SECTION 28 31 00

FIRE ALARM AND SMOKE DETECTION SYSTEM

PART 1 – GENERAL

1.1 PURPOSE

A. This guideline is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. PSP is to apply the principles of this section such that the University of Texas at Arlington (UTA) may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be approved by UTA and may require justification through Life Cycle Cost (LCC) analysis and submitted to UTA for approval.

1.2 **LESSONS LEARNED AND DESIGN CONSIDERATIONS**

A. X

1.3 SUMMARY/OVERVIEW

A. The installation shall conform to:
   1. NFPA 72; current edition.
   2. NFPA 101; current edition.
   3. NFPA 70; current edition.
   4. NFPA 90A; current edition.
   5. International Building Code (IBC); 2015.
   6. International Fire Code (IFC); 2015.
   7. UL 864; current edition, for fire Alarm and UL 2572 for Mass Notification
   8. ADA Accessibility Guidelines (ADAAG); current edition.
   9. Texas Accessibility Standards (TAS); current edition.
   10. Local-city Ordinances; current edition.
   11. NFPA 1; current edition.

B. All electronic equipment shall comply with all FCC limits governing radio frequency electromagnetic interference and be so labeled.

C. None of the terms or provisions of this specification shall be constructed as waiving any of the rules, regulations or requirements of Codes.

1.4 WORK INCLUDED

A. This Section specifies the requirements for furnishing and commissioning a fully functional addressable fire alarm and mass notification system with full interface with other related systems. Work shall include, but not limited to, the following.
   1. Fire alarm control and annunciator panels
   2. Mass Notification System
   3. Manual fire alarm stations
   4. Automatic fire, smoke, and heat detection devices
   5. Audible and visual alarm notification devices
   6. Required batteries, battery panels, and associated accessories
   7. Fire door control, security door control
   8. Air handler duct smoke detection, and shutdown
   9. Sprinkler system PIVs, OS&Y valves, and tamper switch monitoring
   10. Sprinkler systems water flow and/or pressure switch monitoring
   11. Monitoring of fire pump controls
   12. Fire/smoke damper control and Fire/smoke shutter control
   13. Elevator recall and power shutdown
   14. System acceptance testing and commissioning
   15. Fire Sprinkler floor control assemblies on each floor

1.5 SYSTEM DESCRIPTION

A. The automatic fire detection and alarm system shall consist of a main fire alarm control panel, local control

panel nodes, operator workstation, graphics terminal, audio control panel, printer, remote annunciator, detection devices, audible and visual notification devices, remote devices, and manual stations wired in accordance with the schedule on the Drawings and shall function as specified herein. The system shall use supervised multiplex data communications circuits, close loop initiation circuits, individual zone supervision, and individual audible and visual alarm circuit supervision.

B. The system shall have sufficient capacity to incorporate all equipment and perform all functions as per intent of the specifications and Drawings. The system shall have an overall 20 percent spare capacity that includes but not limited to communication network, terminal strips, amplifier, batteries, etc., reserved for future expansion.

C. The system shall be capable of being programmed on site for downloading, uploading or editing operating sequence or programming to accommodate and facilitate building parameter changes or changes as required by codes.

D. A data communications network and Fire Alarm Audio network transmitting multiplexed input and output signals, which shall be electronically supervised, shall connect all control panel nodes. The communication network shall consist of a communication cable transmitting all system operations in a digitally encoded format, an audible signaling bus serving all remote amplifiers, and a two-way phone communications bus serving all individually controlled fire phone circuits.

E. The fire alarm control panels shall provide power, annunciation, supervision, and control for the fire detection and alarm system. Fire alarm control panels shall be distributed per floor or per zone as practical, such that each fire alarm control panel shall operate as a local stand-alone system with communication network connection to peers and main fire alarm control panel that normally resides in Fire Command Center. The Main Fire Control Panel in Fire Command Center shall monitor and annunciate all alarms and troubles of each Fire Alarm Control Panel in the fire alarm network system distributed throughout the building. All data communication wiring between the controls panels shall be supervised for open circuit, short circuit and ground fault. Provide separate 100AH Battery Cabinet with dedicated electrical circuit on Emergency Power. Provide dedicated electrical circuits on Emergency Power to Simplex Grinnel NAC panels throughout the Building. Provide dedicated electrical circuits on Emergency Power to all Simplex Grinnell Transponder FACPS.

