

SECTION 16720

FIRE ALARM AND SMOKE DETECTION SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire Alarm and Smoke Detection Systems.

1.02 RELATED SECTIONS

- A. Section 16120 Building Wire and Cable.
- B. Section 16130 Boxes.
- C. Section 16195 Electrical Identification.
- D. Section 16721 Fire Alarm Infrastructure – Structured Cabling

1.03 REFERENCES

- A. NFPA 70 , 2017 National Electrical Code
- B. NFPA 72, 2016—National Fire Alarm Code
- C. ANSI A117.1—1986—American National Standard for Building and Facilities Providing Accessibility and Usability for Physically Handicapped People.
- D. NFPA 101 2018 —Life Safety Code.
- E. NEC Article 760—Fire Protective Signaling Systems.
- F. Americans with Disabilities Act of 1990
- G. Florida Accessibility Code for Building Construction—2012
- H. Florida Fire Prevention Code 2020, Seventh Edition
- I. Florida Building Code -Seventh Edition (2020)
- J. FBC Section 453: State Requirements for Educational Facilities

1.04 REGULATORY REQUIREMENTS

- A. System: Listed by a Nationally Recognized Testing Laboratory.

1.05 SYSTEM DESCRIPTION

- A. Furnish, install, and place in operating condition an electronically operated fire alarm system as described herein and shown in the plans. All units on the fire alarm system shall be listed by a Nationally Recognized Testing Laboratory (i.e., Underwriters' Laboratories, Inc., etc.) for fire alarm use, and the control panel shall bear the UL label. The system shall be installed in accordance with requirements set by National Electrical Code and in compliance with applicable provisions of Standard 72 published by the National Fire Protection Association (NFPA).

- B. Fire Alarm: The system shall be a microprocessor based point annunciated fire alarm system with walk-through test capability. The control panel and each individual component used in conjunction with the system shall be UL listed for its use. The system shall be totally supervised with a dynamic LCD display. The control panel shall also be able to monitor and receive analog signals from smoke and duct smoke detectors which indicate obscuration rate and set detector sensitivity. The input power shall be 120 volts, A/C 60 Hz connected per NFPA 72 and NEC. The operating power shall be single power source of 24 volts DC and filtered and regulated within 110% of the normal rating. Total power supply capacity shall be 50% greater than the total alarm load. The control panel shall be supervised on the input power line with automatic switch over to battery backup. The battery backup supply shall be capable of powering the system for at least twenty-four (24) hours and still be capable of energizing all signal devices for a period of at least fifteen minutes. Bypass switches shall be provided for Gas Shutdowns, AHU Shutdowns, Notification Circuits, Elevator Recall, and Door holders.

- C. System's Connection: The control panel shall have a minimum of two (2) initiation circuits (Loops) (IDC) and be capable and wired so that anyone or multiples of fire alarm devices, upon activation, shall sound alarm throughout the entire facility.

- D. Control panel shall provide voice evacuation features as follows:
 - 1. A new control panel 1) installed as part of a new fire alarm system in a new school or 2) installed as part of a an entirely new fire alarm system to replace the existing system in an existing school, shall include voice evacuation features compliant with FBC 907.

 - 2. A new control panel installed to replace an existing control panel (without replacing the entire fire alarm system) shall be installed in assembly areas pursuant to requirements of FBC 453.

1.06 QUALIFICATIONS

- A. Manufacturer: Must be a Certified VES Fire Detection System installer with five years documented experience.
- B. Manufacturer: Must be Certified EST IO System installer with five years documented experience for work in existing buildings.
- C. Installer: Company specializing in smoke detection and fire alarm systems with five year's experience and certified by Florida State Licensing Board as fire alarm installing contractor.

