

SECTION 283111- DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the furnishing, installation and connection of a new microprocessor controlled, intelligent reporting, addressable fire alarm system with voice notification.
- B. The system shall include manual pull stations, smoke and heat detectors, carbon monoxide detectors, control modules, monitor modules, strobes, speakers, speaker / strobes, signal equipment, auxiliary control devices, annunciators, booster panels, amplifiers, wiring and all ancillary equipment typically required for a fully functional and coordinated turn-key installation.
- C. Additionally, the new gym fire alarm system shall be networked with the existing FCI E3 addressable fire alarm system in the main building. The existing fire alarm control panel will continue to dial out for the entire facility. Provide network cards for new and existing panel and class A network cables between the two panelboards as required.

1.2 DEFINITIONS

- A. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- B. Authority Having Jurisdiction (AHJ) Defined, Building Permits.
 - 1. **For private sector or local government projects the AHJ is the local government entity that approves project plans, issues building permits, and inspects construction.**

1.3 SYSTEM DESCRIPTION

- A. General: The system is an addressable type, with a 24vdc nominal operating voltage. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with any instructions included in its listing.
- B. The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the contractor:
 - a. On AC Input: A feed-through (not a shunt-type) branch circuit transient arrester such as the EFI HWM-120, Leviton OEM-120EFI, Northern Technologies TCS-HW, Transtector ACP100BWN3, or any equivalent UL Listed device submitted to and approved by the electrical design engineer. Install suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the arrester in suppressing voltage transients.
 - b. On DC Circuits Extending Outside Building: Adjacent to the FACU, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary

arrester, series impedance, and a fast acting secondary arrester that clamps at 30v-40v. Some acceptable models: Innovative Technology D2S33-2ML, Simplex 2081-9027 and 2081-9028, Transtector TSP8601, Ditek DTKxLVL series, Citel America B280-24V, and Northern Technologies DLP-42. Submit specifications on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show details of graphic annunciator.
 - 1. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
 - 2. Sizing calculations: Voltage drop, battery, and sound
 - 3. Device Address List: Coordinate with final system programming.
 - 4. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 - 5. Submit complete Shop Drawings to the engineer for review, prior to performing any work. These shall clearly demonstrate compliance with the engineer's plans and specifications, which have a System Response Matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. NOTE: Any non-compliant features must be fully described. Engineer's approval (with or without corrections) of contractor's Shop Drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve the contractor of responsibility for full compliance with the project plans and specifications.
 - 6. The fire alarm system shall comply with applicable provisions of the NC Building Code (available for sale at NCDol), and the National Fire Alarm Code (NFPA 72).
 - 7. Furnish all parts, materials, and labor customarily required or provided for a complete and operating system, in accordance with all requirements applicable, even if each needed item is not specifically shown or described in the project plans or specifications
- C. Operating Instructions: For mounting at the FACU.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the FACU manufacturer for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.
- C. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

- D. Comply with NFPA 72.
- E. Comply with NFPA 70.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses (If Used).....2 of each size in system
 - 2. Manual Fire Alarm Boxes.....2% of installed quantity
 - 3. Addressable Control Relays.....4% of installed quantity
 - 4. Indoor Speakers with Strobes Lights.....4% of installed quantity
 - 5. Indoor Strobe-only Notification Appliances.....4% of installed quantity
 - 6. Indoor Speaker-only Notification Appliances.....4% of installed quantity
 - 7. Monitor Modules (Addressable Interface).....4% of installed quantity
 - 8. Isolation Modules / Isolation Bases.....4% of installed quantity
 - 9. Addressable, Electronic Heat Detectors.....4% of installed quantity
 - 10. Spot-Type Smoke Detectors6% of installed quantity

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. FCI E3

2.2 FACP - General:

- A. The FACP shall meet the following general requirements (unless otherwise required by the owner for certain systems):
 - 1. The system is to be the addressable type, with a 24vdc nominal operating voltage.
 - 2. The system is to have multiple access levels so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. How to do this must be included in the training required to be given to the owner's designated personnel, and must also be part of the written documentation provided by the fire alarm equipment supplier.
 - 3. Signal Line Circuits: (SLC) also called addressable loop - Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto an NFPA Style 6 (Class A) Signaling Line Circuit (SLC) with no "T" taps.
 - 4. Initiation Device Circuits: Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).
 - 5. Notification Appliance Circuits: Notification appliance circuits shall be wired Class B (NFPA 72 Style Y).

