

4-23-2015

283110 - Fire Alarm Systems

Sandra Hickey
sandra.hickey@unh.edu

Follow this and additional works at: https://scholars.unh.edu/pdch_5_28

Recommended Citation

Hickey, Sandra, "283110 - Fire Alarm Systems" (2015). *Division 28 – Electronic Safety and Security*. 3.
https://scholars.unh.edu/pdch_5_28/3

This Article is brought to you for free and open access by the Chapter 5 – Technical Construction and Renovation Standards at University of New Hampshire Scholars' Repository. It has been accepted for inclusion in Division 28 – Electronic Safety and Security by an authorized administrator of University of New Hampshire Scholars' Repository. For more information, please contact nicole.hentz@unh.edu.

SECTION 28 3110 - FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. The general provisions of the contract including General and Special Conditions and General Requirements shall apply to all work under this Section.
- B. Building Services Identification Labeling – The University has adopted a comprehensive label identification for the distribution systems for all plumbing, fire protection, air, mechanical piping, electrical, fire alarm, controls, telecommunications, audio/visual, and security. The specific label colors, text, and directional flows for each component part are described in a single comprehensive table that is Chapter 5, Appendix A, Building Services Identification labeling. This labeling system must be part of any construction project, even those that are limited to a portion of a building or a single utility system.
- C. See Chapter 5, Division 01, Section 017700.1.1.B.1.i Closeout Procedures - Project Record Documents for equipment list requirements for all equipment provided in this section.

1.2 DEFINITIONS

- A. Owner - The University of New Hampshire.
- B. Authority Having Jurisdiction (AHJ) - For buildings and facilities owned by the University, the AHJ is the Office of the State Fire Marshal (SFMO). Authority is typically delegated to the Durham Fire Department (DFD) for progress inspections and witnessing of system tests.
- C. Contractor - In the context of this specification section, the contractor is a generic term referring to those responsible for the work including, but not limited to, the general contractor, electrical contractor, fire alarm installer, etc.
- D. Fire Alarm Installer - Firm licensed, and firm's personnel trained, by the fire alarm system manufacturer to sell and install their systems. At a minimum, the Fire Alarm Installer shall:
 - 1. Provide all fire alarm equipment and devices.
 - 2. Perform all programming and troubleshooting of the fire alarm system.
 - 3. Perform all testing of the fire alarm system and components. Prepare and submit associated NFPA Testing & Inspections and Project Completion reports.
 - 4. Provide first response to trouble signals during warranty period.

1.3 DESCRIPTION OF WORK

- A. The work includes providing all labor, materials, equipment, accessories, services and tests necessary to complete and make ready for operation by the Owner a fire alarm system. Perform an acceptance test and make adjustments as required by the authorities having jurisdiction.
- B. Provide as shown on drawings a complete fire alarm system, consisting of the following:
 - 1. A fire alarm control panel with microprocessor based electronics, power supplies, amplifiers and batteries.
 - 2. Automatic and manual initiating devices.
 - 3. Audible and visual notification appliances.
 - 4. Control outputs to ventilation systems.
 - 5. Raceways, wiring and accessories as shown on the drawings and as required for a complete and operable system.
 - 6. A voice evacuation system to function as an integrated fire detection and alarm signaling system.
- C. Provide the following additional work where shown on the drawings:
 - 1. Status monitoring of fire suppression systems.
 - 2. Emergency voice/alarm communications
 - 3. Smoke and heat detectors that initiate an elevator recall.
- D. The following work is not included unless shown otherwise:
 - 1. Fire suppression, except that wiring in switches is included and emergency generator systems.
- E. The Contractor shall prepare all required drawings, wiring and riser diagrams, and make necessary submissions and obtain all approvals as required by The New Hampshire Fire Marshal's Office (SFMO), and the Durham Fire Department (DFD).
- F. All work shall be performed by qualified personnel, with all necessary licenses as required by the local agency having jurisdiction.
- G. All equipment, components and assemblies shall be listed by Underwriters Laboratories, Factory Mutual or other recognized third party listing agency.
- H. The exact location of all equipment shall be coordinated with existing equipment, HVAC ducts, etc.
- I. Under no circumstances shall the input power to the control panel (120 VAC) or auxiliary 24 VDC power from the power supply of the panel be utilized for auxiliary external control functions (e.g. Fusible links, damper, etc.).
- J. All initiating and indicating circuits are polarized and supervised. Polarity must be observed and no parallel-branching (tee-tapping) will be permitted.

1.4 RELATED WORK IN OTHER SECTIONS

- A. University Construction Standards; including but not limited to Chapter 5, Division 26.

1.5 STANDARDS

- A. The system shall conform to the following latest National Fire Protection Standards, and shall be installed as per all local and state building and life safety codes.
- B. The “Durham Fire Department Specifications for the Installation and Maintenance of Fire Protection Systems Fire Hydrants and Fire Lanes” date January 2001, apply to and is an integral part of all work covered under this specification. The Durham Fire Department Specification must be satisfied. Any question must be addressed to the design professional for clarification.
- C. Accessory components as required shall be catalogued by the manufacturer and UL listed to operate with the manufacturer’s control panel.
- D. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions, recommendations and requirements of the following:
 - 1. Durham Fire Department Specifications for the Installation and Maintenance of Fire Protection Systems, Fire Hydrants and Fire Lanes.
 - 2. New Hampshire State Fire Code.
 - 3. New Hampshire State Building Code.
 - 4. American National Standard Institute.
 - 5. National Electrical Manufacturers Association.
 - 6. Underwriters Laboratories.
 - 7. NFPA 1 Fire Prevention Code.
 - 8. NFPA 13 Automatic Sprinkler Systems.
 - 9. NFPA 70 National Electrical Code.
 - 10. NFPA 71 Central Station Signaling Systems.
 - 11. NFPA 72 National Fire Alarm Code.
 - 12. NFPA 90A Installation of Air Conditioning and Ventilating systems.
 - 13. NFPA 101 Life Safety Code.
 - 14. 36 CFR Part 1191 Americans with Disabilities Act.

1.6 SUBMITTALS

- A. All submittals shall be electronic. No paper submittals shall be accepted. Reviewing party shall provide electronic review of submittals.
- B. All submittals shall include a cover letter/transmittal sheet noting the date of submittal, information contained in submittal and any deviations drawings or specifications.
- C. Minimum submittal requirements:

1. Plans for proposed fire detection and alarm systems shall be submitted to University and design professional least 15 days prior to any work being performed. The submittal shall include:
 - a. Detailed floor plan to scale showing:
 - (1) Code Summary to include code editions used and relevant exceptions cited.
 - (2) Connected and non-connected detection devices.
 - (3) Evacuation signals, including visual and audible ratings with riser diagram showing wattage tap and candela rating.
 - (4) Main control panel location.
 - (5) Remote annunciator location.
 - (6) Location of outside A/V signal(s) with riser diagram showing wattage tap and candela rating.
 - (7) The proposed Use of the building.
 - (8) Anticipated ambient noise levels.
 - (9) Type of construction.
 - (10) Unique or unusual features (ceiling pockets, sloped or multi- leveled ceilings, atria etc.).
 - (11) Location of HVAC units and associated air flow volumes.
 - (12) Location of the key box(es).
 - (13) 100 % completion date.
 - b. A riser diagram of the complete fire alarm system including water flow, tamper, and any connections to other fire protection systems. Riser diagram shall include wattage taps and candela ratings for all notification devices.
 - c. Associated battery calculations showing the adequacy of the batteries with respect to system powering. System shall include a 20% factor of safety.
 - d. An annunciator detail drawing showing proposed labeling. Devices are not to be solely numbered, but are to be labeled on plan in English depicting location (i.e. Second floor west wing).
2. Detailed component and equipment list with model and Manufacturer's part numbers, and product sheets for each item of equipment.
3. A set of plans indicating University approval shall be available at the job site until after completion of the required acceptance test.
4. Any changes from the originally proposed or approved plans that should occur during construction will be documented by a written revision and be approved by the NHSFMO.
5. Additions or modifications of existing systems shall require a new approval.
6. Plans showing actual "As Built" shall be submitted after completion and acceptance of the system. These plans shall become the record of the University.
7. The University shall review and approve or disapprove all submittals within thirty days of date of submittal.
8. Submit the following to the University prior to ordering equipment:
 - a. Wiring diagrams showing connections between all system components.
 - b. Description of system operation.