1.07 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Provide wiring diagrams, point to point with voltage drop calculations, data sheets, and equipment ratings, layout, dimensions, finishes, and battery calculations.
- C. Submit manufacturer's installation instructions under provisions of Division 1.
- D. Submit manufacturer's certificate under provisions of Division 1 that system meets or exceeds specified requirements, certification per NFPA 72.
- E. Provide unit prices for training for each member of the District Staff on the operation, maintenance, and repair of the system at the Contractor's expense. Training shall be certified by the manufacturer and be at different times for each person. Include transportation, room and board where needed.
- F. A PERMIT must be obtained from the HCSD Facilities & Construction Department District Fire Official before any work starts.
- G. All existing cables must be removed from existing conduit raceways, if possible reuse the existing conduit raceways. If not the conduit raceways and J-Boxes must be removed.

1.08 PROJECT RECORD DRAWINGS

- A. Submit documents under the provisions of Division 1.
- B. Provide point-to-point as-built drawings for the entire fire alarm system with addresses marked on plans and each device.
- C) Include location of end-of-line devices on plans and each device.
- D) Power Extender Panels (Booster Power Supply) NAC circuits must be labeled in the panel and also have each individual circuit marked on the plans and each device.
- E) Two copies of the Fire Alarm Program must be provided. One is to be located at the school in the Main Fire Panel and the other is to be delivered to the Electronics Dept. Representative.

1.09 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Division 1.
- B. Include operating instructions, and maintenance and repair procedures, with parts list. Three copies of complete troubleshooting and repair manuals.
- C. Include manufacturer representative's letter stating that system is operational.
- D. Maintain system for a minimum of one year after complete acceptance by the Owner, and provide another Test and Certification of the system in accordance with NFPA 72 before warranty period ends

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 1.
- B. Store and protect products under provisions of Division 1.

1.11 EXTRA MATERIALS

- A. Provide a minimum of six (6) spare devices/parts of the following: Duct Detector Housing with Head, Pull Stations with Module, Monitor Relay's, AHU Shutdown Relay, Horn, Strobe and Horn/Strobe Combo.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The system design is based on the VES Fire Detection Systems catalog numbers shown and constitute the type and quality of equipment to be furnished.

2.02 GENERAL

- A. Provide a complete fire alarm system including, but not limited to, the following components:
 - 1. VES Compas (two loop minimum) Panel with network card and flush mount trim kit, Hochiki PE-10SN Power Extender (BPS) and flush mount trim kit, VF0716 Disablement Switch Enclosure and flush mount trim kit, Moxa TCF-142M-ST Fiber Converters, Voice Alert EVAC Panels, other VES devices, and a document box.
 - 2. Provide the VES Guide Software and Hardware to match the system and a HCSD and VES approved computer (windows 10 with battery back-up) at the fire panel in the MDF.

2.03 FIRE ALARM PANEL (FACP) VES FIRE DETECTION SYSTEMS PANELS

- A. Control panel construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions.

A local audible device shall sound during alarm, trouble or supervisory conditions. This audible device shall sound differently during each condition to distinguish one (1) condition from another without having to view the panel. This audible device shall also sound during each keypress to provide an audible feedback to ensure that the key has been pressed properly.

- B. The following primary controls shall be visible through a front access panel:
 - Individual red system alarm LED
 - Individual yellow supervisory service LED.
 - Individual yellow trouble LED.
 - Green "power on" LED.
 - Alarm acknowledge key.
 - Priority two alarm acknowledge key.
 - Supervisory acknowledge key.

- Trouble acknowledge key.
- Alarm silence key.
- System reset key.

C. The control shall provide the following:

- Setting of time and date.
- LED testing.
- Alarm, trouble, and abnormal condition listing.
- Enabling and disabling of each monitor point separately.
- Activation and deactivation of each control point separately.
- Changing operator access levels.
- Walk test enable.
- Running diagnostic functions.
- Displaying software revision level.
- Displaying separate alarm and trouble logs.
- Displaying card status.
- Point listing.
- Monitoring detector obscuration rate.
- Setting of detector sensitivity.

- D. For maintenance purposes, the following lists shall be available from the point lists menu.
- All points listed by address.
 - Monitor point list.
 - Signal/speaker list.
 - Auxiliary control list.
 - Feedback point list.
 - Pseudo point list.
 - LED/switch status list.
 - Horn silence switch.
 - AHU shutdown override switch.
 - Power supply current draw in alarm condition.
 - Power supply current draw in standby condition.