F. Data communication transmission shall use a peer-to-peer network communication channel with token-ring communication protocol as follows.
   1. Each node shall communicate to the next node in a peer-to-peer token-ring configuration.
   2. In the event that the path to the next node on the ring has experienced a communication failure, the node with possession of the token shall transmit it back in the direction from which it came to attempt to reach the next node by going around the ring in the opposite direction. At the same time the status of non-communication node shall be added into the content of transmission.
   3. In the event of communication break down and a group of nodes become isolated from the network, that group shall 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.
   4. In the event that a single node becomes unable to handle the network token, the network interface card shall continue communications to the rest of the network. The off-line node is reported as such to the network and is periodically interrogated to determine if it is ready to be brought back online with the rest of the network.

G. Fire detection initiation devices and audible visual alarm devices shall be wired to the fire alarm control panel on the same floor or with the same zone as practical. Smoke or heat alarm initiation devices shall be individually configurable on site to function desirable selective alarm, general alarm, evacuation, alert, test, fire/smoke damper operation, fire door/security door release, smoke control operation, HVAC interface or trouble warning.

H. The system shall be designed such that alarm indications override trouble conditions. There shall be no limit, other than maximum system capacity, as to the number of addressable devices and/or zones, which may be in alarm simultaneously. The panel shall be capable of measuring the sensitivity of the addressable ionization and photoelectric detectors connected to it.

I. The system shall initiate the following system outputs when any area smoke detector, manual station, or water flow switch operates in accordance with the fire alarm functional matrix:
   1. Audible devices - speakers.
   2. Visual devices - strobes.
   3. Automatically notify fire department, central station, and/or command center.
   4. Display individual detector and/or zone number on alphanumeric display with optional user-defined message.

5. Light an indicating lamp on the device initiating the alarm.
6. Release all magnetic fire door holders.
7. Activate fire/smoke dampers.
8. Activate fire/smoke shutters.

J. The system shall provide a supervisory condition to Fire Alarm Control Panel and shutdown associated HVAC System when any duct smoke detector is activated.
K. The system shall activate the Elevator Recall System upon activation of Elevator Lobby, Elevator Machine Room, or Hoistway Smoke/Heat Detectors.
L. The fire alarm and smoke detection system shall be used to monitor tamper switches and water flow switches on sprinkler and fire suppression systems.
M. Fire alarm and smoke detection system shall release fire doors that are held open and security access controlled doors that are held close if desired.
N. Fire pumps shall be monitored by the fire alarm and smoke detection system.
O. Fire alarm and smoke detection system shall include the installation of duct-mounted smoke detectors, interface with HVAC damper control, and air-handler shutdown.
P. Type and quantity of signals, which are expected to be transferred and monitored by existing campus command/dispatch center, shall be verified during design phase. Compatibility issue also needs to be addressed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. NFPA Certification: Obtain certification according to NFPA 72 by the State of Texas.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver fire alarm system components in factory-fabricated containers.
B. Store in a clean, dry space and protected from the weather.
C. Handle control and annunciator panels carefully to avoid damage to material components, enclosure and finish.

1.8 SUBMITTALS

A. General Submittal Requirements, consistent with NFPA 72 Section 7:
   1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
   2. Shop Drawings shall be prepared by persons with the following qualifications:
      a. Trained and certified by manufacturer in fire-alarm system design.
      b. NICET-certified fire-alarm technician, Level IV minimum.
      c. Licensed the State of Texas.
   3. Product Data: For each type of product indicated.
   4. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   5. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
   6. Include voltage drop calculations for notification appliance circuits.
   7. Include battery-size calculations.
   8. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
   9. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
   10. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
   11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show

size and route of cable and conduits.

B. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
D. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
E. Qualification Data: For qualified Installer
F. Field quality-control reports.
G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 General Requirements.
H. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
I. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
J. Record copy of site-specific software.
K. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    1. Frequency of testing of installed components.
    2. Frequency of inspection of installed components.
    3. Requirements and recommendations related to results of maintenance.
    4. Manufacturer's user training manuals.
    5. Manufacturer's required maintenance related to system warranty requirements.
    6. Abbreviated operating instructions for mounting at fire-alarm control unit.
    7. Software and Firmware Operational Documentation.
    8. Software operating and upgrade manuals.
    9. Program Software Backup: On magnetic media or compact disk, complete with data files.
    10. Device address list.
    11. Printout of software application and graphic screens.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. NFPA Certification: Obtain certification according to NFPA 72 by the State of Texas.

1.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.
B. Technical Support: Beginning with Substantial Completion, provide software support for five years.
C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
D. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
B. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
C. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
D. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
E. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each

type.

F. Keys and Tools: One extra set for access to locked and tamperproofed components.
G. Audible and Visual Notification Appliances: One of each type installed.
H. Fuses: Two of each type installed in the system.

1.12 WARRANTY

A. Manufacturer's standard form in which the manufacturer agrees to repair or replace components that fail in materials or workmanship within three years of substantial completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Simplex Grinnell; Exclusive Acquisition Justification.

2.2 FIRE ALARM CONTROL PANELS

A. Control panel enclosure shall consist of a floor-standing or surface-mounted back-box, hinged door, keyed lock, and tamper switch. Tamper switch shall put control panel into a trouble mode when door is opened. Back-box shall be sized to accommodate batteries, battery charger, power supply, control panel, indicating, initiating, communications, relays, and switch modules.
B. The control panel power connections (whether ac or dc) shall be separately fused within the control panel. The system power supply shall be provided with an integral uninterruptible power source (UPS). This UPS shall provide continuous power to the system in the event of a commercial power failure. Transfer from commercial power shall be instantaneous to ensure proper processor operation and indicated by flashing the system power long-life light-emitting diode (LED).
    1. Loss of commercial power shall be annunciated as a system trouble. System trouble shall be indicated for over-voltage or under-voltage conditions, blown fuses, or disconnected batteries.
    2. The system shall visually and audibly indicate operation from standby power. The system shall automatically restart upon the return of power. No operator intervention shall be required.
    3. A dual-rate battery charger shall be provided, which is capable of recharging the batteries to 80 percent capacity in 12 hours.
    4. Batteries shall be sized to provide 24 hours of standby operation followed by 15 minutes of operation in Full-Load Fire Alarm mode, in compliance with NFPA 72, Section 10.5.6.3.1(2).
C. The control panel shall be modular with solid-state electronics and microprocessor. The control panel shall provide power, annunciation, supervision, and control for the detection and alarm system. The system shall be capable of reading and displaying at the control panel the sensitivity of remote addressable ionization and photoelectric detection devices. The detection system shall remain 100 percent operational and capable of responding to an alarm condition while in the routine maintenance mode. Addressable detection devices shall be individually identified by the system, and any quantity of addressable detection devices shall be in alarm at any time up to the total number connected to the system.
    1. The control panel shall be capable of supporting addressable detection devices.
    2. The panel annunciator shall be an 80 character, alphanumeric display, which shall provide an optional user-definable message associated with each detection device or zone.
    3. Dynamic supervision of system electronics, wiring, detection devices, and software shall be provided by the control system. Failure of system hardware or wiring shall be indicated by type and location on the alphanumeric annunciator. The system shall provide fail-safe operation, i.e., incoming alarms shall automatically override all other modes of operation, and the panel shall automatically return to normal operating mode from any operator- initiated mode.
    4. Ground fault detection shall be provided for all initiating and audible circuits. Lamp test capability shall be provided to test all visual panel indicators and associated software.
    5. The system alarm lamp shall flash and an integral alarm buzzer shall sound upon receipt of any alarm condition. Acknowledgment of the alarm by operation of the silence switch shall silence the audible alarm and cause the alarm lamp to light steadily. Receipt of subsequent alarms shall cause the alarm buzzer to resound and the alarm lamp to flash.
    6. The system trouble lamp shall flash and an integral trouble buzzer shall sound upon the occurrence of any trouble condition. Acknowledgment of the trouble condition by operation of the silence switch shall silence the audible alarm and cause the trouble lamp to light steadily. Receipt of subsequent troubles shall cause the trouble buzzer to resound and the trouble lamp to flash.