- c. Annunciator schedule showing titles for each fire alarm and supervisory zone and/or device.
- d. Manufacturer's installation instructions, operations and maintenance instructions.
- e. A complete layout of the entire system including conduit routing, conduit sizes, wire sizes and types.
- f. Confirmation of the University color code schedule for wiring.
- g. Battery sizing calculations indicating circuit loading and power supply loading. Voltage drop calculations shall be submitted for all notification appliance circuits exceeding 1.5 Amps or 300 feet in length.
- h. Submittals shall be as a complete set. Partial submittal will not be acceptable.
- i. Drawings shall not be on less than 22 x 34 inch sheets and shall identify all symbols used.
- j. Submittals shall comprise:
 - (1) Detailed component and equipment lists with model numbers.
 - (2) Manufacturer's specification sheets for each item of equipment.
 - (3) Description of how specified system functions.
 - (4) Confirmation that manufacturer's representative will provide jobsite supervision during installation, perform final testing, and instruct operating personnel on system operation.
 - (5) Standby battery calculations showing all system components and the adequacy of their capacity with respect to system powering. Calculations shall be provided with the plan submittal. Component (including amplifiers) power requirements and formulas used to compute 60-hour required standby power plus 15 minutes of alarm at the end of this period. Notification appliance circuit load calculations shall be by speaker and strobe circuits. Indicate formula and basis used for worst possible case.
 - (6) Detailed wiring diagrams of specified system and all interconnection wiring. Wiring diagrams shall include total risers, terminal-to-terminal, exact color-coding, location, and function of each device. Drawing indicating one-line diagrams or typical wiring diagrams will not be accepted.
 - (7) Manufacturer's original catalog data and descriptive information shall be supplied for all major components of the equipment to be supplied. Supplier's qualifications shall indicate years in business, service policies, warranty definitions, and a list of similar installations.
 - (8) Contractor's qualifications shall indicate years in business and prior experience with installations that include the type of equipment that is to be supplied. All pertinent information shall be furnished regarding the reliability and operation of the equipment to be supplied. Delivery dates of the equipment to be supplied shall be furnished.
 - (9) Sufficient information shall be furnished so that the exact function of each installed device is known.
- k. Submittals shall include proposed annunciating language of each device for review and approval by UNH and Durham Fire Department (DFD). An

editable electronic copy shall also be provided upon request for University modifications.

- I. Submittal of shop drawings shall contain at least one (1) set of original manufacturer's specification and installation instruction sheets. Subsequent sets may be copied. All equipment and devices on the shop drawings to be furnished under this contract shall be clearly marked in the specification sheets.
 - m. Supply documentation from the manufacturer that University personnel, to be identified by Project Manager will be allowed to attend a factory certification school on servicing and programming the system prior to its acceptance. Documentation shall also indicate whether the system programming software is included in the installed price. One (1) University representative shall become factory certified.
 - n. Available pre-recorded messages shall be submitted to University and DFD for selection/approval.
- D. Submit prior to final acceptance testing.
1. Contractor shall submit, upon completion of system verification, an NFPA Testing and Inspections form providing a point-by-point check list indicating the date and time of each item inspected and a Record of Completion confirming that the inspection has been completed and the system is installed and functioning in accordance with the specifications.

1.7 PERMITS

- A. The installing contractor must secure a permit from the Durham Fire Department before working on the fire alarm or suppression systems. This permit indicates the plans for such system have been reviewed and approved by the fire department.
- B. Anyone performing maintenance or testing on any fire protection system must secure a permit from the fire department before starting any work on the system. Any additions or modifications to an existing system will require a new permit.
- C. This permit is in addition to any required mechanical, plumbing, or electrical permit required by the Town of Durham or State of New Hampshire.
- D. Prior to conducting any work that has any chance of transmitting a trouble of fire alarm signal, the Durham-UNH Communications Center shall be notified (862-1392). Only those persons listed on the permit, and who can provide the proper permit number, shall operate system controls.
- E. Permit numbers are to be kept confidential and not broadcasted via 2-way radio.
- F. During periods of system shut down, the permit holder is responsible for occupant and fire department notification, should an emergency arise. Unexplained system activations are to be investigated.
- G. Systems shall not be shut down overnight. The fire department should be notified anytime that a fire protection system is left out of service.

- H. The permit holder is responsible for restoring the system prior to leaving the building. The permit holder shall verify with the dispatch center the alarm condition, and explain if the system is left in trouble.
- I. The permit holders are responsible for system security. Control panels or other equipment are not to be left unlocked, nor are keys or codes to be left in the panel or control box.

1.8 RECORD DOCUMENTS, OPERATIONS AND MAINTENANCE MANUALS

- A. Complete record documents before scheduling acceptance test. Record documents shall include all information required by the above SUBMITTALS section.

1.9 GUARANTEE

- A. The contractor shall warranty all equipment and wiring free from inherent mechanical and electrical defects for one year (365 days) from the date of final acceptance. The contractor shall provide a phone number answered 24 hours per day, 7 days per week, and also a phone number for a replacement part source answered 24 hours per day, 7 days per week. During the warranty period, the installing contractor shall provide first response to trouble signals that report into UNH Dispatch, and determine cause and take corrective action that does not void the warranty, or necessitate the University maintenance service contractor to assume responsibility for malfunctioning systems.

1.10 PHASE SEQUENCING

- A. The Contractor shall perform construction in phases sequenced as described below. The Contractor shall provide dates for completion of each work phase.
 - 1. Phase 1:
 - a. Verify fire alarm system devices.
 - b. Submit shop drawings for approval.
 - c. Order all components.
 - d. Commence installation of raceways and wiring.
 - 2. Phase 2:
 - a. Install the new fire alarm system without any modification to the existing system. All work concerning the active portions of the fire alarm system shall be coordinated with the Owner to prevent false alarms and avoid unnecessary loss of protection.
 - b. Post a temporary plastic laminated sign ("Out of Service" – final wording to be approved by Owner) on any new or existing pull station during such times that it is installed but not in service. These signs shall be provided and maintained by the Contractor.
 - c. Perform acceptance testing.
 - 3. Phase 3:

- a. Transfer operation from the existing fire alarm system to the new fire alarm system, to be coordinated with Owner and the Durham Fire Department. The existing fire alarm system shall remain in operation until installation and testing of the new fire alarm system are complete.
 - b. Ensure continuous alarm protection.
 - c. If interruption of the existing fire alarm system is required, the Contractor must first obtain written permission from the Owner not less than 5 business days prior to such interruptions. The Owner shall coordinate with the Durham Fire Department and with maintenance subcontract personnel.
 - d. When requesting permission to interrupt service, the Contractor shall specifically state the work to be performed, together with the exact time and length of service interruption. Separate permission shall be requested for each interruption.
4. Phase 4:
- a. Disconnect and remove the existing fire alarm control panel, peripheral devices, and all associated wiring and raceways without disrupting the operation of the new fire alarm system.
 - b. Electrically disconnect equipment and all associated wiring and raceways to be removed at the point of power source.
 - c. Where building systems or circuits are interrupted because of the demolition work, they shall be rerouted or relocated, modified and reconnected to provide a continuous system.
 - d. Where abandoned conduits are embedded in the structure, cap existing empty conduits, provide blank cover plates and plug open knockouts in existing electrical equipment.
 - e. Include as part of the scope of work all cutting, patching, finishing, etc., for removed and relocated electrical equipment. All holes and damage caused by the demolition work shall be properly patched with suitable materials to match existing surfaces.
 - f. All materials, equipment and debris resulting from demolition shall become the property of the Contractor and shall be removed from the site and disposed of properly by the Contractor.
- B. The Contractor may submit alternate approaches and phasing. Alternate deduct(s) to reuse existing conduit or wiring, while minimizing the time frame of potential nuisance alarms, may be considered by the Owner if the risks are manageable.
1. The Contractor shall specify work periods for work concerning the active portions of the fire alarm system, during which nuisance alarms may occur.
 2. The fire alarm system or portions thereof may not be inoperable for extended periods of time.
 3. If interruption of the existing fire alarm system is required, the Contractor must first obtain written permission from the Owner not less than 5 business days prior to such interruptions. The Owner shall coordinate with the local authority having jurisdiction and with maintenance subcontract personnel.
 4. In all cases where existing branch circuit conduit and wiring is to be re-used within the remodeled area, the Contractor shall test for grounding continuity and shall test the existing branch circuit wiring as though new, in accordance with the testing procedures outlined elsewhere in these Specifications.