2.05 DEVICES AND ACCESSORIES

All panel circuits and devices on system shall be addressable and labeled clearly with its address on each circuit/device.. Addressable shall be defined as a smart device that is assigned an address in plain language for monitoring on the LCD. All addressable devices shall have the capability of being disabled or enabled individually.

Should a device fail, it will not hinder the operation of other system devices.

All devices on system shall be supervised. A supervised system shall detect troubles in panel or wiring, removal or tampering of point devices, monitor either open or closed circuits, and verifies system integrity.T-tapping of the circuit wiring will not be accepted.

Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact. Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. The system must verify that proper type device is in place and matches the desired software configuration.

All addressable smoke and heat detector heads as specified below will be pluggable into their bases. The bases will contain electronics that communicate the detector status (normal, alarm trouble) to the control panel over two (2) wires. The same two (2) wires shall also provide power to the base and detector. Different detectors heads (smoke or heat) must be interchangeable. Upon removal of the head, a trouble signal will be transmitted to the control panel. Auxiliary contacts shall be provided and wired to the elevator controller where shown as smoke detectors with elevated recall contacts.

- A. **PHOTOELECTRIC DETECTOR HEAD:** The photoelectric type detector shall be a plug-in unit which mounts to a twist-lock base and shall be UL approved. Detector to provide an analog signal to the panel for monitoring of obscuration rate and maintenance of constant detector sensitivity.

To minimize nuisance alarm, voltage and RF transient suppression techniques shall be employed as-well-as a smoke verification circuit and an insect screen. The detector design shall provide full solid-state construction and compatibility with other normally open fire alarm detection loop devices (heat detectors, pull stations, etc.). The detector head shall be easily disassembled to facilitate cleaning.

The detectors shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry.

The detector shall fit into a verifiable type base that is common with both the heat detector and ionization type detector and shall be compatible with other addressable detectors, addressable manual stations and addressable zone adapter modules on the same circuit. The detector shall also fit into a non-addressable base that is capable of being monitored by an addressable zone adapter module.

There shall be no limit to the number of detectors or zone adapter modules which may be activated or in alarm simultaneously. The operating voltage shall be 24 VDC and operate on a supervised loop. The control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate for duct and dirty conditions that could affect detection operations. The adjustable level shall be between 0.2% and 3.7% smoke obscuration.

The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined value, a "DIRTY SENSOR" trouble condition shall be audibly and visually indicated at the control panel. Additionally, the LED on the sensor base shall glow steady. If a "DIRTY SENSOR" is further contaminated, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel.

The control panel shall continuously perform an automatic self-test routine on each sensor to ensure the accuracy of the values being transmitted to the control panel by the sensor. Any problem with the self-test shall be indicated by a "SELF TEST ABNORMAL" trouble condition at the panel.

Each sensor shall be capable of being individually set for percent smoke, time of day for percent, and multiple threshold settings.

- B. **OPTICAL BEAM SMOKE DETECTOR:** The optical beam smoke detector shall have 330 feet x 50 feet area coverage. The transmitter shall project a modulated infrared light beam to the receiver. When the signal strength at the receiver is reduced to a level between the obscuration threshold and 93% for more than 8 to 10 seconds, the fire alarm output relay is activated. The alarm obscuration threshold shall be selectable at 25%, 35%, or 50% obscuration.

- C. **PULL STATIONS:** Pull stations will contain electronics that communicate the station's status (alarm, normal) to the transponder over two (2) wires which also provide power to the pull station. They will be manufactured from ABS plastic with a toggle switch, raised white lettering and a smooth high gloss finish and will have a toggle switch to activate the system. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations will be normally open, dual action manual stations with Stopper II Cover .

The front of the station is to be hinged to a back plate assembly and must be opened with a key to reset the station toggle switch. The key shall be common with the control panels. Stations which use Allen wrenches or special tools to reset will not be accepted.

The manual station shall be capable of field programming of it's "address" location on all addressable initiating circuit and labeled with it's device address.

There shall be no limit to the number of stations, detectors, or zone adapter modules, which may be activated or in alarm simultaneously.

