully programmable and mounted within 3 feet of the device being controlled.

B. Duct smoke detectors shall be rated for an air velocity range of 300 to 4000 ft/min.

C. Duct detector housing shall have a transparent cover to monitor for the presence of smoke, secured by four (4) screws.

D. Duct detector housing shall provide two (2) test ports for measuring airflow and for testing, allowing aerosol to be injected into the housing and duct detector for functional testing.

E. For maintenance purposes, access to the sampling tube through the duct front housing front cover shall be required to clean the duct housing sampling tubes.

F. Duct smoke detector shall have a Remote Test Station with an alarm LED and Test switch, as shown on the drawings. All concealed duct detectors shall have fire rated and lockable access doors/hatches provided by the electrical contractor and installed by others.

2.22 Addressable Manual Pull Stations

A. Manual pull stations shall be of the non-coded, dual action type, surface or semi-flush mounted, as selected by the owner, 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 the FACU.
D. Manual pull stations shall be mounted at a specific height of 44 to 48 inches measured to the activating handle, above the finished floor.

E. Each manual pull station shall have an adhesive label, “P – Touch” or equal, installed on its face which will indicate its associated address.

F. All surface mounted manual pull stations shall be installed in the SimplexGrinnell approved surface mount box.

2.23 Addressable Modules

A. Provide addressable modules to supervise and monitor the status of each non-addressable device, such as fire pump supervision contacts.

B. Each addressable module shall be able to support any number of normally open (N/O) devices. Wiring to the devices(s) being monitored shall be Class A supervised (NFPA-72 Style B). Zone status (normal, alarm, supervisory, trouble) shall be transmitted to the fire alarm and emergency communications system control panel.

C. When addressable modules are installed in the FACU room, they shall be mounted in a terminal cabinet located in the fire alarm and emergency communications system control room.

D. The addressable modules shall provide address-setting means.

E. An LED shall be provided which shall flash under normal conditions, indicating that the module is operational and in regular communication with the control panel.

2.24 Addressable Control Relay Output Modules

A. Provide addressable control relay output modules to permit hardwired control capability from the signaling line circuit. Relay contacts shall be DPDT, rated 2 amperes at 24 VDC.

B. Provide addressable control relay output modules for the following functions:
   1. Elevator recall
   2. Elevator power shunt trip
   3. Electronic door lock release operation
   4. Magnetic door hold-open release operation
   5. HVAC fan control
   6. Smoke damper control

C. Provide suppressors for inductive loads.

D. Relays shall be supervised for relay fault conditions at the FACU.

E. Each relay shall operate according to the control program resident in the FACU.

F. Relay output modules shall include a mounting plate for installation in a junction box.

G. The Relay Output Module shall provide address-setting means and shall also store an internal identifying code which the control panel shall use to identify the type of device.

H. 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 FACU.
2.25 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.

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 FACU.

E. After the wiring fault is repaired, the fault isolator modules shall test the lines and the system shall be manually reset.

2.26 Audible/Visual Notification Appliances

A. All strobe circuits shall be independent from the speaker circuits and the power load on each strobe circuit shall not exceed 75% of the individual circuit power available from the FACU.

B. Where provided, the synchronized, speaker/strobe units shall be listed with Underwriters Laboratories for use with fire alarm and emergency communications system and accepted by the University.

C. The speaker, whether integral with a combination speaker/strobe unit or a separate appliance, shall have a minimum output designation from UL of 85 peak dBA at 10 feet. All speaker circuits shall be independent from strobe circuits and the power load shall not exceed 75% of the individual circuit power available from the fire alarm and emergency communications system amplifiers.

D. Where buildings have automatic sprinklers, a separate horn circuit shall be installed to operate one exterior, weatherproof horn located where shown on the drawings. This horn shall be programmed to operate only on sprinkler waterflow.

E. As applicable, each elevator car in a high rise building shall be equipped with a speaker connected to a separate paging zone.