2.1 BASE BID MANUFACTURERS

- A. Equipment shall be Notifier, with the exception of manual pull stations and combination smoke / CO alarms. No substitutions will be considered (ref. UNH Purchasing & Contract Services SAMS#5787-0001). All devices shall be compatible with Notifier fire alarm panels.

2.2 SYSTEM DESCRIPTION

- A. Furnish and install a completely functional addressable Digital voice evacuation fire alarm system with all initiating and indicating appliances, modules and circuitry. The system shall consist of, but not be limited to, the following:
 - 1. Voice evacuation shall utilize new speakers or speaker/strobes to provide a slow-whoop tone signal followed by a pre-recorded general alarm message per local requirements, followed by the same slow-whoop tone. Subsequent zone alarm(s) shall cause resounding of the slow whoop signal.
 - 2. ADA compliant strobe visual devices to flash at 120 flashes/minute, synchronized.
 - 3. Addressable dual action pull stations, smoke detectors and heat detectors.
 - 4. Duct detectors with addressable adapter modules. Duct smoke detectors shall send the fire alarm system into alarm, and shut down the associated equipment.
 - 5. Tamper switches, flow switches and pressure switches with addressable modules.
 - 6. Remote Test and Indicating Stations:
 - a. Alarm initiating devices located in concealed areas shall have remote indicating stations in locations approved by the AHJ (authority having jurisdiction).
 - b. Duct smoke detector(s) shall have remote indication and testing station(s) in location(s) approved by the Durham Fire Department.

2.3 SYSTEM OPERATION

- A. Multiprocessor-Based:
 - 1. The system shall be of multiprocessor design to allow each I/O functional module to hold and execute its own microprocessor and software program under the control of the main system microprocessor. A common RS-485 style communications network shall tie all I/O functional modules in an integrated Internet work affording true "Distributed Processing" of all system operations. Each network-interconnected module shall have its own processor and memory.
- B. Degrade Mode:

1. The system shall have two modes of degrade operation to assure reliable system operation under the most adverse conditions. This extra degree of survivability is accomplished as follows:
 - a. In the event of a failure of the main system microprocessor, each subordinate processor shall be capable of operating a general alarm program.
 - b. In the event of multiple failures, the system shall automatically revert to ADAC (Auxiliary Degrade Alarm Mode), which will operate the system in a general alarm configuration. Activation of any conventional, non-addressable initiating device will automatically operate all notification devices in a non-coded pattern and shall activate the city connection to notify the Fire Department.

C. Field Programmable:

1. The system shall be field programmable in two modes:
 - a. Front panel programmed through the use of the on-board 2-digit display, and the use of the programming switches on the System Control Unit, and the individual input and output circuits including zones, notification appliance circuits, and relays. While in the programming mode, the control panel shall provide fire alarms override to assure that no alarms will be missed or lost. Systems that must come "off-line" to be programmed will not be accepted. Programming shall be password protected and shall not require the use of an additional programming appliance or tool.
 - b. Computer programmed through the use of an FCP (Field Configuration Program) dedicated software package. The system configuration shall be saved to CD, and stored in the control panel for easy access and field program modification, without the addition of programming hardware. While in the programming mode, the control panel shall provide fire alarms override to assure that no alarms will be missed or lost. Systems that must come "off-line" to be programmed will not be accepted. A "hard" copy of the final system configuration showing all inputs, outputs, descriptions, addresses, programming matrixes, etc., and a copy of the software for programming the panel shall be furnished at no extra cost.

D. Comparison Of Updated Programming:

1. The field programming configuration program shall contain as an integral part, a UL recognized program that shall create an audit trail of changes made to the system configuration in the form of ASCII files, which can be reviewed, printed and/or archived, using commonly available text and file utilities. This program shall actually compare the updated file that is about to be downloaded with the system configuration that is actually in the control panel. Programs that simply compare old and new files resident in a computer shall not be acceptable.
2. Upon completion of the system configuration comparison and download, a file shall be created in the sub-directory containing the field configuration software. This file shall contain detailed information on the system configuration changes being made to the configuration currently residing in the control unit, and shall include identification of the following changes such as:
 - a. System Data:

- (1) System battery type.
- (2) Notification Appliance circuit output coding pattern.
- (3) Notification Appliance circuit silence inhibit time.
- (4) Walk test timeout.
- (5) System ID description label.
- (6) Keyboard Display Unit access codes.
- (7) Number of signaling line circuits (addressable loops) in the system.
- (8) System class.
- (9) Service reminder dates.
- (10) Day operation start/end times.
- (11) Weekend definitions.

b. Inputs:

- (1) Addition or deletion of both sensor and monitor points.
- (2) Point type.
- (3) Location.
- (4) Verification.
- (5) Status (ON-OFF).
- (6) Logic set (mapping).
- (7) Analog sensor sensitivity.

c. Outputs:

- (1) Addition or deletion of both output and control points.
- (2) Notification appliance circuits.
- (3) Municipal circuits (polarity reversal).
- (4) Analog Output Modules.

E. Control-By-Event (CBE) Program:

1. Operation of a manual station or automatic activation of any smoke detector, heat detector, or water flow zone shall activate the system control-by-event program to cause:
 - a. All notification appliances to sound in a temporal pattern and lamps to flash.
 - b. Shut down all air-handling units as shown on plans.
 - c. The "SYSTEM ALARM" red LED shall also flash and the panel audible sounder shall pulse rapidly.
 - d. Indicate on the Keyboard Display Unit (KDU) the description of the specific digital addressable device in alarm via an 80-character alphanumeric display. The "SYSTEM ALARM" LED shall also flash and the SCU audible sounder shall pulse. The displays shall be of the liquid crystal type (LCD), clearly visible in poor light conditions.
 - e. Close all magnetically held doors automatically.
 - f. Perform any additional function, as specified herein or as shown on the plans.
 - g. Notify the UNH Dispatch.

F. General System Operation:

1. When an alarm occurs on a zone, the control panel indicates the alarm condition until manually reset.

2. An alarm may be acknowledged by pressing the "ACKNOWLEDGE" button. This shall silence the panel sounder, and change the "SYSTEM ALARM" LED and the individual zone LED, from flashing to steadily lit.
3. Audible notification appliances (except exterior audible appliances) may be silenced by pressing the "SILENCE" button. This shall steadily light the "SIGNAL SILENCE" LED. If a subsequent alarm is activated, the notification appliances shall "resound" until again silenced. Once silenced, audible notification appliances may be restored again by pressing the "SILENCE" buttons. Water flow zones shall be silenceable. Exterior audible appliances shall be non-silenceable. All visual notification appliances (interior and exterior) shall be non-silenceable. All visual notification appliances shall remain activated until the system is reset.
4. If the microprocessor fails, the system shall execute a default signaling program. This program will enable the panel to sound the audible signals and notify the UNH Dispatch. In addition, a yellow "DEGRADE" LED shall light to indicate the programming failure. Inability of the system to sound signals, or notify the fire department during microprocessor failure, shall not be acceptable.

G. Green "Power ON" LED:

1. A green "POWER ON" LED shall normally be lit, indicating that the system is receiving normal AC electrical power. A failure of normal control panel power shall cause this LED to extinguish. The system shall operate on 120 or 240 V AC input power without modification or special components.