- D. AUTOMATIC HEAT SENSOR:** Device shall be combination rate-of-rise/fixed temperature sensor of which both operations are self-restoring. The temperature shall be field selectable. Auxiliary contacts shall be provided and wired to the elevator controller where shown as heat detectors with elevator shunt trip contacts.
- E. VISUAL FLASHING LAMPS (XENON STROBE):** Visual indicating appliances shall be comprised of xenon flashtube and be entirely solid state. These devices shall be UL listed and be capable of either ceiling or wall mounting. The Lexan lens shall be pyramidal in shape to allow better visibility. Separate alarm indicating circuits shall be provided for strobes. The maximum strobe pulse duration shall be 0.2 seconds with a maximum duty cycle of 40 percent. The flash rate shall be at least 1 Hz but not to exceed 2 Hz. Strobes shall be provided in accordance with the latest applicable version of NFPA 72 and the candela rating of strobes provided shall be sized to meet the room requirements. All strobes shall be ceiling mounted unless wall mounted strobes are requested by the HCSD. Where requested, wall mounted strobes shall be mounted 80 inches above the finished floor to center line of lens, or six inches below the ceiling, whichever is lower. All visual indicating appliance output levels will be sized per NFPA 72, Chapter 6. Submitted shop drawings will show output levels per each strobe.
- F. Combination Alarm Unit (Horn and Strobe):** Provide Manufacturer's heavy duty construction combination horn and strobe (clear lens) unit. Horns shall be listed for fire alarm use by Underwriter's Laboratories, Inc. The horn strobe units shall be ceiling mounted unless wall mounted strobes are requested by the HCSD. Where requested, wall mounted strobes shall be semi-flush mounted 80 inches above the finished floor to center line of lens, or six inches below the ceiling, whichever is lower at the locations indicated on the plans. No outdoor alarm signals devices will be accepted.
- G** All audible alarms must be 15 dba above ambient or exceed any maximum sound level for 60 seconds by 5 dba, whichever is louder. Sound levels not-to-exceed 120 dba.
- H. COMBINATION ALARM UNIT (SPEAKER AND STROBE):** The fire alarm speaker shall be VES VF4022-10. The speaker shall be capable of producing alarm tones or voice on all 25 or 70.7 VRMS audio systems. The speaker shall provide incremental tap settings of 1/8, 1/4, 1/2, 1, 2 or 4 watts. Minimum dBA ratings at 1/4 watt shall be 76.7dBA and at 4 watts 87.9dBA. Tap settings shall be adjustable with field selectable jumper pins. The speaker shall also have a visual signal capability. The visual signal shall have a 1Hz flash rate regardless of input voltage. All field wiring connections shall be made via separate inout terminal connections and the speaker or speaker strobe shall be UL, CSFM and BS&A/MEA listed and comply with all local, state and federal fire alarm codes/standards. All visual alarms shall be ceiling mounted unless the HCSD request wall mounted, then they should be mounted 80 inches above the finished floor to center line of lens, or six inches below the ceiling, whichever is lower. All visual indicating appliance output levels will be sized per NFPA 72, Chapter 6. Submitted shop drawings will show output levels per each strobe.

- I DUCT DETECTOR:** Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Detector shall include relays as required for fan shutdown.
1. The addressable duct smoke sensors shall operate on the light scattering, photo-diode principle, and shall communicate actual smoke chamber values to the system control. The sensors shall not have a self-contained smoke sensitivity setting and shall automatically communicate actual smoke chamber values to the system control unit. The sensor's electronics shall be shielded to protect against nuisance alarms from EMI and RFI.
 2. The duct housing (VES Model # VF5014) shall provide an auxiliary alarm relay with two "Form C" contacts rated at 2A @ 28 VDC or 120 VAC . This auxiliary relay operates when the sensor reaches its alarm threshold, or when the control unit via software control, manually or automatically operates the relay in response to inputs from other devices.
 3. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
 4. Each duct detector shall have a VES Model # VF5023-00 Key Operated Test Switch with LED Indicator for each duct smoke detector. Located in mechanical rooms serving same and label all stations with an affixed nameplate indicating AHU number and supply/return as applicable.