F. All strobes shall conform to both the current editions of the Americans with Disabilities Accessibility Guidelines (ADAAG) and NFPA 72, National Fire Alarm and Signaling Code requirements and listed to UL 1971.

G. All appliances shall be rated at 24 VDC.

H. All speaker circuits shall be rated at 70 VRMS.

I. Speaker circuits and control equipment shall be arranged and installed so that loss of any one speaker circuit will not cause the loss of any other speaker circuit in the system.

J. All speakers shall operate on 70VRMS with field selectable output taps available from 0.25 watts to 2.0 watts, with a minimum frequency response of 400 Hz to 4000 Hz.

K. The audibility levels required by the current edition of NFPA 72, National Fire Alarm and Signaling Code.

L. Voice message intelligibility shall be provided as indicated on the design drawings in acoustically distinguishable spaces (ADS), or in ADS’s as determined by the Owner’s Designated Representative. SimplexGrinnell shall be required to test the intelligibility levels in all ADS’s.

M. All strobes serving an evacuation zone (floor, stairway, corridor, etc.) shall be synchronized to flash at the same rate throughout the evacuation zone.

N. The residential unit mini-horn, whether integral with a combination mini-horn/strobe unit or a separate appliance, shall have a minimum output designation from UL of 85 peak dBA at 10 feet or 15dBA above the average ambient sound level, whichever is louder. All horn circuits shall be...
independent from strobe circuits and the power load shall not exceed 75% of the individual circuit power available from the FACU.

O. All horns, mini-horns and smoke detector audible bases shall sound in a temporal code-3 pattern.

P. All horns serving an evacuation zone (floor, stairway, corridor, etc.) shall be synchronized to sound the temporal code 3 pattern uniformly throughout the evacuation zone.

2.27 Transmission of Signals

A. Public Safety shall be automatically notified of a fire alarm, waterflow alarm, fire alarm system trouble or fire alarm system supervisory condition via connection as follows:

1. For the existing Digitize system, from the RS232C communication port of the FACU to the existing Princeton University alarm monitoring system. SimplexGrinnell shall submit the output protocol to the University as part of the installation package.

2. From the SimplexGrinnell 4100 FACU to the 4120 network of the TSW system

PART 3 EXECUTION

3.01 Examination

A. The electrical contractor shall:

Coordinate examinations with the Owner’s Designated Representative.

I. Examine and verify actual location of equipment, initiating devices, notification appliances, monitor modules, output modules, fault isolation modules, remote power supplies and other components.

II. Examine and verify actual locations of vertical and horizontal raceway including existing raceway that may be reused.

III. Promptly report conflicts with proposed solutions.

3.02 General Equipment Installation

A. The electrical contractor’s installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance with the current edition of NFPA 72, National Fire Alarm and Signaling Code.

B. The electrical contractor shall provide and install all required equipment and accessories necessary for the proper operation of the system.

C. All electrical contractors work shall be performed in accordance with the best and the most modern practices of the trade. The final installation shall present a neat appearance.

D. The electrical contractor shall install the entire system in a workmanlike manner, in accordance with their standard instructions, and in accordance with their approved wiring diagrams unless otherwise specifically permitted by the Owner’s Designated Representative, or as modified by this specification.

E. The system shall be installed under the supervision of a qualified, trained NICET (minimum Level II) Certified SimplexGrinnell representative. The system shall be demonstrated to perform all of the functions as specified.

F. SimplexGrinnell supervisory work shall include, but not necessarily be limited to, checking all the system wiring connections; advising The electrical contractor installation team members 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 sys-
tem.

SimplexGrinnell’s representative shall be on site, as required by the Owner, during the en-
tire installation and reconnection of the new control center equipment. The technical repre-
sentative shall monitor all wiring changes and assist the electrical contractor installation
team members to ensure a smooth transition to the new control center equipment.

SimplexGrinnell’s 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.