H. Yellow "System Trouble" LED:

1. A yellow "SYSTEM TROUBLE" LED shall light and the system audible sounder shall steadily sound when any trouble is detected in the system. Failure of normal power, opens or short circuits on the notification appliance or zone circuits, disarrangement in system wiring, failure of the microprocessor or any identification module, or system ground faults shall activate this trouble circuit.
2. This shall silence the panel trouble buzzer. If additional trouble conditions occur, the trouble circuitry shall resound. The "ACKNOWLEDGE" switch shall acknowledge up to ten (10) trouble signals per switch operation.
3. During an alarm condition, all trouble signals shall be suppressed with the exception of lighting the yellow "COMMON TROUBLE" LED steadily.

I. Alarm Verification:

1. Smoke detector alarm verification shall be a standard option on all zones while identifying any dry contact device (i.e., manual stations, heat detectors, etc.) as an immediate alarm. This feature shall allow those smoke detectors, that are installed in environments prone to nuisance or unwanted alarms, to operate with the following sequence:
 - a. System Ready - prior to smoke detector alarm.
 - b. Smoke Detector Alarm - @ time = 0.
 - c. Pre-Alarm Window – 15 seconds; a distinctive pre-alarm indication shall be displayed.
 - d. Zone Reset - 5 seconds (occurs at end of pre-alarm window).

- e. Alarm Verification Window - 30 seconds; the system shall respond to a second alarm from the same smoke detector zone as a system alarm.
 - f. System Ready - no alarm verification.
2. NOTE: The verification sequence is suspended once a system alarm is activated.
 3. When the system is in verification, there shall be no indication on the panel or at dispatch.
- J. Alarm Signals:
1. All alarm signals shall be automatically latched or "locked in" at the control panel until the operated device is returned to its normal condition, and the control panel is manually reset. When used for water flow, the SILENCE switch shall be bypassed.
- K. Electrically Supervised:
1. Each initiating and notification appliance circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring.
 2. The occurrence of any fault shall activate the system trouble circuitry, but shall not interfere with the proper operation of any circuit that does not have a fault condition.
 3. Each initiating circuit shall be capable of being wired using Class A, Style 7 supervised circuits (a ground fault on either conductor, or a break shall not prevent a device from operating on either side of the break) at no extra cost.
- L. Drift Compensation - Analog Smoke Sensors:
1. System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to the effects of component aging or environment (i.e., dust). Each smoke sensor shall maintain its actual sensitivity under adverse conditions to respond to actual alarm conditions while ignoring the factors that generally contribute to nuisance alarms.
 2. The system trouble circuitry shall activate, display "DIRTY DETECTOR" and "VERY DIRTY DETECTOR" indications, and identify the individual sensor when a smoke sensor has been compensated beyond its acceptable limits, and transmit a trouble signal to campus dispatch.
- M. Analog Smoke Sensor Test:
1. System software shall automatically test each analog smoke sensor a minimum of three times each day. The test shall be a recognized functional test of each ionization chamber (Analog Ionization Sensors) and photoelectric (Analog Photo Electronic Sensors) as required annually by NFPA 72. Failure of an analog smoke sensor shall activate the system trouble circuitry, display a "Test Failed" indication, and identify the individual sensor.
- N. Dual Mode Walk Test
1. The control unit shall provide a Dual-Mode Zoned Walk Test Program, which shall enable a single individual to test the Alarm/Supervision status of each

initiating device connected to the system. During walk test, the control unit shall automatically reset after an alarm condition enabling the testing technician to continue testing the system without requiring a return to the control panel. The system shall allow the technician to disable certain actions such as elevator recall, mechanical unit shut down, and security interface.

- a. During an Audible walk test, the act of placing a device in alarm will cause four pulses on the notification appliance circuits. Operation of a supervisory switch will cause three pulses, while removal or disconnection on an initiating device will cause two pulses on the notification appliance circuits. All tests will be recorded by a printer for historical reference.
- b. A Silent walk test will record all tests by a printer for historical reference while not activating the notification appliance circuits.

O. Printed Circuit Boards, Control Panel Components:

1. All control units shall be contained in a 16-gauge steel cabinet.
2. All groups of circuits or common equipment shall be clearly marked and shall be expandable by inserting interchangeable units.
3. The control unit shall be red in color and shall include the following features:
 - a. Auxiliary SPDT alarm and trouble dry contacts.
 - b. Auxiliary circuitry in the control panel to operate remote relays for control of air handling equipment.
 - c. Sixty (60) hours of battery standby (as required per NFPA 72) using rechargeable batteries with automatic charger, to maintain standby batteries in a fully charged condition.
 - d. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting normal microprocessor operation and minimize resultant nuisance troubles and/or alarms. This circuit shall be physically isolated from the power supply to facilitate service. The system shall automatically transfer back to AC power when available and battery back-up system shall recharge.
 - e. A ground fault detector to detect positive or negative grounds on the initiating circuits, notification appliance circuits, power circuits, and telephone line circuit. A ground fault LED shall light, and the general trouble devices shall operate as specified herein, but shall not cause an alarm sound. Ground detection shall detect any condition 10k ohms or greater.
 - f. Short circuit LEDs for all notification appliance circuits shall be a standard feature of the fire alarm control panel. Each circuit shall be monitored for short circuits and shall have a distinctive LED for visual indication of the circuit and operating trouble devices as specified herein, but shall not cause an alarm to sound.
 - g. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, notification appliance circuits, and telephone line circuit. Systems that require an optional module to provide this protection shall not be considered equal.

- h. Individual circuit fuses shall be provided for the following: smoke detector (resettable) power, main power supply, battery standby power, and auxiliary (non-resettable) output.
- i. A common reset and lamp test switch, labeled "RESET/LAMP TEST" shall be provided to reset the Series control panel.

P. Campus Connection:

- 1. The fire alarm system shall be connected to the UNH dispatch center via supervised reverse polarity remote station connection. The connection shall be self-restoring upon return of telecommunications lines after outages.

Q. Multiplex Configuration:

- 1. The system shall be designed to accommodate module placement at either central location, or from one to fifteen remote locations. System integration shall utilize the RS485 style multiplex communications with a true "Distributed Processing" of system intelligence.
 - a. The system shall be able to maintain both degrade modes to assure maximum survivability of the system in the event of either, the loss of system communications, or failure of any or all microprocessors.
- 2. Provision shall be made to accommodate coding at all remote panels, to be synchronized to the coding patterns generated at the central control panel, to assure proper phasing of alarm signals.

2.4 SYSTEM COMPONENTS

A. General System:

- 1. The analog/multiplex system shall consist of, but not be limited to the following units, components, and peripheral devices, each of which is described in detail in this section.

B. System Cabinet:

- 1. Except as otherwise approved by Owner, the system cabinet shall be semi-flush mounted with a red or black finish, at Owner's option, and shall consist of backbox, backplate, trim ring, dress panels, battery panels and door. The system cabinet houses the microprocessor and related system circuitry modules. The cabinet shall be labeled with the manufacturer's name and logotype to assure the integrity of the complete system.
- 2. The cabinet shall be of dead-front construction and 16-gauge cold rolled steel. The door lock system shall consist of two locks, which will each accept the same key. One CAT-30 Operative "OPER" key shall allow dead front access to the module displays for all operator functions, and shall also allow access to all control panel electronics, without further dismantling of the cabinet, control unit, or wiring.
- 3. The system components shall be installed on a hinged mounting plate which may be removed to facilitate easy installation and testing of field wiring. A minimum of

a 1-inch wiring gutter space shall be provided behind the mounting plate to protect the system electronics at completion of the installation. Wiring shall be terminated on removable terminal blocks to allow field servicing of all modules without disrupting system wiring.

C. Main Fire Alarm Control Panel:

1. The FACP shall be completely microprocessor based.
2. Basic System Operator Controls:
 - a. Acknowledge Switch: Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON.
 - b. Alarm Silence Switch: Activation of the alarm silence switch shall cause all programmed devices to return to the normal condition after an alarm.
 - c. System Reset Switch: Activation of the System Reset switch shall cause all devices and circuits, to return to their normal condition.
 - d. Lamp Test: The Lamp Test switch shall activate all system LEDs and light each segment of the liquid crystal display.