7. The service mode shall permit the arming and disarming of individual detection or output devices, as well as manually operating output devices. Status of these devices shall be displayed upon command from the control panel. The panel shall automatically return to normal mode in the event the panel remains unattended in the service mode. The panel shall be capable of receiving and processing alarms even when in the service mode.
8. The control panel shall report, by specific device number, any device removed from an addressable initiating circuit, and all other devices shall continue to function.
9. The control panel shall have the ability to support an optional printer terminal.
10. No alarm or trouble indication shall be resettable until it has been acknowledged. It shall not be possible to reset the system until all alarms have been acknowledged and devices cleared.
11. Each network addressable Fire Alarm panel shall have the following capacity:
    a. Support for up to 2500, intelligent analog/ addressable points per panel.
        1) Onboard Strobe Circuits: 10 circuits rated for 2 amps each at 24 Vdc.
        2) Onboard Speaker Circuits: 10 circuits rated for 25 watts each at 70.7 VRMS.
        3) Onboard Telephone Circuits: 10 fireman's telephone circuits.
        4) Onboard Auxiliary Relay Circuits: 10 general input circuits, 10 general output circuits.
    b. Amplification: 500 watts, 70.7 VRMS, distributed, with one 500-watt backup amplifier every three panels.
    c. Audio Channels: two.
    d. Power Supply: 20 amps, 24 Vdc.
    e. Battery Backup: 140 ampere-hour backups at 24 Vdc.
    f. Mounting: NEMA 12 wall- or floor-mounted enclosure.
    g. System Power: 120 Vac, 60 Hz, and single phase.
12. The following primary controls shall be visible through a front control panel.
    a. 80-character display.
    b. Individual red fire alarm LED.
    c. Individual red priority 2 alarms LED.
    d. Individual yellow supervisory service LED.
    e. Individual yellow trouble LED.
    f. Green “power on” LED.
    g. Yellow signals silenced LED.
    h. Fire alarm acknowledge key.
    i. Priority 2 alarm acknowledge key.
    j. Supervisory service acknowledge key.
    k. Trouble acknowledge key.
    l. Alarm silence key.
    m. System reset key.
    n. Speaker circuit selection switches with LEDs.
    o. Master audio control microphone.
    p. Master fire fighters phone.
    q. Phone circuit selection switches with LEDs.
13. The following functions shall be provided by operating the front control panel.
    a. LED testing.
    b. Alarm, trouble, and abnormal condition listing.
    c. Enabling and disabling of each monitor point separately.
    d. Activation and deactivation of each control point separately.
    e. One-person test enable.
    f. Running self-diagnostic.
    g. Display historic logs.
    h. Point listing.
14. Scrolling through menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user. These controls shall be located behind an access door.
15. Under normal conditions the front display panel shall display a “System Normal” message and the current time and date. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for supervisory and trouble conditions. The LCD shall display the following information relative to the abnormal condition of a point in the system.

a. 40 character custom location label
b. Type of device (i.e., smoke, pull station, water flow)
c. Point status (i.e., alarm, trouble)

D. Fire alarm audio control panel shall provide complete voice annunciation control of the fire alarm system. Panel shall include ability to select paging zone by area or all call. Panel shall include master fireman's telephone handset, and interface shall be integral to panel. Panel shall support both live paging and prerecorded digital messages. Performance:
1. Audio Channels: two simultaneous 70.7 VRMS channels, minimum.
2. Phone Risers: two fireman's telephone risers, minimum.
3. Audio Levels: VU meter for audio level monitoring.
4. Digital Message Length: 10 messages, 30 seconds each, minimum.
5. Preamp Supervision and Automatic Changeover: yes.
6. Amplification: supports 10 distributed- or central bank amplifiers.
7. Backup Amplification: supports four backup amplifiers.
8. Degrade Mode: degrade mode reverts to tone generation.
9. Mounting: NEMA 12 wall- or floor-mounted enclosure.
10. System Power: 120 Vac, 60 Hz, single phase.

E. Initiating circuit modules shall maintain complete reporting of device status while in trouble due to any addressable device having its active transmitting component fail, open, or shorted. The initiating circuit modules shall detect a line break and provide information to the control panel, allowing the user to determine between which two devices the break has occurred.