6. Digitized electronic signals shall employ check digits or multiple polling. In general a single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 7. Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
- B. System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
1. The system alarm LED shall flash.
 2. A local piezo-electric signal in the control panel shall sound.
 3. The 80-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 4. On systems equipped with a printer, printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
 5. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated. Exact programming shall be provided by the Contractor to meet the Owner's requirements.
 6. Activate all fire alarm Notification Appliances in the building, sounding and flashing in synchronization continuously until manually silenced, or until the initiating device and control unit have been reset to normal condition.
 7. Activate digital alarm communicator.
 8. Deactivate control relays allowing HVAC units to run.
- C. System Response to a Trouble Condition:
1. Systems AC power trouble signal shall not be sent unless maintained for 1 to 8 hours (or more) Provide additional relays as required for this purpose.
 2. Provide immediate transmission of all other supervising signals.
 3. Provide adjustable time delay for all other trouble signals prior to transmission.
- D. FACP - Minimum Requirements: The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, printers, annunciators, and other system controlled devices. The main FACP shall perform the following functions:
1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
 2. Supervise all initiating, signaling, and notification circuits throughout the facility by way of connection to monitor and control modules.
 3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
 4. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, panel display, and annunciators.

- E. System Capacity and General Operation: The system shall have the following capacities and general operation modes:
1. The FACP shall provide, or be capable of expansion to 198 intelligent/addressable devices per SLC and 2048 annunciation points, minimum, per system. The number of SLCs provided shall be as indicated on the Drawings. Total points shall be as indicated on the drawings or otherwise specified.
 2. The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
 3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.
- F. The FACP shall be able to provide the following features:
- Upload/Download to PC Computer
 - Charger Rate Control
 - Alarm Verification with Tally
 - Drift Compensation
 - Automatic Day/Night Sensitivity Adjust
 - Device Blink Control
 - Pre-alarm Control Panel Indication
 - Trouble Reminder
 - NFPA 72 Smoke Detector Sensitivity Test
 - System Status Reports
 - Periodic Detector Test
 - Alarm Verification, by device, with tally
 - Non-Alarm Module Reporting
 - Block Acknowledge
 - Smoke Detector Maintenance Alert
 - Control-By-Time
- G. The control panel shall be capable of printing historical data and device parameters and shall include all equipment necessary to produce printouts, including an external printer and shall be U.L. listed as meeting the NFPA sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
- H. The system shall perform time based control functions including automatic changes of specified smoke detector sensitivity settings.
- I. The Fire Alarm System shall have multiple access levels which permit the Owner's authorized personnel to disable individual alarm inputs or normal system responses (outputs) for alarms

without changing the system's executive programming or affecting operation of the rest of the system. This must include the ability to override selected alarm inputs or system responses to alarms without affecting the remaining portions of the system. The owner shall be taught how to make these changes in the training program provided.

- J. Central Processing Unit: The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
1. The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if system primary and secondary power supplies fail.
 2. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
 3. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.
- K. Operators Control: Provide an operators interface which allows the following minimum functions. In addition, the operators interface shall support any other functions required for system control and/or operation:
1. Acknowledge (ACK/STEP) Switch
 2. Signal Silence Switch
 3. System Reset Switch
 4. System Test Switch
 5. Lamp Test Switch
- L. Display: The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
1. The system display shall provide an 80-character back-lit alphanumeric Liquid Crystal Display (LCD).
 2. The Display shall also provide four Light-Emitting-Diodes (LEDs), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.
 3. The system display shall provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
- M. Signaling Line Circuit (SLC) Interface Board: The FACP shall contain SLC interface boards as required to communicate with the SLC. Each SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.

1. Each SLC interface board shall contain its own microprocessor, and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC Loop operations. SLC interface boards shall provide power and communicate with all intelligent addressable detectors and modules connected to it's SLC Loop on a single pair of wires. This SLC Loop shall be capable of operation as NFPA Style 6.
 2. Each SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
- N. Power Supply: The FACP power supply(ies) shall operate on 120 VAC, 60 Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. Further, the power supply shall be expandable for additional notification appliance power in 3.0 Ampere increments.
- O. The power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge.
- P. Batteries: Shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm (maximum load) upon a normal AC power failure. NAC circuits shall not exceed 75% of maximum current load allowed.
- Q. Enclosures: The FACP shall be housed in a 3rd party listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).
1. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACU.

2.3 INITIATING DEVICES

- A. Addressable Devices - General: All initiating devices shall be individually addressable. Addressable devices shall comply with the following requirements:
1. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed and sensitivities set prior to acceptance of the system.
 2. Address Setting: Addressable devices shall provide an address-setting means.

3. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with two (2) wires.
 4. Operational Indications: Addressable initiation devices shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. Both LEDs shall be placed into steady illumination by the FACP to indicate that an alarm condition has been detected. The flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the device base to connect an external remote alarm LED.
 5. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
 6. Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
 7. Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
 8. Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition.
 9. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either ION, PHOTO, or THERMAL.
- B. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
- C. Ionization Smoke Detector: Ionization smoke detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.
- D. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F. (58°C.) and shall have a rate-of-rise element rated at 15°F. (9.4°C.) per minute. It shall connect via two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 99 intelligent heat detectors may connect to one SLC loop. Thermal detectors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.
1. Non-Rate of Rise Detectors: Provide thermal detectors with non-rate of rise thermal elements. Non-rate of rise detectors are indicated by NRR adjacent to the thermal detector symbol.