D. AC Unit (ACU):

1. All AC line connections shall be isolated from the power supply unit and circuitry for all system power supplies to meet U.L. Standard 864 for "brown-out" operation. The ACU shall operate from either 120 or 240 VAC as a standard feature.
2. Loss of AC power trouble signal shall be programmable with a variable (adjustable) delay preventing trouble signals upon minor power sags. All remote stations shall be neatly and permanently labeled, as to the particular device it serves.

E. Power Supply Unit (PSU):

1. The power supplies shall be transformer-converted to low voltage, rectified and filtered 24 VDC (nominal) for system operation and to eliminate the possibility of line voltage being present on any internal panel components.
2. The system shall be fully supervised and contain an integral, filtered, nominal 24 VDC at 5 amps power supply, which shall comply with UL Standard 864 for power-limited operation.
3. The system shall have a separate, lockable AC circuit disconnect provided. A circuit breaker in an electrical panel containing other circuits shall not be acceptable.
4. Primary Power LED Indicator And Outputs:
 - a. A green LED on the power supply card shall indicate the presence of primary power.
 - b. Power supply outputs shall be as follows:
 - (1) 24 VDC Non-Resettable, 1.75 amp. max., power limited.
 - (2) 24 VDC Resettable, 1.75 amp. max., power limited.
 - (3) NOTE: Maximum combined output for both shall be 3.0 amps.

5. Battery Charger:
 - a. The power supply shall contain a battery charger with a maximum average charging current of 1.0 amp. (This current shall be sufficient to maintain the system batteries at full charge). If the system loses AC power, a "System Trouble" shall occur. The charger output shall be supervised and fused.
 - b. Battery charger cabinet shall be equipped with a lock cylinder and be "CAT 30" Key Operative.

6. Batteries:
 - a. Batteries shall be supervised and monitored.
 - b. Batteries shall be of sufficient capacity to provide power for the entire system upon loss of normal AC power for a period of sixty (60) hours with fifteen (15) minutes of alarm signaling at the end of this sixty-hour (60) period.
 - c. Battery enclosure shall be equipped with a lock cylinder and be CAT-30 Operative.

F. Connections And Circuits:

1. Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Electrical Code (NEC). The circuit and connections shall be mechanically protected. The circuit disconnect shall be located electronically before the main service disconnect. The circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM SYSTEM."

G. System Control Unit (SCU):

1. Enclosed within the system cabinet, the SCU shall contain the microprocessor, memory, system operating software stored on a non-volatile EPROM, system configuration memory stored on a non-volatile EEPROM, and the circuits necessary to support a fire alarm system. The SCU shall function as the system information and control center, processing all messages from the field devices (supervisory, trouble, alarm).
2. SCU Microprocessor:
 - a. The SCU microprocessor shall execute all supervisory programming to detect and report the failure or disconnection of any module or peripheral device. An isolated "watchdog" circuit shall monitor the microprocessor and upon failure shall activate the system trouble circuits and the "DEGRADE" LED.
 - b. The SCU microprocessor shall access the system program, which is stored in non-volatile EEPROM memory, for all control-by-event (CBE) functions. The system program shall not be lost upon failure of both primary and secondary power. Volatile memory shall not be acceptable.
 - c. A common RS485 style communications bus network shall tie the SCU microprocessor on-line with all other microprocessors within the multiprocessor network, to afford rapid response to all alarm, or trouble conditions within the system.

3. Programming/Diagnostic Center:

- a. A two-character, seven-segment Programming/Diagnostic Center Display shall be provided to annunciate system operation, programming, and internal trouble-shooting features.
4. Real-Time Clock:
 - a. The SCU module shall contain a real-time, 24-hour military time clock monitoring all real-time programming, and all time control functions.
5. Notification Appliance Circuits:
 - a. Two (2) independent notification appliance circuits shall be provided on the SCU unit, each polarized and rated at 1.75 amps DC, individually FTC protected and supervised for opens, grounds, and short circuits. They shall be wired Class A, supervised and FTC protected. Specifications are as follows:
 - (1) Voltage Current:
 - a) 24 VDC Non-regulated 1.75 amps: Maximum alarm.
 - b) .001 amps: Normal standby.
 - (2) Provide a minimum of one audible and one visual circuit per floor, per stair and per elevator cab.
6. Trouble Input:
 - a. The trouble input, if used, shall accept a 5 to 24 volt input from an external source.
 - b. Trouble Dry Contacts (Form A or Form B; jumper selectable) shall be provided rated 2 amps @ 24 VDC (resistive) and shall transfer whenever a system trouble occurs.
7. Alarm Dry Contacts:
 - a. Alarm dry contacts (Form C) shall be provided rated 2 amps @ 24 VDC (resistive) and shall transfer whenever a system alarm occurs.
8. Digital /Addressable Signaling Line Circuits:
 - a. Analog/Addressable signaling line circuits (initiating/control) shall be wired as Class A, Style 7.
- H. Keyboard Display Unit (KDU):
 1. Shall furnish audible and visual annunciation of all alarm, trouble, supervisory and security signals. Dedicated LED displays shall be provided for:
 - a. Power (green).
 - b. Controls Active (green).
 - c. Fire Alarm (red).
 - d. Pre-Alarm (red).
 - e. Security (blue) if applicable.
 - f. Supervisory (yellow).
 - g. System Trouble (yellow).

- h. Other Event (yellow).
 - i. Signals Silenced (yellow).
 - j. Point Disabled (yellow).
 - k. CPU Failure (yellow).
 - 2. The KDU shall contain a 640 character backlit display that shall provide status of all analog/addressable sensors, monitor and control points, and a 12-key keypad that shall permit selection of functions. The display shall be of the liquid crystal type (LCD), clearly visible in the dark, and under all light conditions.
 - 3. The KDU shall contain eleven LED status indicators:
 - a. Power.
 - b. Controls Active.
 - c. Fire Alarm.
 - d. Pre-Alarm.
 - e. Security.
 - f. Alert.
 - g. Supervisory.
 - h. Trouble.
 - i. Signal Silence.
 - j. CPU Failure.
 - k. Point Disabled.
 - l. Other event.
 - 4. The system shall support up to 32 remote ACS annunciators and modules.
- I. Dual Signal Unit (DSU):
- 1. Dual Signal Units (DSU) shall be provided in accordance with the number of notification circuits required by the plans and specifications. Each DSU shall provide two (2) notification circuits, each polarized and rated at 1.75 amps DC, PTC protected and supervised for opens, grounds, and short circuits. They shall be capable of being wired Class A, supervised and PTC protected.
- J. Fault Indicator Module:
- 1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
 - 2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
 - 3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
 - 4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

K. Quad Relay Unit (QRU):

1. The Quad Relay Unit (QRU) shall provide four (4) independent Form "C" relay contacts rated 2 amps @ 24 VDC (resistive only). This relay output shall be used to perform auxiliary functions and may be programmed through the system software or may be hardwired directly from a 24 VDC input. When a QRU relay is activated, the green "ON" LED shall light.
2. Each QRU relay shall be supplied with an "OFF/AUTO/ON" control and programming switch. When the switch is manually turned off, the yellow "OFF" LED shall light.
3. All relay coils shall be supervised for opens and shall light the "OFF" LED steadily and activate the system trouble circuit when a fault condition is detected.
4. All relays may be jumper selected for default programming.

L. High-Current Relay Unit (HRU):

1. The High-current Relay Unit (HRU) shall provide four (4) independent Form "C" relay contacts rated 5 amps @ 24 VDC resistive or 1 amp @ 120 V AC inductive. This relay output shall be used to perform high-power auxiliary functions and may be programmed through the system software or may be hardwired directly from a 24 VDC input. When an HRU relay is activated, the green "ON" LED shall light.
2. Each HRU relay shall be supplied with an "OFF/AUTO/ON" control and programming switch. When the switch is manually turned off, the yellow "OFF" LED shall light.
3. All relay coils shall be supervised for opens and shall light the "OFF" LED steadily and activate the system trouble circuit when a fault condition is detected.
4. All relays may be jumper selected for default programming.