2.06 NETWORK

- A. The system must provide communication with initiating and control devices individually, and other control panels, via Certified Dedicated Fire Alarm 12 strand Fiber Cable with all strands to be terminated with (ST) connectors between Panels using Moxa TCF - 142M- ST Fiber Converters in a Hubbell Fiber Cabinet (Model # - FCW4SPRDGSA). All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
- Alarm
 - Trouble
 - Open
 - Short
 - Device missing/failed
- B. The communication format must be a complete RING protocol to allow for proper degree of communication reliability, which allows the checking routines for address codes and check sum routines for the data transmission portion of the protocol.
- C. All Fiber Optic Cabling and associated equipment shall be furnished and install in compliance with the HCSD Specification Section 16721 Voice/Data Infrastructure - Structured Cabling where required as part of a Fire Alarm System installation

2.07 REMOTE ANNUNCIATOR PANEL (FARA)

- A. Where shown on the plans, provide and install a serial annunciator. The annunciator(s) shall be eighty character liquid crystal display. The annunciator shall communicate to the control panel over one twisted shielded pair of wire and operating power shall be 24 VDC and be fused at the control panel and emulate all of the control/annunciation functions of the control panel.
- B. The serial annunciator shall provide a common alarm and trouble circuit consisting of, but not limited to, the following:
 - 1. Control pushbutton switches for: alarm silence, trouble silence, system reset, and manual evacuation duplicating the control panel switches. A key "enable" switch shall be provided to activate or deactivate the control switches.
 - 2. Tone Alert—Duplicates the control panel tone alert during alarm and trouble conditions.
 - 3. System trouble LED.
 - 4. Power ON LED.

2.08 BATTERY BACK-UP

- A. The system shall be battery back-up for 24 hours with fifteen (15) minutes of alarm capabilities (per NFPA 72).

2.09 LIGHTNING PROTECTION

- A. Provide Isolated Loop Circuit Protectors.
- B. Provide lightning protection at all points entering and leaving each building and at the FACP and FATC locations shown on drawings.
- C. Data Loop protection shall be manufactured by Ditek DTK-4LVLPSCPLV and listed for use with the fire alarm system. NAC Circuits protection shall be manufactured by Ditek DTK-4LVLPSCPLV.
- D. Provide Ditek DTK-HW for all other AC circuits in the fire alarm system.

2.10 ALARM COMMUNICATION TRANSMITTER

- A. Provide an AES Intellinet RF Mesh Radio Transmitter Model# 7788F where shown on the drawings.
 - 1) TRANSMIT ALARM, SUPERVISORY AND TROUBLE SIGNALS TO THE CENTRAL MONITORING CENTER

PART 3 EXECUTION

3.01 INSTALLATION OF FIRE ALARM SYSTEM

- A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECAS "Standard of Installation." Locate FACP Panels in the MDF or Electric/Storage Secured Area and the FARA Panels and the Voice Evacuation Panel with microphone at the Main Office and in the Areas of Assembly.
1. Fire Alarm Control Panels and Power Extender Panels shall be labeled inside the door to include: Electrical Panel, breaker number, and Panel Location Room Number. Each Panel that supplies AC power to the fire alarm system equipment shall be labeled on the panel cover to indicate that fire alarm equipment is supplied from the panel. Each breaker shall be equipped with a locking device and shall be clearly identified in the panel
 2. Provide Power Extender Panels (Booster Power Supplies) with a minimum 30% spare capacity. Power Extender Panels (Booster Power Supply) NAC circuits must be labeled in the panel and also have each individual NAC circuit marked on the plans and on each device
- B. Wiring Systems and Materials
1. Wiring shall be in accordance with requirements of the National Electrical Code and NFPA Regulation #72. The fire alarm system, including components and wiring shall be completely installed and wiring shall be properly tagged and color coded. The Fire Alarm Contractor shall make final connections as shown and required by the equipment manufacturer's wiring instructions.
 2. Use 18 GA Stranded FPLP wire for fire alarm detection/initiating and 14GA Stranded FPLP wire for the signal circuit. Install wiring in a Minimum ¾ inch metal conduit. Provide wiring of adequate size to prevent voltage drop. Submit load calculations for each signal circuit and zone circuit indicating actual voltage drop and proper size conductors.
 3. Color Code—the color codes of the fire alarm cabling shall conform to the following:
 - a. Horn/Visual Strobes 14 GA FPLP Stranded White Jacket Cable using Red (+) and Black (-). Must be equal or greater than Reliable Wire Co # RWC-P142C-WH
 - b. Pull Station/Heat/Smoke Detector—18 GA FPLP Stranded Blue Jacket Cable using Red (+) and Black (-). Must be equal or greater than Reliable Wire Co # RWC-P182C/MI-BL
 - c. DC Power, Fan Shut-down/Door Release Relays— 14 GA FPLP Stranded Red Jacket Cable using Red (+) and Black (-) Must be equal or greater than Reliable Wire Co # RWC-P142F-STR-RD