2. Specialized Element Temperature Ratings: Provide thermal detectors with specialized element temperature ratings. Specialized element temperatures are indicated by a temperature rating adjacent to the thermal detector symbol, e.g. 195°F.
- E. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate a velocity rated photoelectric detector. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP.
1. Installation: Duct detectors and related items shall be furnished and connected by the Division 16 (Electrical) Contractor but installed by the Division 15 (Mechanical) Contractor.
- F. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
1. All pull stations shall be dual-action, have a positive, visual indication of operation and utilize a key type reset.
 2. Construction: Pull stations shall be constructed of Lexan or other material suitable to the installation environment with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger. Stations shall be suitable for surface mounting or semiflush mounting as shown on the plans. Unless otherwise indicated on the Drawings pull stations shall be mounted at 48" Above Finished Floor.

2.4 MISCELLANEOUS SYSTEM ITEMS

- A. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone (either Style D or Style B) of non-addressable Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
1. Indication of Operation: An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
 2. Mounting Requirements: Monitor Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical boxes. Modules must be located in conditioned spaces unless they are tested, listed and marked for continuous duty across the range of temperatures and humidities expected at their installed location.
 3. Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler switch.
- B. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, Class A or B (Style D or B operation) of non-addressable 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings. Modules must be located in conditioned spaces unless they are tested, listed and

marked for continuous duty across the range of temperatures and humidities expected at their installed location.

1. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
2. Mounting Requirements: Monitor Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical boxes.

C. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay. The control module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. Modules must be located in conditioned spaces unless they are tested, listed and marked for continuous duty across the range of temperatures and humidities expected at their installed location.

1. Mounting Requirements: Control Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical boxes.
2. Configuration: The control module NAC circuit may be wired for Style Y (Class B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
3. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, 3rd party listed remote power supply. A/V power sources and connections are not shown on the Drawings
4. Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.

D. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. 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. Modules must be readily accessible (not above ceiling) and clearly labeled.

1. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. 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.
2. Mounting: The Isolator Module shall mount in standard 4-inch square, 2-1/8" deep electrical boxes. 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.

3. Labeling: Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built system drawings.
- E. Serially Connected LED Annunciator: Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings. Up to 10 annunciators may be connected to the EIA-485 communications loop.
1. Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset. All annunciator switches and indicators shall be software programmable.
 2. LCD Alphanumeric Display Annunciator: The Alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD annunciator shall display all alarm and trouble conditions in the system.
 3. System Capacity: The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence and Reset.
 4. Connections: The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.
- F. Remote Annunciator Indicator Lights (RAIL): RAILS shall be provided with a key type switch for testing of the annunciated device. In addition, RAILS shall have the following features:
1. Voltage: RAILS shall operate on 24 VDC nominal.
 2. Mounting: Provide flush mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Unless otherwise indicated on the Drawings, RAILS shall be mounted as described for electronic sounders above.
- G. Door Hold-Open Magnets: Door hold open magnets shall be suitable for mounting in a single gang electrical device box. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings. Holding force of the magnet shall be appropriate for the door to be held open. Door hold open magnets shall operate in a fail safe manner, i.e., the door shall release in event of a failure of voltage to the device.
1. Power Source: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised. Door hold open magnet circuits which use step-down transformers, 120 VAC, or local relays are not permitted.
 2. Device box support: Door hold open magnet device boxes shall be securely attached to the building structure by means of wood blocking or other equally effective means. Boxes attached directly to only one metal stud or boxes supported by means of expansion type fasteners are not acceptable.

- H. Battery Power Supply (BPS) &/or Supplementary Notification Appliance Circuit (SNAC): These types of panels shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 15 minutes of alarm upon a normal AC power failure. Battery cabinet shall be twice the size of the batteries it will contain. NAC circuits shall not exceed 75% of maximum current load allowed.
- I. Surge Protection: The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the electrical contractor:
1. On AC Input: A series type, feed through (not shunt-type) branch circuit transient suppressor such as the EFI E100HW120, Leviton 51020-OWM, Emerson/Northern Technologies TCS-HWR, Transtector ACP100BW series, or equivalent UL 1449 - 2nd Edition Listed device submitted to and approved by the electrical design engineer.
 2. On DC Circuits Extending Outside Building: Adjacent to the FACP, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrester, series impedance, and a fast acting secondary arrester that clamps at 30v-40v. Some acceptable models: Innovative Technology D2S33-2ML, Simplex 2081-9027/-9028, Transtector TSP8601, Ditek DTKxLVL series, Citel America B280-24V, Leviton 3824-OWM, Northern Technologies DLP-42. Submit data on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

2.5 NOTIFICATION APPLIANCES

- A. Alarm notification appliances, both audible and visible, shall comply with NFPA 72 requirements for intensity and placement. The standard audible evacuation signal shall be intelligible voice messaging as described in NFPA 72. Strobe lights shall be selected and located per NFPA 72 and all those installed in a single space must be synchronized.
- B. Alarm notification appliance (NAC) circuits shall be NFPA 72 Style Y (Class B). The load connected to each circuit must not exceed 80% of rated module output and the coverage of each circuit shall not exceed 3 floors (to limit the effect of faults, and to facilitate trouble-shooting). The NAC voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. To achieve this, the design must consider wire size, length of circuit, device load, inherent voltage loss within the FACU's power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.