F. Detection line circuit monitoring shall be provided by a zone input module. Each circuit shall be capable of Class A or B wiring. With Class B wiring, a capacitive end-of-line device shall be required. Each zone shall accommodate up to 96 ionization or photoelectric detectors, or 96 flame detectors, as well as any quantity of shorting-type contact devices. Upon actuation of any detector or device installed on a zone circuit, that particular zone shall lock into alarm and the zone identification and location shall be annunciated at the control unit. Zone troubles, such as opens, shall be annunciated at the control unit giving zone identification and trouble description. Alarm information and transmission shall have priority over trouble.

G. An output circuit indicating operation of dc audible devices, leased line or city tie shall be provided by an indicating module. Upon command by the control unit the output circuits will respond as configured. Leased line or city circuits shall be limited energy outputs. All signal circuits shall require and be fitted with an appropriate end-of-line resistor (EOLR). Each circuit shall be fused separately. The module shall be supervised by the control unit for open and shorted circuits. Open circuits shall report trouble only and respond with circuit identification. A shorted circuit shall respond in a similar manner. Each output circuit shall be individually fused with replaceable fuses.

H. For control of air-handling units, elevators, and beacon lights, relay modules shall be provided. The module shall be system interconnected and shall be operable by the control unit or manually. It shall contain eight independent relays, fitted with Form C contacts, rated at 120 Vac, 10 amps, minimum, inductive.

2.3 PERIPHERAL DEVICES

A. All detection devices shall contain an integral alarm LED. All addressable detectors shall be individually identifiable by zone. Mounting bases shall be provided by life safety contractor, included with detector as a complete assembly.

B. The addressable photoelectric smoke detector shall be a plug-in, twist/lock unit, which shall be capable of removal from or installation into its base with one hand. Ionization smoke detectors shall:
1. Operate at 24Vdc, nominal.
2. Comply with UL 268.
3. The detector shall be dynamically supervised, indicating a trouble condition at the control panel when the detector is unable to sense a fire condition due to either internal and external operation conditions or malfunctions.

C. The analog addressable photoelectric/ thermal smoke detector shall contain an LED as its light source and photodiode as a light receiver. An automatic gain control circuit shall be provided to maintain correct sensitivity by compensating for detector aging and dirt accumulation. The detector shall be a plug-in twist/lock unit, which allows for easy connection to its mounting base. The detector shall provide complete supervision of the detector optics. The detector shall be supervised for complete failure of the LED light source or a critical reduction in the light output of the LED caused by excessive dirt, which could not normally be compensated for by the automatic-gain control circuit.