- d. Audio/Speaker Cable --- Belden 9571 18/2 UTP Red Jacket FPLR or Belden 16/2 UTP Red Jacket FPLR, or Belden 9580 14/2 UTP Red Jacket FPLR or Belden 9582 12/2 UTP Red Jacket Cable per Manufacture requirements, Red (+) Black (-).
4. All junction box covers shall be painted red and all lengths of conduit shall have at least one red stripe every five feet.
5. Shutdown relays and control equipment shall be mounted within three feet of controlled device. Label all fan shutdown relay modules with an affixed nameplate. Relays to be located directly adjacent to motor starters.
6. If the Owner approves copper between Buildings, Portables, then West Penn Aquaseal Stranded Fire Alarm Cable must be used and sized based to manufacture specifications.
7. Horn and strobe appliance circuits shall be loaded no more than a maximum of 70% of the circuit's operating capacity.
8. Provide Power Extender Panels (Booster Power Supply with a minimum 30% spare capacity. Power Extender Panels (Booster Power Supply) NAC circuits must be labeled in the panel and also have each individual circuit marked on the plans and each device.

3.02 QUALITY ASSURANCE

- A. NEC Compliance—Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories.
- B. UL Compliance and Labeling—Provide fire alarm and detection system components which are UL listed and labeled. Installation is to be by a UL listed installer.
- C. Miscellaneous Compliance—The fire alarm system is to be installed in accordance with the equipment manufacturer's written instructions and complying with all applicable portions of the NECAs "Standard of Installation" and all local codes and ordinances.

3.03 FIELD QUALITY CONTROL

- A. Inspect relays and signals for malfunctioning, and where necessary adjust units for proper operation to fulfill project requirements. Any final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of fire alarm and detection system equipment. The Manufacturer's representative shall perform a quality inspection of the final installation. Then, in the presence of the Fire Alarm Contractor, Fire Marshall and Owner's Representatives, shall perform a complete functional test of this system. A system certification verifying the proper system operation shall be required prior to acceptance by the Owner.

*****Note: A Low Voltage Inspection by the HCSD Electronics Dept. Representative is required before Final Trim Out *****

- B. Testing: The Contractor shall perform all electrical and mechanical tests required by the equipment manufacturer's form and National Fire Protection Association Standard 72. 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, one (1) copy of which will be registered with the equipment manufacturer, one (1) copy to be maintain at the Fire Alarm Control Panel. The report shall include, but not be limited to:
1. A complete list of equipment installed wired and tested.
 2. Indication that all equipment is properly installed and functions and conforms to the manufacture specifications.
 3. Tests of individual SLC Loop.
 4. Address numbers, locations by SLC Loop and model number for each installed detector and remote led.
 5. Response time on thermostats and flame detectors (if used).
 6. Technician's name, certificate number and date.
- C. Documentation: After completion of the tests and adjustments listed above, the Contractor shall submit the following information to the Owner.

A copy of the test report described in this specification and a Certificate of Compliance prepared as per National Fire Protection Association Standard 72 Chapter 2, Section 2-2.4, and State Fire Marshal's Rule 4A-48 to be complete at final test.