2.6 Wiring

- A. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.

1. Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires unshielded cable
2. In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.

B. All cable shall be plenum rated.

2.7 CONDUIT

- A. All conduit and fittings shall be minimum 3/4 inch size, with compression type fittings having insulated throats.

PART 3 - EXECUTION

- A. firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
- B. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result.
1. Most applications of analog addressable smoke detectors do not require alarm verification to reduce nuisance alarms, as they are better able to discriminate between fire and common non-fire ambient events. A short operational test with normal occupancy can determine if transient ambient events are a problem
- C. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep.
1. High sensitivity may be appropriate in relatively benign, clean environments such as art museums and libraries, to improve system response time without causing nuisance alarms.
 2. Duct smoke detectors shall be programmed for supervisory annunciation per 2012 NC Fire Code 907.4.1.
- D. Print a complete System Status and Programming Report, after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.

3.2 FIRE ALARM CONTROL EQUIPMENT INSTALLATION

- A. The technician who makes final connections and programs the FACP is legally the "installer" even though most field connections to system devices and appliances are normally made by electrical contractor personnel. The responsibility for assuring a proper installation overall rests with this individual fire alarm system technician. In addition to doing the final hookups and activating the system, this individual is expected to check enough field connections to assure a

proper job was done there. The absence of system "trouble" signals is not a sufficient measure of the field wiring, which could have "T" taps, the wrong type of wire, improper terminations, ground (drain wire) issues, etc.

- B. No splices shall be made in the fire alarm system other than at device terminal blocks, or on terminal blocks in cabinets. Wire nuts and crimp splices are not permitted.
- C. The electrical contractor is not permitted to apply power to the FACP or any system power supplies, or to make any connections to them. However, the electrical contractor is responsible for installing and making field connections to initiating devices, notification appliances, control relays, and other components.
- D. The FACP must have an Alarm Silence switch, and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area must also include an audible signal with alarm resound feature.
- E. Notification Appliance Circuit booster power supplies must be individually monitored by the FACP and protected by a smoke detector per NFPA 72. They shall not be located above a ceiling, or in non-conditioned space. A 24vdc power circuit serving addressable control relays must also be monitored for integrity.
- F. All junction boxes shall be painted red prior to pulling the wire. Those installed in finished areas are permitted to be painted outside to match the finish color.
- G. Basic operating instructions shall be framed and permanently mounted at the FACP. (If the owner concurs, they may instead be affixed to the inside of the FACP 's door.) In addition, the NFPA 72 "Record of Completion" must either be kept at/in the FACP, or its location shall be permanently indicated there by engraved label.
- H. Provide an engraved label inside the FACP identifying its 120vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number.
- I. Alarm notification appliances (audible and visible) are to comply with NFPA 72, the North Carolina Building Code, and North Carolina Accessibility Code criteria for intensity and placement. The standard audible evacuation signal is the ANSI S3.41 three-pulse temporal pattern except it shall not be used if the planned action during fire emergency is to relocate occupants or protect in place, instead of immediate evacuation (e.g., some health care facilities, prisons). All strobe lights installed in a single space must be synchronized. See additional alarm notification appliance requirements for special situations. Contact the AHJ for additional information or to seek approval of any alternative design.

3.3 ADDRESSABLE INTERFACE MODULES (Control and Monitor Modules)

- A. Addressable interface modules (used to monitor all contact type initiating devices) must be located in conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location.
- B. One module can serve as many as 3 sprinkler system valve supervisory switches in a single space; otherwise provide one module per switch.

- C. One module may serve as many as 6 heat detectors, in a single space.
- D. Sprinkler system supervisory circuits for monitoring valve position, air pressure, water temperature, pump status, etc., must cause distinct audible and visible indications at the FACP. The audible supervisory signal shall either be a 4" diameter bell or a pulsing piezo-electric alarm. Provide the following engraved label adjacent to the bell/alarm: "SPRINKLER STATUS ABNORMAL". If only valve position is supervised, provide an engraved label reading: "SPRINKLER VALVE CLOSED"

3.4 SURGE PROTECTION

- A. For each AC power circuit that interfaces with fire alarm equipment install a series type, AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients. Shunt type suppressors are not allowed.
- B. On DC Circuits Extending Outside Building: Near the point of entry to or exit from each building install the surge arrester in a labeled enclosure.

3.5 RISER DESIGN

- A. The outgoing and return loops run in 2 separate vertical risers, to promote survivability during fire (critical for high-rise).
- B. A single loop is permitted to serve a maximum of 3 floors. However, if any loop serves more than 1 floor, include an isolation module at each terminal cabinet it uses.
- C. Provide isolation modules (or isolator bases) along each SLC (addressable loop).
- D. Notification Appliance Circuits (NAC's) are permitted to be Class "B" and serve a maximum of 3 floors.