D. The addressable thermal detector shall be of the rate-compensated, fixed-temperature type. The detector shall be individually annunciated on the control panel. The detectors shall contain an integral alarm lamp.
E. The addressable programmable interface module is designed to provide an interface for direct- shorting contact devices. The unit is used with water flow switches, pressure switches, tamper switches on OS&Y valves, and other contact closure devices. The unit shall electrically supervise wiring to contacts via EOLR provided by life safety contractor.
F. The addressable manual pull station shall operate on any addressable detection circuit. The addressable manual pull station shall be individually annunciated on the control panel. The unit shall be double-action initiated, having latching relays.
G. The air duct smoke detector shall operate on a cross-sectional air-sampling principle to overcome stratification and skin effect. The air duct detector shall consist of a standard addressable photoelectric detector mounted in an air duct sampling assembly and sampling tube that protrudes across the duct of the ventilating system. The air duct detector shall retain the features of the addressable photoelectric detector, and be installed in the ventilating duct as indicated in the manufacturer's instructions. The air duct smoke detector shall come with appropriate addressable detector and base, remote test station, and inlet sampling tubes.
H. The detector mounting base shall be of the twist/lock type with screw terminals. Pigtails or inline connectors shall not be permitted. It shall be possible to secure the detector in the base. The detector mounting base shall be universal for addressable photoelectric detectors.
I. Alarm speakers (non-ceiling mounted) shall be of the polarized 24-Vdc type. The speaker shall have 70.7 VRMS inputs and have field-selectable power taps from 1/8 watt to 8 watts. Speaker shall have frequency response of 400 to 4,000 Hz and be UL listed for fire alarm voice evacuation use. Speaker shall have vandal-resistant white grill faceplate. Speakers shall be designed to be mounted on a wall or other suitable rigid surface and shall be capable of being surface, semi flush, or flush mounted.
J. Alarm speakers (ceiling mounted): The speaker shall have 70.7 VRMS inputs and have field selectable power taps from 1/8 watt to 8 watts. Speaker shall have frequency response of 400 to 4,000 Hz and be UL listed for fire alarm voice evacuation use. Speaker shall have 4-inch cone and shall have 7.25-inch-diameter circular metal faceplate with white enamel finish. Speakers shall be designed to be mounted on a wall, ceiling, or other suitable rigid surface and be capable of being flush mounted.
K. Alarm speakers (extra loud): The speaker shall have 70.7 VRMS inputs and have field- selectable power taps from 0.9 watt to 15 watts. Speakers shall have frequency response of 400 to 4,000 Hz and be UL listed for fire alarm voice evacuation use. Peak speaker output shall be 121 dB at 4 feet, 15 watt or 111 dB at 10 feet, 15 watt. Speaker shall have high- efficiency compression driver with re-entrant horn, and shall have a baked, white epoxy finish. Speakers shall be designed to be mounted on a wall, ceiling, or other suitable rigid surface, and be capable of being surface mounted.
L. Strobe lights shall produce 15, 30, 75 or 110 candelas, as indicated per Notification device on Drawings, at approximately one flash per second with continuously applied voltage. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40 percent. Rated voltage shall range from 18 to 31.2 volts for nominal 24-Vdc models. The flash and associated circuitry shall be enclosed in a translucent white polycarbonate lens with no inscription on the device. Plate color shall be white.
M. Water flow switches: Flow switches shall be UL listed for its intended purpose; furnished under Division 23 and electrically connected under Division 26. Individual addressable modules shall be provided on each switch.
N. Sprinkler Valve Tamper Switches: Switch shall be provided with either one or two sets of SPDT micro switches as required. Tamper switch shall be UL listed for its intended purpose, furnished under Division 23 and electrically connected by Division 26. Individual addressable modules shall be provided on each switch.

2.4 MASS NOTIFICATION

A. Mass notification shall meet audio intelligibility requirements. Intelligibility shall not be required to be determined through quantitative measurements. If quantitative measurements are desired, please follow Guidelines set forth in NFPA 72 Annex D.4 – Acceptability Criteria. Refer to testing requirements in Part 3.
B. Provide 8 channel, digital audio capabilities. The system shall have digital memory capacity for a minimum of 32 minutes of recorded messages.
C. The mass notification amplifier shall have an auxiliary input for a third party audio source.

2.5 CIRCUIT WIRING

A. Networked fire alarm addressable loop circuit communications shall be Class "A", style 7.
B. Fire alarm notification circuits shall be class "B", style Y.

C. Fire alarm auxiliary circuits shall be class "B".
D. Fire alarm system shall be capable of communications via TCPIP Ethernet network.

2.6 SPARE CAPACITY
A. System shall be designed to maintain a minimum of 20% spare capacity of all circuits.

2.7 REPORTING AND SIGNALING
A. System shall relay signals and report to the Campus Police Department, per Campus requirements.

PART 3 – EXECUTION

3.1 INSPECTION
A. Contractor shall examine the areas and conditions under which the fire alarm system is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install system and materials in accordance with the manufacturer's written instructions, drawing set, and details, the applicable requirements of the NEC and NFPA 72, and specifications in Division 26.
B. Junction boxes used as back boxes for fire alarm system field devices shall be 4-inch square with 2 1/8-inch minimums in depth. Install adapter plates and extension rings where required. Junction boxes for concealed conduit system shall be flush mounted.
C. Mount outlet box for electric door holder to withstand 80-pound-pulling force.
D. Upon initial installation, all fire alarm detection devices shall have the original plastic dust covers installed. Dust covers shall not be removed until installation is completed and the system is ready for test.
E. Each conductor shall be identified as shown on the shop drawings by attaching permanent alphanumeric wire markers within 2 inches of the wire termination at both ends. Marker legends shall be visible. Junction box and pull box covers shall be painted yellow or have embossed adhesive tape labeling that is minimum 1/4-inch white letters over a yellow background with text “Fire Alarm”. Install end-of-line device in box with text “End-of-Line” or “EOL”. Number-code or color-code conductors, appropriately and permanently for identification and servicing of system.
F. Splices shall only be made on terminal strips. All fire alarm wring shall be installed in raceways as per drawing. All external wiring shall be color-coded and shall not be installed in the same outlet box, junction box, or conduit with conductors of lighting or power systems.
G. Locate and install the detector assembly for optimum response time and easy accessibility.