M. Meter Display Unit (MDU):

1. A Meter Display Unit (MDU) shall be supplied containing a 0-50 VDC Voltmeter, a 0-5 ADC Ammeter, and a 2-position DPDT toggle switch. The switch shall allow the operator to display either of the following conditions.
 - a. System Operating Voltage and System Operating Current.
 - b. Battery Voltage and Charging Current.

2.5 PERIPHERAL DEVICES

A. Smoke Detectors:

1. Analog Photo Electronic Smoke Sensors for duct detection application.
 - a. These sensors shall be of the photo electronic type. Each sensor shall be capable of being set at four sensitivity settings of "LOW, MEDIUM, NORMAL, and HIGH" levels, with a predefined setting of LOW.
 - (1) Automatic and manual functional sensitivity and performance tests shall be possible on all. Photo electronic sensors without the need of generating smoke. This test method shall test all sensor circuitry and

- a "Failed Test" indication shall be provided on the KDU upon any failed test.
- (2) Two LED visual indicators providing local 360-degree visibility of operating status and alarm indication shall be provided on each sensor. The LEDs shall pulse periodically indicating that the sensor is receiving power, and communication is being supplied. This feature shall be field programmable. Upon alarm these two LEDs shall light continuously. A visible alarm signal shall be capable of being remotely annunciated.
- (3) The system shall check the sensitivity of each sensor periodically. If a sensor alarm threshold sensitivity has changed, due to aging and/or dust accumulation, the system shall automatically compensate for this sensitivity change (drift compensation).
- (4) The sensor screen and cover assembly must be easily removable for field cleaning. Wire connection shall be made by clamping plate and screw.
- (5) Each sensor shall be interchangeable with the analog ionization sensor and the analog thermal sensors via twist lock mounting base, to ensure matching the proper sensor to the potential hazards of the areas being protected. In all cases, the system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.

B. AUXILIARY DEVICES

1. Analog Thermal Sensor Series:

- a. Analog thermal sensors shall operate on the combination "Rate-of-Rise" and "Fixed Temperature" principles with the fixed temperature operation at 135 Deg F unless noted otherwise. The sensor shall also contain state-of-the-art dual thermistor sensing circuitry for fast response.
- b. Two LED visual indicators providing local 360-degree visibility of operating status and alarm indication shall be provided on each sensor. The LEDs shall pulse periodically, indicating that power and communication is being supplied to the sensor. This feature shall be field programmable. Upon alarm these two LEDs shall light continuously. A visible alarm signal shall be capable of being remotely annunciated.
- c. Each sensor shall be interchangeable with the analog photo electronic sensors, and the analog ionization sensor via twist lock mounting base, to ensure matching the proper sensor to the potential hazards of the areas being protected. In all cases, the system shall recognize when an improper sensor type has been installed in a previously programmed sensor type location.

2. Addressable Monitor Module:

- a. An addressable monitor module with an initiating circuit capable of being configured Class A, Style 7 shall be furnished to provide an address for individual normally open (N.O.) contact devices.
- b. The monitor module shall contain a yellow status LED that shall flash when in a quiescent mode and light continuously when activated. The status LED

- shall be field programmable not to provide quiescent status indication, if so desired.
- c. The monitor module shall be visible. In the event that the module is not visible (i.e., mounted above an accessible ceiling), provide a wall mounted remote indicator/test station below the ceiling in a visible location.
3. Addressable Output Module:
 - a. An addressable output module shall be connected to the same signaling line circuit as the analog/address-able monitor devices and shall provide a relay output (Form "C" 2 amp @ 24 VDC, resistive only), or a notification appliance circuit output (1 amp @ 24 VDC, requiring separate power input). The output module shall contain a yellow status LED, which shall be field programmable not to provide quiescent status indication, if so desired.
 - b. Addressable output modules shall be located in visible locations. In the event it is not visible, provide a remote indicating test station in a visible location.
 4. Manual Fire Alarm Stations:
 - a. Double Action Manual Station:
 - (1) Furnish and install a manual station at each location indicated on the drawings or called for within this Specification. Each manual station shall be of the non-coded double action type, requiring an outer door to be lifted to expose the actuator door. Upon the pulling forward of the actuator door, the unit shall lock into a readily observable "alarm" position. The manual station shall be constructed of aluminum (6063/T5). Each manual station shall not be equipped with a break glass rod or any other part or component that breaks upon operation of the station and require replacement. Each manual station shall require a key to reset the actuated station. This key shall be keyed alike with the fire alarm control panels, battery boxes and be "CAT 30" Key Operative. CAT 30 key shall be front operable (side mounted operators will not be accepted). The manual stations shall employ a highly reliable action to activate an alarm. This feature shall provide an exceptionally high resistance to accidental operation.
 - (2) Manufacturer shall be Reliable Security Group, Lakewood, CA.
 5. Remote indicators:
 - a. Shall be LED with an integral magnetically operated remote test station. The combination shall be mounted in a single box. Separate devices will not be accepted. All remote indicators/test stations shall be visible and easily accessible at 6'-0" A.F.F. unless noted otherwise.
 6. Evacuation Signal Devices:
 - a. All devices shall:
 - (1) Be predominately red in color.
 - (2) Be labeled "FIRE."
 - (3) Be in compliance with the Americans with Disabilities Act.

- b. Visual signals shall be a flashing strobe behind translucent lenses. Visual signals must be synchronized.
 - (1) Exception: Synchronized visual signals are not required if the visual signals have been tested by an independent testing laboratory and shown not to induce seizures.
 - c. Devices shall be engineered to comply with NFPA 72. The average ambient sound level for the various occupancies is listed below and may be used as a guide for engineering purposes.
 - (1) Business occupancies 45dBA
 - (2) Educational occupancies 45dBA
 - (3) Industrial occupancies 80dBA
 - (4) Institutional occupancies 50dBA
 - (5) Mercantile occupancies 40dBA
 - (6) Pier & water surrounded 40dBA
 - (7) Places of Assembly 40dBA
 - (8) Residential occupancies 35dBA
 - (9) Storage occupancies 30dBA
 - (10) Underground/windowless 40dBA
 - d. Devices shall be engineered to be such in number and location as to assure the evacuation signal is readily heard in all occupied areas of the building. In no case shall the evacuation signal be less than fifteen (15) decibels above averaged ambient sound levels.
 - e. Audible signals shall have a sound level of not less than 75 dBA at ten (10) feet or more than 120 dBA at the minimum hearing distance from the audible appliance.
 - f. Buildings occupied by or having the potential to be occupied by deaf or hearing-impaired persons shall provide for occupant notification as necessary to ensure evacuation of these occupants.
 - g. The audio evacuation signal shall be provided with a temporal tone audio evacuation signal followed by a pre-recorded voice evacuation signal.
 - h. In addition the fire alarm system shall have live voice communication capabilities. Live voice communication from the fire alarm panel shall override the pre-recorded message. Should there be a failure of the pre-recorded message, the temporal tone shall be continuous.
 - i. The AHJ (authority having jurisdiction) must approve all pre-recorded messages.
 - (1) Message is to be repeated twice.
 - j. Exterior weatherproof audiovisual (A/V) devices shall be provided. Exterior audible devices shall be horns. Such devices shall be located in the immediate vicinity of each building entrance/exit. The exterior A/V devices shall be non-silenceable and must remain in operation until the system is reset.
7. Fire Protection System Alarm Devices:
- a. Provide Type OSYS-U UL listed and FM approved fire protection gate valve tamper switch(es), with two single-pole/double-throw contacts, as shown on

Drawings. Provide mounting bolts and hardware. Wire to fire alarm system.

- b. Provide UL listed and FM approved fire protection water-flow alarm switch(es) with two single-pole/double-throw contacts, adjustable time delay and mounting collar hardware. Switch components that contact water shall be non-corrosive.
- c. Provide UL listed and FM approved fire protection water pressure alarm switch(es).