3.6 AC POWER

- A. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.
- B. The branch circuit breaker(s) supplying the system must be physically protected by panelboard lock or handle lock and each must be identified with a 1/4" permanent red dot applied to handle or exposed body area.
- C. Provide an engraved label at each fire alarm system control unit, system sub-panel or data gathering panel, supplementary notification appliance (SNAC) panel, digital alarm communicator, etc., identifying its 120vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number.

- D. The fire alarm system shall monitor 120vac power to shunt trip breakers used in conjunction with fire suppression systems. Examples include a shunt trip used for cooking appliance power shut-off when the kitchen hood fire suppression system shoots, or primary elevator power shut-down upon sprinkler flow in any elevator equipment space or shaft. Use an addressable monitor module to accomplish this supervisory function.

3.7 CONDUIT AND WIRING

- A. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides. All painting of junction boxes and junction box covers shall be accomplished prior to installation of the boxes to avoid possible problems with overspray.
- B. Provide metal backboxes or plastic skirts as manufactured by the fire alarm manufacturer for devices installed in a surface mounted application. Such boxes shall match device in size and color.
- C. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- D. All fire alarm system wiring shall be in metal conduit. All fire alarm system raceway, couplers, and connectors must meet the performance and installation requirements of Section "RACEWAYS". Provide 3/4" minimum conduit.
- E. All conduit shall be concealed in finished spaces.
- F. All outlet, junction and pull boxes shall be concealed in finished spaces.
- G. All conduits that penetrate outside walls from air conditioned space must have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.
- H. All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:
 - 1. Initiating Circuits, General Red (+)/White (-)
 - 2. Initiating Circuits, Smoke Only Violet (+)/Gray (-)
 - 3. Signal Line Circuit cable Red jacket with Red(+)/Black(-)
 - 4. Alarm Indicating Appliance Circuits Blue (+)/Black (-)
 - 5. AHU Shutdown Circuits Yellow (+)/Brown (-)
 - 6. Door Control Circuits Orange
- I. Signaling Line Circuits (SLC's, also called addressable loops) must be NFPA Style 6 (Class A) with no "T" taps. Each must have a minimum of 20% spare addresses, for future use. Individual loops are permitted to cover more than 1 floor of a building.
- J. To minimize wiring fault impact, isolation modules shall be provided in all of the locations listed below. If ceiling height ≤ 10 feet, isolator base type initiating devices are permitted to be used to satisfy any or all of the following

1. In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators must be in the same room as the FACP and within 15 feet.
 2. After each 20 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer. (Check instructions.)
 3. For loops with less than 20 devices and control points, install an isolator at the approximate middle of the loop (in addition to those at the FACP).
 4. Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
 5. For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator[s] on any floor with over 20 addresses).
 6. Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings
- K. Except as required otherwise all circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductors, installed in conduit. Color code as shown below throughout the system, without color change in any wire run.
1. Alarm notification Appliance Circuits (strobes).....Blue (+)/Black (-)
 2. Separate 24vdc Operating Power (for equipment).....Yellow (+)/Brown (-)
 3. Door Control Circuits (magnet power, if from system).....Orange
 4. Circuits from Addressable Modules (ZAM's) to Monitored Devices (AWG 14/16)...Violet(+)/Grey (-)
- L. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.
- M. Style 6 Circuits Required: Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple non-addressable initiation zones, shall comply with the NFPA 72 requirements for Style 6 circuits.
- N. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- O. Permanent wire markers shall be used to identify all splices and terminations for each circuit. For splices, use markers or other means to indicate which conductors leads to the FACP. All junction boxes and covers shall be painted red prior to pulling wire. Those boxes in finished areas are permitted to be painted to match the finish color.
- P. In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. If building layout requires the terminal cabinet to be above a drop ceiling, its location must be clearly and permanently identified with a placard readable from floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

- Q. All new wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with a megger. Provide advance notice to the A/E of these tests.
- R. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.

3.8 NOTIFICATION DEVICES

- A. Both audible and visible alarm signals shall be provided. Visible signals must be the strobe (flash discharge) type, with white or clear lens, and shall comply with current ADA requirements for intensity and placement.
- B. The coverage of each fire alarm zone as described in the Drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable.
- C. Alarm notification appliance (NAC) circuits shall be NFPA 72 Style Y (Class B). The load connected to each circuit must not exceed 80% of rated module output and the coverage of each circuit shall not exceed 3 floors (to limit the effect of faults, and to facilitate trouble-shooting). The NAC voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. To achieve this, the design must consider wire size, length of circuit, device load, inherent voltage loss within the FACP 's power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.
- D. End of Line (EOL) resistors: On fire alarm notification circuits, end of line resistors shall be installed in accessible terminal cabinets or dedicated accessible boxes, to facilitate testing and maintenance. EOL resistors shall be located as follows:
 - 1. In a location that is accessible to fire alarm maintenance personnel.
 - 2. In an area where maintenance or testing at the EOL resistor location will not be disruptive to the normal use of the facility.
 - 3. In an area that is not easily accessible to the normal building occupants (objective is to avoid accidental or malicious damage by building occupants).
 - 4. In an area that is no higher than 9 ft. or lower than 7 ft. from the floor level.
 - 5. Not located in a stairway or bathroom location.