3.3 TESTING
A. The entire fire alarm system shall be field tested in accordance with NFPA standards and other applicable standards in the presence of the Construction Inspector. Inspection and test method shall be in compliance with NFPA 72. Inspection and test record forms that are recommended by NFPA 72 shall be utilized. Results of such testing shall be recorded on forms approved for the purpose, certified and submitted to the Construction Inspector prior to final acceptance.

3.4 INTELLIGIBILTY TESTING FOR MASS NOTIFICATION
A. Speaker Intelligibility Testing: The speakers and sound levels shall be tested by the contractor to insure that the system meets the intelligibility standards for Fire Alarm and Mass Notification Systems. The sound from the speakers shall be a minimum of 15dB above the ambient noise levels throughout the facility. Testing shall be done with a Sound Level Meter or an Audio Analyzer. Contractor shall record the ambient and alarm sound levels as part of the “System Certification Test Report”. Also, the contractor shall test the intelligibility of the speakers throughout the facility to insure that the intelligibility meets the requirements of the UFC 4-021-1.The test shall be performed with an Audio Intelligibility Analyzer such as a Goldline DSP- 30B or the Quest Technologies Sound Pro SE/DL. The sound levels shall be tested at ear level throughout the facility and the results included in the “System Certification Test Report”. The minimum Intelligibility score shall be a .8 CIS (Common Intelligibility Score) or .7 STI (Speech Transmission Index). The mean value of at least three readings shall be used to compute the intelligibility score at each test location.
B. In areas that fail to meet the Intelligibility requirements, the contractor will add a sufficient number of speakers and retest the area until the intelligibility requirements are satisfied. In high ambient noise areas or in areas

where it is deemed impractical to meet the intelligibility levels, the AHJ has the authority to waive the testing in this area.

C. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than 0.8 if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet to a location with a CIS score of at least 0.8.

D. All test equipment; instruments, tools, and labor that required conducting the system tests shall be provided by the Contractor. The following equipment, but not limited to, shall be a minimum for conducting such tests.
   1. Ladders and scaffolds as required for access all field devices.
   2. Multi-meter for reading voltage, current and resistance.
   3. Intelligent device programmer/tester.
   4. Laptop computer with programming software for any required program revisions.
   5. Two-way radios, flashlights, smoke generation devices and supplies.
   6. Spare printer paper.
   7. Decibel meter.

E. Perform all electrical and mechanical tests required by the equipment manufacturer's certification form. In addition, measure and adjust each of the ionization detectors to the maximum stable sensitivity setting. This must be performed with the detector at its operational environmental conditions in the area. Bench settings are not acceptable. All test and report costs shall be in the contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate, of which one copy will be registered with the equipment manufacturer. The report shall include, but not be limited to:
   1. A complete list of equipment installed and wired.
   2. Indication that all equipment is properly installed and functions and conforms to these Specifications.
   3. Serial numbers, locations by zone and model number for each installed detector. All intelligent devices shall be tested and logged for correct address and sensitivity using test equipment specifically designed for that purpose. Sensitivity settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
   4. Wiring runs shall be tested for continuity, short circuits and ground before system is energized. Resistance, current and voltage reading shall be made as work progresses.
      a. A systematic record shall be maintained for all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates, and witnesses.
      b. The Owner shall be notified before the start of the required tests. All items found at variance with the applicable drawings and/or specifications during testing and inspection by the Owner shall be corrected by Contractor at no additional cost to the Owner.
      c. Test reports shall be delivered to the Owner when completed.
   5. Test of individual zones as applicable.
   6. Duct detector cfm readings with HVAC system operating.
   7. HVAC shutdown response upon smoke detection.
   8. Water flow alarm response upon water flow or tamper switch activation.
   9. Elevator recall, alternate floor recall, and power shutdown response.
   10. Firefighter’s emergency telephone response time.
   11. Response time on thermostats and flame detectors (if used).
   12. Technician's name, certificate number, and date.