3.03 Wiring Installation

A. The wiring and raceway system for the fire alarm and emergency communications system
shall be in accordance with the current edition of NFPA 70, National Electrical Code. De-
vice 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 and emergency communications
system. Wiring shall be of the type as specified herein and recommended by the
manufacturer and shall be installed in metal raceway throughout.

C. All fire alarm Junction Boxes (JB) covers shall be painted red or marked “Fire Alarm” to dis-
tinguish the JB as connected to a fire alarm raceway.

D. Fire alarm and emergency communications system wiring within the building shall be in-
stalled in metal raceway with steel couplings and box connectors in accordance with NFPA
70 (NEC).

E. All fire alarm and emergency communications system riser conduits shall be minimum 3/4-
inch in diameter.

F. All wiring shall be installed continuous from device to device.

G. Raceways containing conductors identified as "fire alarm and emergency communications
system" conductors shall not contain other conductors, and no AC carrying conductors
shall be allowed in the same raceway with the DC fire alarm and emergency communications
system detection and signaling conductors, unless so allowed by the Owner’s Design-
nated Representative.

H. 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 notifi-
cation appliance circuit in the system.

I. Exposed raceways shall be run parallel and perpendicular to the walls and ceilings. Whe-
never practical, exposed raceways shall be run on the ceiling as close as possible to a wall
or as high as possible on a wall. 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. No spanning from beam to beam or
rib to rib shall be permitted. The use of a raceway body on one side of a beam or rib shall
be permitted provided it shall be readily accessible. Where concealed, provide access pa-
nels for all junction boxes, pull boxes and conduit bodies per NFPA 70 (NEC).

J. Fault isolator modules shall be furnished as required and shall be mounted as directed by
this specification. 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.
3.04 Cleaning and Protection

A. The electrical contractor shall not install smoke detectors prior to substantial completion by other trades that may be working in the space into which the fire alarm and emergency communications system is being installed.

B. The electrical contractor shall remove paint splatters and other spots, dirt, and debris, and touch up scratches and marred finish to match original finish. Clean unit(s) internally using methods and materials recommended by SimplexGrinnell published information.

3.05 Equipment Removal

A. The electrical contractor shall completely remove the existing fire detection and alarm system control equipment, components and equipment that are not specified as being part of the new system. The equipment removed shall be boxed, labeled and delivered to the University Site Protection Shop Supervisor. All unused, existing fire alarm and emergency communications system wire and cable shall be removed and disposed of properly off-site by the electrical contractor.

B. The electrical contractor shall perform all removal work efforts in accordance with the best and most modern practices.

C. All cutting, coring, and approved and listed fire stopping needed as a result of this work shall be the responsibility of the electrical contractor and shall be coordinated with the Owner’s Designated Representative.

3.06 As-Built Drawings

A. During the course of the project, the Owner’s Designated Representative will provide the electrical contractor with an updated AutoCAD disk containing the floor plans.

B. The electrical contractor shall hire SimplexGrinnell to develop and produce a complete set of as-built drawings.

C. During the fire alarm and emergency communications system installation, the draft as-built drawing(s) shall be updated every 24 hours. The on-site as-built drawings shall be available for inspection and review on request by the design engineer and the Owner’s Designated Representative.

D. The as-built drawings shall be reviewed and under the direct oversight of the design Engineer of Record (EOR). The design engineer shall confirm all changes made to the original design, if any, and if required by the AHJ, submit a signed and sealed set of as-built drawings to the Owner’s Designated Representative.

E. A copy of the original draft as-built drawings shall be submitted to the Engineer of Record prior to the Demonstration Test. The EOR shall review and verify the original draft as-builds during the Demonstration Test with the electrical contractor. The electrical contractor shall make all corrections to the original draft as-builds during the Demonstration Test.

F. The Engineer of Record shall ensure the original draft as-builds are correct and transmit them with the EOR signed letter of approval to the Owner’s Designated Representative.