2.6 AUXILIARY FUNCTIONS

A. HVAC Control (when applicable):

1. Each designated HVAC unit shall be controlled through an addressable relay unit after an alarm condition has been initiated from any device as shown on the plans.

B. Magnetic Door Holders (when applicable):

1. Electromagnetic door holders shall be provided to hold fire and smoke barrier doors open until released by an alarm condition. The door holders shall have approximately 35 lb. (15.9 kg) holding power and offer fail-safe operation. Furnish and install where shown on plans.
2. All magnetic door holders shall release through the contacts of the control panel, after an alarm condition has been initiated from any zone on the plans, or loss of power. All door holder circuits shall be separately fused.
3. Magnetic door holders shall be wall mounted behind the door with the exact location coordinated between the electrical contractor and the University of New Hampshire. Provide blocking in wall suitable to support weight of door on hold open.
4. Magnetic door holders shall operate at 24 volts DC.
5. Magnetic door/holder may utilize chain extension, not to exceed 1 foot in length, for doors that do not swing immediately next to wall.

C. Door Closers (when applicable):

1. Door closers shall be failsafe type, LCN Door closers shall be provided to hold fire and smoke barrier doors open until released by an alarm condition. The door holders shall have approximately 35 lb. (15.9 kg) holding power and offer fail-safe operation. They shall be UL listed for smoke barrier or labeled fire doors, and shall conform with life safety code, NFPA 101. Furnish and install where shown on plans.
2. All door closers shall release through the contacts of the control panel, after an alarm condition has been initiated from any zone on the plans, or loss of power. All door closers circuits shall be separately fused.
3. Door closers shall be mounted on top of the door, preferably on the top jamb (push side), with the exact location coordinated between the electrical contractor and the University of New Hampshire. Provide blocking in wall suitable to support weight of door on hold open.

4. Door closers shall allow the door to open to a minimum of 90 degrees. Provisions for wider door swing and greater hold-open angle shall be made for door closers on all doors that will be opened further than 90 degrees up to 180 degrees as required.
 5. Door closer holding solenoid shall operate at 24 volts DC.
- D. The system shall allow the operator to disable sprinkler system by floor, smoke detectors by floor, elevator shaft/pit/machine room devices and door holders, and individual strobe and speaker circuits. Whenever a zone or device is disabled the panel must show a trouble signal.
- E. The system shall allow the operator or technician to disable any auxiliary function via the keypad.
- F. Elevators:
1. All elevators that travel 25 feet or more shall be connected to the building fire alarm system and be equipped with elevator recall. Each elevator lobby, at each level and the elevator machine room(s). The elevator system/fire alarm system interface shall match existing conditions and be coordinated with UNH and current elevator service contractor, Stanley Elevator.

2.7 GRAPHIC MAP

- A. Contractor shall provide a graphic layout of the building. Level of detail and size of graphic to be coordinated with UNH and Durham Fire. Graphic map to be printed on heavy bond glossy paper with indelible ink and mounted in a GD8 Graphic Display Frame supplied by Space Age Electronics, Inc., or approved equal.

2.8 RACEWAYS AND CONDUCTORS

- A. All systems shall be wired as Class A such that a single break in any conductor shall not prevent the detection or signaling of an alarm.
- B. All fire alarm system wiring shall be installed in conduit raceway, $\frac{3}{4}$ " minimum, unless otherwise approved by the Owner. It is the responsibility of the installer to comply fully with the National Electric Code; however, particular attention shall be paid to wire fill limitations and derating requirements. All junction and pull boxes and covers shall be painted red. All boxes shall be labeled with circuit information and include the function when housing a remote control or monitor module. Each junction box shall be sized to accommodate a 40% future increase in wiring. A maximum of one box extender may be used before the contractor must use a larger box.
- C. Grounding:
1. All fire alarm raceway/conduit systems shall have an equipment grounding conductor pulled in with the other fire alarm conductors. Each joint and termination must be tight so that there is electrical continuity.

2. All junction boxes, pull boxes, switch boxes, outlet boxes, etc., shall be bonded to the equipment grounding conductor by means of a green bonding jumper and screw.
- D. Raceways containing conductors shall be identified as "Fire Protective Control Panel" conductors and shall not contain any other conductors. No AC current carrying conductors shall be allowed in the same raceway with the DC fire alarm detection and signaling conductors.
- E. Fire alarm cable shall be UL-listed FPLR with twisted #14 AWG minimum solid copper conductors. Shielding and jacket color-coding shall be as follows:
 1. Initiating circuits - solid red jacket; unshielded. If a second circuit is needed it shall be solid red jacket with an orange stripe. If more than two initiating circuits within a building shall be differentiated via permanent labeling (Brady labels or similar) at all terminations and junction/pull boxes.
 2. Horn/strobe circuits - red jacket with white stripe; unshielded.
 3. Speaker circuits - red jacket with blue stripe; shielded.
 4. Power (24-volt) circuits - red jacket with black stripe; unshielded.
 5. Communications line - red jacket with yellow stripe; shielded.
 6. Audio interconnect – red jacket with green stripe; shielded
 7. Booster interconnect – red jacket with purple stripe; shielded
- F. Fire alarm related fiber optic cabling shall be labeled at all terminations and junction boxes to read "Fire Alarm – Do Not Remove" and to indicate source and/or destination, as applicable.

2.9 IDENTIFICATION AND LABELS

- A. Labeling:
 1. Panels shall be labeled "Fire Alarm Control" on outside cabinet front in contrasting lettering at least 1" in height and 1/16" stroke. All labels/tags applied to the exterior of the fire alarm control panel shall be laser etched metal, mechanically secured.
 2. A copy of the cabling color code schedule shall be permanently affixed in each fire alarm cabinet.

PART 3 - EXECUTION

3.1 INSTALLER'S RESPONSIBILITIES

- A. The installer shall coordinate the installation of the fire alarm equipment with the manufacturer or his authorized distributor.
- B. All conductors and wiring shall be installed according to the manufacturer's recommendations.

- C. It shall be the installer's responsibility to coordinate with the supplier regarding the correct wiring procedures before installing any conduits or conductors.
- D. Any conflicts between the manufacturer's wiring requirements and the wire and cable requirement specified herein shall be brought to the attention of the Owner immediately.

3.2 INSTALLATION OF SYSTEM COMPONENTS

- A. System components shall be installed in accordance with the latest revisions of the appropriate NFPA Standards, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ).
- B. All wire used on the fire alarm system shall be U.L. listed as fire alarm protection signaling circuit cable per the National Electrical Code, Article 760.

3.3 WIRING

- A. Label wiring at all termination points.
- B. Contractor shall clearly re-label all Fire Alarm Control Panels with new zones with typed labels.
- C. In general, it is the intent of this specification that all fire alarm wiring be run in conduit concealed within walls and/or above ceilings. Surface mounted raceways will only be permitted as a last resort. Where surface mounted, the conduit shall be painted to match the surface mounted to. All painting shall be in accordance with University Construction Standards. Fire alarm cable shall contain a 2 – hour circuit integrity rating where required.
- D. Cutting, drilling and patching of existing masonry walls shall be the responsibility of the fire alarm contractor. All holes through existing masonry shall be made with dry or wet coring only. When dry coring, a vacuum collar shall be used to control dust. Rotary hammers or demolition hammers will not be allowed. The fire alarm contractor shall be responsible for all clean up. All floor wall and ceiling penetrations shall be fire caulked using approved methods and materials and finished to match existing conditions. All fire stopping materials and methods must be submitted for approval prior to installation.
- E. Notification appliance circuits shall be limited to 75 percent of available power provided by power supply.
- F. Design wattage of speakers shall not exceed 80% of the maximum allowable input for the unit.

3.4 DETECTOR INSTALLATION

- A. Smoke detectors shall not be installed prior to the completion of sanding/patching/cutting or painting of wall and ceilings. Should fire protection or

construction circumstances mandate early installation of smoke detectors, they shall be bagged tightly in clear plastic. Should active detection be a requirement of occupancy, the plastic shall be removed at the conclusion of each workday and rebagged prior to the start of work.