3.9 DETECTORS

- A. Detectors used for elevator: Primary and/or alternate recall points are as indicated on the control Matrix. Elevator capture or control signals shall come from the FACP as relayed by control modules.
- B. The FACP and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally).

- C. When installed in a room, detectors shall be oriented so their alarm light is visible from the nearest door to the corridor, unless Remote Alarm Indicator Light (RAIL) equipped.
- D. Spot-type smoke detectors shall have a built-in locking device to secure the head to the base, for tamper resistance. For detectors mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.
- E. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors must be replaced.
 - 1. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and must not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.
- F. Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACP: (Addressable Loop # -- Device #). Show on the as-built plans, and also permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception: For detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing. Device labels may not be affixed to the device. Identification labels must be printed labels with black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- G. Set spot-type smoke detector sensitivity to normal/ medium, unless directed otherwise by the design engineer or owner's representative. Make additional changes as directed during testing and certification of the system.
- H. Unless suitably protected against dust, paint, etc., detectors shall not be installed until the final construction clean-up has been completed. Contaminated detectors must be REPLACED by the Contractor at no additional cost to the Owner.

3.10 DUCT MOUNTED SMOKE DETECTORS

- A. All air duct/plenum detectors must have a Remote Alarm Indicator Lamp (RAIL) installed in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling. Duct smoke detectors are permitted to be installed only inside an air duct. It is not appropriate to mount them in front of a return air opening. Duct detectors shall also be installed in a manner that provides suitable, convenient access for required periodic cleaning and calibration.
- B. Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal.
- C. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with far end support for stability.
 - 1. The preferred method for providing support is to extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall, and plug the end with a rubber stopper. This facilitates visual inspection, intake tube cleaning, and injection of smoke or equivalent aerosol for testing the detector

- D. Duct smoke detector mounting position and air sampling tube orientation, are critical for proper operation. The Manufacturer's detailed installation instructions must be followed. The contractor shall mark the direction of air flow on the duct at each duct detector location.
 - E. All duct smoke detectors shall be programmed for supervisory annunciation per 2012 NC Fire Code 907.4.1.
 - F. position.
 - 1. This is to provide the owner with a convenient means to temporarily resume HVAC operation in the event an unwanted alarm will not clear, prior to arrival of the fire alarm service technician.
 - G. If the system includes AHU shutdown, silencing the alarm (without resetting) must not reverse the shutdown. A supervised "AHU Shutdown Defeat" switch must be provided in the FACP. The switch must be labeled and its "Normal" position indicated. Provide supervised Hand-Off-Auto switch(es) at the FACP for any building smoke control equipment (pressurization or exhaust fans).
- 3.11 ANNUNCIATOR - Each addressable fire alarm system must include an LED-type "zone" annunciator at (or in) the FACP. As a minimum, this annunciator is to indicate the specific type of alarm or supervisory signal (smoke detector, waterflow, sprinkler valve closed, etc.), for groups of addressable devices. The area ("zone") that is represented by each LED shall not exceed 1 floor or 22,500 square feet, and must not cross building fire walls or smoke compartments.
- A. Systems with a Graphic Annunciator (GA) are permitted to omit the LED-type "zone" annunciator.
 - B. The LED annunciator may be omitted if the FACP has a multi-line display that automatically defaults to displaying the first alarm, plus the first 3 (minimum) waterflow alarms and the last alarm. This is permitted to be done using 2 automatically alternating screens.
- 3.12 ALARM VERIFICATION FOR SMOKE DETECTORS
- A. The fire alarm system shall be equipped with Alarm Verification.
 - B. System shall provide as a feature an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable during system programming. The total effective delay created by the verification algorithm shall not exceed 60 seconds.
- 3.13 REMOTE ALARM TRANSMISSION REQUIREMENTS
- A. Each system with automatic fire detection, or which monitors a sprinkler system, shall be equipped with a 4-channel (minimum) Digital Alarm Communicator Transmitter (DACT) for transmission of fire alarm, supervisory, and trouble signals to a Central Station, Remote Supervising Station, or Proprietary Supervising Station. DACT shall be dual line type in accordance with NFPA 72.