F. Final Acceptance Test (FAT)
   1. The FAT shall be conducted in the presence of the Owner and under the supervision of the Manufacturer. Prior to FAT, the Owner shall be provided drawings showing the correct address for all addressable alarm initiation devices. The address shall be shown in their respective locations for the device on drawings. Signals shall be sequentially numbered as the address of the controlling module.
   2. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
      a. Open, short, and ground fault for intelligent analog signaling circuit.
      b. Open, short, and ground fault for intelligent digital signaling circuit.
      c. Open, short, and ground fault for network signaling circuit.
      d. Intelligent device removal.
      e. Primary power or battery disconnected.
      f. Type of device miss-match the address ID.
      g. Polarity check.
      h. Printer trouble, off line or out of paper.

3. System indications shall be demonstrated as follows:
    a. Correct message display for each alarm input at the remote control panel, central control panel and operator's workstation graphic display.
    b. Correct annunciator light for each alarm input at each annunciator and color graphic of operator's workstation.
    c. Correct printer logging for all system activity.
    d. Secondary power capacities shall be demonstrated as follows.
        1) System primary power shall be disconnected for a period of 8 hours. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period of 5 minutes.
        2) System primary power shall be restored 48 hours and system charging current shall be normal trickle charge for a fully charges battery pack.
        3) System battery voltages and charging currents shall be checked at the fire alarm control panel using the test code and displayed on the LCD display.
    e. Firefighter's HVAC override system functions shall be demonstrated as following.
        1) On/off control of each controlled element and test for interaction of others automatic and manual control functions while in the override mode.
        2) Correct status display of monitored elements.
        3) Correct logging of activity to printer and historical memory as programmed.
4. Test the entire system to verify compliance with the building emergency operation sequence specified by contract documents. Required tests include, but are not limited to, fire door control, security door control interface, air handler duct smoke detection shutdown interface, sprinkler system PIVs, OS&Y valves, and tamper switch monitoring, sprinkler systems water flow and/or pressure switch monitoring, monitoring of fire pump controls, fire/smoke damper control, smoke purge control interface, activation of deluge or pre-action sprinkler systems, and elevator recall power shutdown.
5. In the event of system failure to perform as specified and programmed during the FAT, the test shall be terminated at the discretion of the Owner.
    a. The Contractor shall retest the system correcting all deficiencies and providing test documentation to the Owner without additional cost to the Owner.
    b. In the event that software changes are required during the FAT, a utility program shall be provided by the system manufacturer to compare the edited program with the original. The utility shall field a printed list of the changes and all system functions, inputs and outputs affected by the changes. The items listed by the program shall be the minimum acceptable to be retested before calling for resumption of the FAT. The printed list and the printer log of the retesting shall be submitted before scheduling of the FAT.
    c. The Owner may elect to require the complete FAT to be performed again if, in their opinion, modifications to the system hardware or software warrant complete retesting.
    a. Provide power distribution boards with independently fused outputs.

3.5 MANUFACTURER'S FIELD SERVICES

A. Include services of factory-certified technicians to supervise installation, adjustments, calibrations, final connections, and system testing. A representative of the manufacturer shall instruct the Owner and demonstrate the system after the Owner has occupied the building.

B. Formal training for the operation and maintenance of fire alarm equipment and the systems specified herein shall be provided by manufacturer trained and certified personnel. The formal training shall consist of a minimum of five-day eight-hour training sessions or the number of hours as indicated per contract document. The timing of the training shall coincide with the schedule for the manufacturer's representatives to be on site for testing and start-up of each building fire alarm system. The formal training shall be provided at a location designated or provided by the Owner for number of personnel selected by the Owner, in addition to any informal on-site orientation and training.

C. A formal training proposal shall be submitted with curriculum material, schedule, instructor's qualification for the Owner's approval at least 60 days prior to formal training. The trainer shall provide approved training material manuals at the time of training with quantity of copies per Owner's instruction.

D. As-built drawings shall be provided upon acceptance of the system with quantities per contract document.

END OF SECTION