G. The Owner’s Designated Representative shall transmit the EOR approved as-built drawings to SimplexGrinnell.

H. SimplexGrinnell shall develop the as-builds on the disk provided by the Owner’s Designated Representative.

I. SimplexGrinnell will be required to show the following on these floor plans for as-built drawings:

   I. The exact locations and installation details of the installed equipment and address of each addressed device.
II. The exact location of all existing initiating devices and notification appliances.

III. The address of each addressed device.

IV. The installed wiring and color coding and wire tag notations for the exact locations of all installed equipment.

V. Locations of each End-of-Line Resistor, End-Of-Line Device and fault circuit isolator.

VI. Specific point-to-point interconnections between all equipment and internal wiring of the equipment. Typical point-to-point wiring diagrams are not acceptable. The location of all “T-tap connections,” if specifically allowed by the Owner’s Designated Representative, shall be shown on the as-built drawings.

VII. Locations of all conduits and junction boxes.

VIII. Updated sequence of operation matrix and battery and voltage drop calculations.

J. SimplexGrinnell shall produce the AutoCAD drawings within 30 days of receipt from the Owner’s Designated Representative and at that time deliver one electronic copy and one paper copy of the final color as-built drawings to the Owner’s Designated Representative.

K. Upon delivery of the final As-Built drawings, SimplexGrinnell shall also provide one laminated copy of the as-built drawings hung in the vicinity of the fire alarm control unit. The drawings shall include floor plans with device and appliance locations, wiring and JB locations and the sequence of operation matrix.

3.07 Training Requirements

A. Public Safety Response Teams - Prior to final acceptance of the fire alarm and emergency communications system, SimplexGrinnell shall provide operation training to each shift of Public Safety Response personnel, as directed by the Owner’s Designated Representative. Each training session shall be a minimum of 1 hour and shall be conducted on shift or at a time acceptable to the Owner’s Designated Representative. 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. Each session shall include a complete demonstration of the system. Dates and times of each training period shall be coordinated through the Owner’s Designated Representative, not less than one week prior to the training session.

B. Site Protection Shop Technicians - SimplexGrinnell shall arrange for manufacturer training representatives to provide the necessary training for operation, and troubleshooting of the installed equipment to the University Site Protection Shop personnel.

3.08 Warranty

A. The electrical contractor shall guarantee all new equipment installed and new wiring free 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 and acceptance by the Owner.

B. SimplexGrinnell shall guarantee all new system equipment for a period of two (2) years from the date of substantial completion of the project and acceptance by the Owner.

C. The electrical contractor shall guarantee all new raceways, new wiring and connections to existing wiring to be free from inherent mechanical or electrical defects for one (1) year from date of substantial completion of the project and acceptance by the Owner.

D. The warranty period will begin on the date of beneficial occupancy of the project and written acceptance by the Owner.
E. For the purposes of this specification, beneficial occupancy shall mean that stage of construction of a building or facility, before final completion, at which Princeton can occupy it for the purpose it was constructed.

3.09 Operation and Maintenance Manuals

A. The electrical contractor shall provide two (2) complete indexed bound sets of the Operating and Maintenance (O&M) manuals, as outlined in the current edition of NFPA 72, National Fire Alarm and Signaling Code, within 30 days after the Acceptance Test of the system. One set shall be distributed to the Owner’s Designated Representative and one set shall be placed at the FACU. One electronic set shall be posted to the Centric Project.

B. These O&M manuals shall include the following:

C. The final equipment list identifying the quantities and types of equipment listed by manufacturer’s part number.

D. The input/output sequence of operation matrix, as listed previously in this specification.

E. An equipment datasheet (or specification sheet) on every piece of fire alarm and emergency communications system equipment installed.

F. Operator instructions for basic system operations, including alarm acknowledgement, system reset, interpretation of system output, operation of manual evacuation signaling and ancillary function controls.