- B. No automatic detector shall be mounted within the airflow of a supply air register. A minimum of 36" shall be provided between detector location and air register.

3.5 LOCATION OF EQUIPMENT

- A. Instruments shall be located as shown on the drawings. In general:
 - 1. Smoke/Heat Detectors - Ceiling Mounted.
 - 2. Speaker/Strobes – Ceiling mounted wherever possible or wall mounted 80" AFF or 6" below ceiling, whichever is lower.
 - 3. Pull Stations -Wall mounted 4' – 0" AFF.
 - a. Be predominately red in color.
 - b. Be mounted in accordance with NFPA 72.
 - c. Be labeled "FIRE".
 - d. Be located within 5 feet of all exit ways from each floor, unless otherwise approved by the AHJ (authority having jurisdiction).
 - e. Be situated perpendicular to the wall.
 - f. In areas susceptible to malicious false alarms the fire department may require alarmed Lexan type covers over the pull stations.

3.6 DEVICE DESCRIPTIONS AND ZONE ASSIGNMENTS

- A. Device descriptions shall be clear and concise and based on permanent room/building nomenclature, not construction drawing nomenclature. Coordinate with the Owner. Device descriptions shall utilize compass directions that are based on the assumption that Main Street in Durham runs east/west. Consistency in device descriptions for similar devices is important. Where reasonably possible while still providing for rapid response, device descriptions should avoid reference to room numbers as room numbers are subject to change. In general, the custom label a device description should direct the responding emergency personnel as close to the location of the active initiating device as possible (e.g. 3rd Fl Corridor East). The extended label should provide further detail as coordinated with AHJ. Extended label to identify side of building; consider location of FACP or responding entrance as Side A, proceeding clockwise around the building. For devices utilizing monitor modules that do not report the type of device, the device description shall include that information.
- B. Zone assignments shall be established in logical grouping to allow for easy enabling and disabling of devices. For example, all pull stations should be zoned together as should all sprinkler related devices. Heat and smoke detectors should be zoned together on a floor by floor basis. Zone assignments shall be clearly posted inside the fire alarm control panel.

- C. Device descriptions and zone assignments along with floor plans showing device locations and corresponding device numbers shall be submitted to the Owner and DFD for review at least three weeks in advance of anticipated acceptance testing.
- D. At least two weeks prior to anticipated acceptance testing, a meeting shall be held to review device descriptions. Attendees shall include representatives from the fire alarm installer, the Owner and DFD.
- E. Upon finalization, device descriptions and zone assignments shall be incorporated into the system programming prior to scheduled acceptance test.

3.7 ACCEPTANCE TEST

- A. Prior to scheduling acceptance test, check system and perform preliminary testing to verify that the system operates correctly and is ready for an acceptance test.
- B. No acceptance test will be conducted prior to the installation of finished floors, walls and ceiling, in new or renovated construction. Exception: When ongoing construction does not adversely affect the system in any way, and when the ongoing construction will have no bearing on the system (i.e., conducting a final inspection on a kitchen hood system while unrelated construction is ongoing in other areas of the building).
- C. Prior to final testing, the contractor shall submit to Owner a test plan noting what devices will be tested, what test methods will be used and how the test will be documented. No test will be conducted until the test plan has been approved by Owner.
- D. Except as necessary to test the remote signal transmission, the premises shall be completely disconnected from UNH Dispatch. Comply with shutdown notification and restoration requirements above.
- E. Before the installation shall be considered completed and acceptable, a test of the system shall be performed as follows:
 - 1. The test shall be performed by the fire Alarm Installer in the presence of representatives of the Owner, and the DFD. An additional Fire Alarm Installer technician shall be present or assist with testing and to perform necessary field changes that may arise. At the Owner's option, a representative of the Owner's current fire alarm service contractor may also be present. The test shall be scheduled with all parties at least two weeks in advance.
 - 2. The test shall include activation of every building fire alarm device to verify proper operation and correct annunciation at the control panel.
 - 3. All tests shall be performed in accordance with the latest edition of NFPA 72. At least one-half of all tests shall be performed on battery standby power.
 - 4. Except as necessary to test proper operation and coverage of interior and exterior A/V devices, testing may be performed in silent mode.
 - 5. The installer shall furnish all materials required to conduct the test. This includes sources of heat and smoke (FM approved "canned" smoke). All devices shall be tested in accordance with manufacturer's testing criteria. All testing shall be non-destructive.

6. The signaling line circuits and notification appliance circuits shall be opened in at least two (2) locations per zone, to check for the presence of correct supervisory circuitry.
7. If the building is occupied at the time of the test and the system activates building audiovisual warning devices, the installer must make provisions to notify all building occupants of the test. Building occupants must be again notified when the test is complete.
8. The Fire Alarm Installer shall complete and submit to the Owner, DFD and the SFMO a certification letter stating that the system has been 100% tested, and functions in complete compliance with system specifications, manufacturer's specifications and fire department requirements. The certificate shall be signed by the installer(s). Attachments to the certification letter shall include completed NFPA Testing & Inspections and Project Completion forms, with all signature blocks executed.
9. Any failure or noncompliance during the final acceptance test indicates that the system has failed. If the failure or non-compliance cannot be corrected during the time it takes to complete the testing, a re-test must be scheduled. At the option of the Owner and DFD, the re-test may be limited to the specific failures and non-compliances. Or, the Owner and DFD may require partial or complete re-testing. The cost associated with the re-test shall be billed to the contractor.

3.8 PROJECT CLOSEOUT REQUIREMENTS

A. As-Built Drawings, Testing, and Maintenance Instructions:

1. As-built drawings:
 - a. A complete set of "as-built" drawings showing installed wiring, color coding, and wire tag notations for exact locations of all installed equipment, junction and pull boxes, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system. The system shall not be deemed accepted or complete until these Drawings have been processed, and a paper copy is located at the fire alarm control panel. Contractor shall provide both a clean, computer generated print and a digital copy (CD) to the University. Digital copy shall be in AutoCAD and *.pdf format.
 - b. The installer shall provide a printed copy of the system program, a listing of all devices and their addresses along with the initial device sensitivity report. These shall be kept with the as-built drawings on site.
2. Operating and Instruction Manuals:
 - a. Complete operating and instruction manuals shall be submitted prior to testing of the system. Three (3) complete sets of operating and instruction manuals shall be delivered to the owner upon completion. Manuals shall be specific to the system and/or equipment installed and shall include detailed information regarding the installation, operation, maintenance and programming. Also, each set of operation and maintenance manuals shall be provided with electronic and paper copy of all system specific programming, data files, point lists, etc. and a detailed programming instruction manual.

- b. Control panel and voice evacuation operating instructions shall be provided and prominently displayed on a separate sheet located next to the control panel and voice evacuation unit, respectively, in accordance with UL Standard 864. Coordinate with Owner's representative.
3. Testing Frequency Instructions:
 - a. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment; methods for testing each individual piece of equipment, and a complete troubleshooting manual explaining how to test the primary internal parts of each piece of equipment, shall be delivered to the owner upon completion of the system.
 - b. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
 - (1) Instructions for replacing any components of the system, including internal parts.
 - (2) Instructions for periodic cleaning and adjustment of equipment with a schedule of these functions.
 - (3) A complete list of all equipment and components, with information as to the address and telephone number, of both the manufacturer and local supplier of each item.

B. Spare Parts

1. The contractor shall provide and turn over replacement stock to the Owner for subsequent storage in the Fire Command Center as follows (as appropriate):
 - a. 5% of total smoke detectors provided for project.
 - b. 5% of total temperature heat detectors provided for project.
 - c. 5% of total rate of rise heat detectors provided for project.
 - d. 5% of total pull stations provided for project
 - e. 5% of total 120 volt combination CO / smoke alarms provided for project.
 - f. 5% of total duct smoke detectors provided for project.

END OF SECTION 28 3110