- B. The following signals shall be reported as applicable:
 1. Fire Alarm
 2. Sprinkler Waterflow Alarm
 3. Fire Pump Running Alarm (if pump provided)
 4. Fire Pump Abnormal Status Supervisory Signal
 5. Sprinkler Valve Tamper (Closed) Supervisory Signal
 6. Sprinkler Low Temperature / Air Pressure Supervisory Signal
 7. Burglary / Intrusion / Duress / Other Security or Emergency Alarm
 8. Fire Alarm System AC Power Trouble (only if 120vac interrupted for 1 to 8 hours)
- C. The precedence of DACT / signals transmitted to the Supervising Station shall be as follows:
 1. Fire Alarm
 2. Security Alarm
 3. Supervisory Signal
 4. Trouble Signal*
- D. * Loss of AC power to FACP must not be transmitted until it has continued for 1 hour minimum. This avoids nuisance transmissions to the supervising station for brief power outages (switching transients, thunderstorms)
- E. "Trouble" signals shall not be sent unless maintained for 60 seconds or more to avoid nuisance transmissions due to alarm verification cycles.
- F. DACT shall be compatible with the owner's alarm receiving equipment. Contractor shall program the PROM, connect each DACT to the telephone line(s) provided, and verify proper signal receipt by the Supervising Station.

3.14 AUTOMATIC SMOKE DOOR AND AUTOMATIC LOCK REQUIREMENTS

- A. Wall-mounted magnetic door holders and separate heavy-duty closers shall be used, instead of combination door control units. The electromagnets shall be controlled by the building's smoke detection system FACP. Individual smoke detector auxiliary contacts shall not be used to release door holders.
- B. Automatic door locks controlled by the system must be either fail safe magnetic locks or fail-safe electro-mechanical with reverse bevel dead bolts.
- C. All lock protected doors must immediately unlock upon fire alarm, loss of AC power, disablement of the fire alarm system (defined as loss of 24 VDC power) or upon manual operation of an unlock switch at a constantly attended location.

3.15 SPRINKLER SYSTEM MONITORING

- A. The following sprinkler system alarm and supervisory functions shall be provided as a part of the fire alarm system:
 1. Waterflow alarm, by sprinkler zone (not to exceed one floor).
 2. Supervision of each control valve.

- B. Sprinkler supervisory monitoring of flow switches, tamper switches, and similar functions shall be accomplished with a separate system address for each activity monitored.

3.16 FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION

- A. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) must be supervised.
- B. Graphic Chart must be mounted behind Plexiglass and secured to surface. Mounting shall be such that charts cannot be removed without a flat head screw driver.
- C. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the control panel. A separate sheet shall be provided for each floor. Plans shall be reduced in size from engineering plans in order to fit on 11 x 14 sheets. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line resistors. Plans shall be bound in book form. Sheets shall be laminated. Provide legend for symbols. Provide holder for plan book in panel or in a locked box adjacent to panel keyed to match panel. Provide label for box and book.
- D. Loop 1 shall be assigned to the first floor devices and loop number shall increase with floor number. Device numbering starts in the same location on each floor and increase accordingly as circuit location increases.

3.17 FIRE AND LIFE SAFETY CRITERIA FOR DOORS CONTROLLED BY FIRE ALARM SYSTEM:

- A. Any exit or exit access doors that are locked to delay egress, in accordance with the NC Building Code, by use of one of the following types of locking hardware:
 1. Magnetic Lock (fail-safe) utilizing a 24vdc magnet and contact plate
 2. Electro-Mechanical Lock (fail-safe) with reverse bevel type dead bolt

Shall immediately unlock upon any fire alarm signal, loss of building AC power, disablement of the fire alarm system (defined as loss of its 24vdc power).
- B. Smoke doors held open by 24vdc wall/floor-mounted magnets powered by the FACP shall be released upon alarm. The resulting current drain shall be included in the standby battery calculations or the system must be programmed to drop the door hold-open magnet load 60 seconds after the loss of 120vac power.

3.18 SYSTEM DOCUMENTATION, TRAINING, AND MAINTENANCE

- A. Maintenance: The manufacturer, or authorized distributor, must maintain software version (VER) records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER to correct operating problems, free upgrade shall apply during the entire life of the system.

- B. System Report In addition to the Shop Drawing submittal described elsewhere, the fire alarm system contractor shall provide the engineer two bound copies of the following technical information, for transmittal to the owner:
1. As-Built wiring diagram showing all loop numbers and device addresses, plus terminal numbers where they connect to control equipment.
 2. Manufacturer's detailed maintenance requirements.
 3. Technical literature on all control equipment, isolation modules, power supplies, alarm/supervisory signal initiating devices, alarm notification appliances, relays, etc.
 4. The as-built "calculations" sheet
 5. Electronic archive: Complete configuration data (site-specific programming) for the system must be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A CD or USB jump drive copy of this data shall be submitted to the engineer for transmission to the owner on the day the system is commissioned.
- C. The contractor shall provide the owner with three copies of the following:
1. As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing all interconnections in the system.
 2. Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
 3. Technical literature on all major parts of the system, including control panels, batteries, detectors, manual stations, alarm indicating appliances, power supplies, and remote alarm transmission means.
- D. The contractor shall provide the owner with one copy of the following:
1. All software required, both for the installed fire alarm system and for any personal computer (PC) necessary to access the fire alarm system for trouble shooting, programming, modifications, monitoring, de-bugging, or similar functions.
 2. Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for system functions as described in (i) above.
 3. Framed floor plans, mounted at the FACP. Plans shall show all system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represented in the as-built drawings and those reported at the FACP and the LCD annunciator.
- E. The Contractor shall provide the owner with an interconnection cables, any dongle, hasp or software/hardware keys required, to connect the fire alarm system to a PC.
- F. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 2 hours on-site time shall be allocated for this purpose. Two copies of a written, bound summary shall be provided, for future reference.
1. Scheduling of training must be arranged to meet the Owner's schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.
 2. Training shall be in the Owner's provided classroom.
 3. The training may not be waived, deleted or reduced in the number of hours required.
 4. Training shall cover the following topics at a minimum:

- a. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
- b. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacture's approval or assistance.
- c. Explanation of all control functions.
- d. Methods and means of troubleshooting and replacement of all field wiring devices.
- e. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
- f. Manuals, drawings, and technical documentation.

3.19 SYSTEM TESTING & CERTIFICATION

- A. Interim Testing: Any changes to the existing system program, loop wiring or device modifications shall require 100% testing of the modifications and life safety functions of the system plus testing of 10% of existing devices. All interim testing shall be closely coordinated with the owner and shall be conducted after hours. Full operation of the existing system shall be maintained at all times while the building is occupied. Any lapses in coverage or notification shall require a contractor provided, third party fire watch.
- B. Upon completion of the installation the Division 28 Contractor and the Manufacturer's authorized installer together shall conduct a 100% performance test of each and every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Division 28 Contractor shall be present for the full 100% test.
- C. All Audio Visual Device Testing shall be scheduled with the owner. Testing to be conducted after hours or during student breaks.
- D. 100% Test: The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".
 - 1. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc. The engineer must be notified in advance of these 100% tests, to permit witnessing them if desired.
 - 2. If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device.
 - 3. The digital communicator shall be on-line and tested for proper communication to the receiving station.
 - 4. All supervised circuits shall be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)

5. 10% of the existing building shall also be tested at this time as required for recertification of the entire system.
 6. All testing described above shall be repeated in the event that subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
- E. Test Documentation: The installer shall fill out and submit the following documentation to the owner:
1. Written verification that this 100% system test was done with copy of print out generated during test.
 2. The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code-required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) shall sign this form.
 3. The System Status and Programming Report described in NFPA 72. This shall be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
 4. After completion of the 100% system test and submission of documentation as described above the installer is to request the engineer to set up an inspection. The system shall operate for at least two days prior to this inspection.

3.20 FINAL INSPECTION

- A. The fire alarm system shall be inspected and tested with the local fire marshal. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source.
1. The test will be conducted entirely by the Contractor. A copy of the final database software must be presented to the Owner before this test. The software shall be loaded from these disks into the system in the presence of the Owner. The review will then be conducted using this software. Any deficiencies shall be recorded and corrected. After the items have been corrected, the system shall be tested again.
- B. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections.
- C. Test Report: Upon successful completion of the Inspection and after the correction of all deficiencies, the manufacturer's authorized representative shall issue a test report to the Engineer and Owner, detailing and certifying the test.
- D. System Acceptance: After successful Final Acceptance and recommendation of the Engineer, the system will be accepted by the Owner. At this time the warranty period begins.

3.21 GROUNDING

- A. Ground cable shields and equipment according to system manufacturer's written instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

3.22 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean equipment internally using methods and materials recommended by manufacturer.

3.23 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within one year of date of Final Acceptance, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested visits to Project site for this purpose.

END OF SECTION 283111

TABLE I -- APPLICATIONS MATRIX FOR SELECTING DETECTION DEVICES

SMOKE/FIRE DETECTOR APPLICATION	ACCEPTABLE DETECTOR TYPES*			
	ION	PHOTO	IR/UV FLAME	HEAT
Atriums/Auditoriums		B**		
Corridors – Any Occupancy		X		
Office Areas	X	X		
Cable Rooms (PVC)		X		
Elevator Equipment Rooms	X			
Furnace/Boiler Rooms				X
Gymnasiums		B**		
Laboratories (Chemical)			X	X
Linen Rooms		X		
Mech/Elect. Equipment Rooms	X	X		X
Motor-Generator Rooms			X	X
Attics (Non-Conditioned Environment)				X
Loading Docks			X	X
Non-Conditioned or Hostile Environment			X	X
Storage (Conditioned Environment Only)	X	X		
Duct Smoke Detectors		X		

** "B" symbol indicates projected beam (linear beam) type smoke detector with separate transmitter and receiver, or with transceiver and prism reflector.

Spaces which may be exposed to vehicle exhaust, fumes from nearby cooking, fireplaces, etc., high/low temperatures or high humidity (including dishwashing, laundry) are generally unsuitable for the use of smoke detectors. Heat detectors should include the rate-of-rise feature unless installed where temperatures may rise more than 15°F/minute from space heaters, vehicle exhaust stacks, furnaces, or following outside door closure.

END OF SECTION 283111