G. Battery standby power calculations that coincide with the equipment that has been installed in the building.

H. A point ID list referencing the signaling line circuit loops and the devices on those loops.

I. A sensitivity report for all smoke detectors at the time of beneficial occupancy.

J. A service directory, including a list of names and contact numbers of the SimplexGrinnell personnel who provide both routine and emergency service for the system.

3.10 Electrical contractor Pre-Test

A. A pre-test of the entire system shall be conducted by the electrical contractor and Simplex-Grinnell. Any deficiencies found shall be corrected prior to the Demonstration Test.

3.11 Demonstration Test

A. The electrical contractor shall be responsible for coordinating and conducting the Demonstration Test in the presence of the engineer of record and a Princeton University representative.

B. Upon completion of the installation of the fire alarm and emergency communications system, the electrical contractor shall provide a minimum of one week’s notice to the Owner’s Designated Representative that the fire alarm and emergency communications system has been satisfactorily tested by The electrical contractor and is ready for the Demonstration Test with authority having jurisdiction in order to close the permit.

C. The Demonstration Test shall be conducted during a time acceptable to the Owner’s Designated Representative.

D. The electrical contractor shall provide a completed and signed copy of the NFPA 72 Record of Completion Form after the Demonstration Test has been completed.

E. At a minimum, The electrical contractor shall perform the following:

1. Operate every building fire alarm and emergency communications system device to ensure:
a. proper operation  
b. correct annunciation at each remote annunciator (if required and shown on the drawings)  
c. correct annunciation at the FACU  
d. proper operation of auxiliary functions  
e. where applying heat would destroy any detector, they may be manually operated.  

F. Circuits shall be opened to check for the presence of correct supervisory circuitry.

G. One-half of all tests shall be performed on battery standby power.

H. Verify all signals are transmitted and received at the Public Safety Monitoring System.

I. If unsatisfactory results occur during the Demonstration Test, The electrical contractor shall be responsible for any and all additional charges incurred by the Owner with respect to corrective action, including but not limited to test monitoring and engineering services during the time it takes to obtain Final Acceptance by the Owner.

J. Final Acceptance by the owner means that the fire alarm and emergency communications system is:
   1. completely operational and in conformance with this specification
   2. in conformance with applicable codes and standards
   3. all documentation has been submitted as required by these specifications
   4. all training as required by these specifications has been completed to the satisfaction of the Owner's Designated Representative.

K. When the testing has been completed to the satisfaction of the electrical contractor’s job foremen and the engineer of record, and if required by the AHJ, the engineer shall submit a signed and sealed letter attesting to the results of the Demonstration Test.

3.12 Final Acceptance Test

A. Before the installation shall be considered completed and acceptable by the Owner and the Owner’s Designated Representative, the Final Acceptance Test shall be performed. This test shall be coordinated and performed by the electrical contractor’s job foreman, the Owner’s Designated Representative, and the appropriate Authorities Having Jurisdiction. In order to assure attendance of the necessary representatives, prior to the final test, each representative scheduled to witness the test, must be provided reasonable notification of the test date by the electrical contractor (at least forty-eight (48) hours). The test will not be conducted until all parties agree on the scheduled test date.

B. The electrical contractor shall provide all the necessary personnel and equipment to conduct the tests.

C. At a minimum, The electrical contractor shall perform the following:

D. Operate every building fire alarm and emergency communications system device to ensure:
   1. proper operation
   2. correct annunciation at each remote annunciator (if required and shown on the drawings)
   3. correct annunciation at the FACU
4. proper operation of auxiliary functions
5. where applying heat would destroy any detector, they may be manually operated.

E. Circuits shall be opened to check for the presence of correct supervisory circuitry.
F. One-half of all tests shall be performed on battery standby power.
G. Verify all signals are transmitted and received at the Public Safety Monitoring System
H. Upon satisfactory completion of the tests, the electrical contractor shall leave the fire alarm and emergency communications system in proper working order and without additional expense to the Owner, shall replace any defective materials or equipment provided by the electrical contractor under this Contract within one year from the date of final acceptance by the awarding authority.

END OF SECTION