Affixed to the main FACP a standard service tag, as described in rule 4A-48 for fire alarm contractors by the Office of the State Fire Marshal.

Final tests and inspection shall be held in presence of the Owner and Engineers' representatives and to their satisfaction. The Contractor shall supply personnel and required auxiliary equipment for this test without additional cost.

To assure that wire size, power supply, number of devices on a circuit, etc. are suitable to support 100% of devices being in alarm or operated simultaneously, this test shall include the following:

1. Place all sensors and monitor modules in alarm. Each shall display it's address or zone and alarm condition. At least the first five (5) devices on each circuit shall also have their alarm LEDs lighted.
2. Operate all control modules for the alarm or operated condition. Each module shall display it's address and condition.
3. Reset all alarmed and operated devices. The panel shall display the address or zone of any off-normal devices.

4. Test a representative number of sensors for alarm verification by momentarily testing for alarm. The sensor shall not initiate an alarm. Then, test by placing the sensor in alarm such that it remains in alarm for the selected verification time. The sensor shall initiate an alarm.
5. Verify the operation of the latching relay associated with the Central Monitoring Station Mesh Radio. Reset the relay after each test.
6. Perform Pressure Differential/Air Velocity test for each duct-mounted smoke detector. Include the results of each test in the testing reports.

Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any unwarranted alarms. Should unwarranted alarm(s) occur, the Contractor shall readjust or replace the detector(s) and begin another ninety (90) day test period. The Contractor shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until the Owner has obtained beneficial use of the building under tests.

If the requirements provided in the paragraph above are not completed within thirty (30) days after beginning the tests described therein, the Contractor shall replace the system and the process repeated until acceptance of the equipment by the Owner.

The Contractor shall provide three (3) sets of signed and sealed submittals to be accepted upon the Engineer's approval.

A statement of guarantee including date of termination and name and phone number of the person to be called in the event of equipment failure. Individual factory issued manuals containing all technical information on each piece of equipment installed. In the event that such manuals are not obtainable from the factory, it shall be the responsibility of the Contractor to compile and include them. Advertising brochures or operational instructions shall not be used in lieu of the required technical manuals.

One (1) copy of all approved shop drawings, instruction sheets, operating instructions, and spare parts bulletins.

A training session, for up to ten (10) hours to personnel selected by the Owner, shall be presented by a fully qualified, trained representative of the equipment manufacturer who is thoroughly knowledgeable of the specific installation.

Provide a written description of standard control panel functions and user instructions at each FACP. These instructions shall be written in standard laymen's English so that an unfamiliar operator can accomplish basic functions such as reset.

Provide a site map in the main front entry by the annunciator and at the main FACP location, indicating where all nodes are located thru-out the campus.

3.04 SYSTEM GUARANTEE

- A. All components, parts, and assemblies supplied by the Manufacturer (or supplied and installed by the contractor) shall be guaranteed against defects in materials and workmanship for a period of twelve (12) months, unless Manufacturer provides additional warranty period, commencing the date of Final Acceptance by the Fire Marshall or Substantial Completion, whichever is later. Warranty service shall be provided by a qualified factory-trained representative of the equipment manufacturer during normal working hours. The representative must be able to respond to warranty calls within twelve (12) hours, including weekends, of notice whether oral or written.

- B. Provide, within one (1) year after final acceptance, testing as per National Fire Protection Association 72, which shall consist of:
 - 1. Regularly and systematically examine, adjust and clean all the electrical and mechanical components of water flow switches as required by code.
 - 2. Test and Written report which certify that all initiating devices have been tested and which indicate the result of the inspection.

3.05 LIGHTNING PROTECTION

- A. Isolated Loop Circuit Protector (ILCP)
 - 1. Furnish and install an isolated loop circuit protector device on all fire alarm (initiating device circuit), (signaling line circuit), (audio riser), wiring, which extends beyond the main methods (walkways, bridges, or other above ground connectors).
 - 2. The ILCP shall be located as close as practical to the point at which the circuits leave or enter a building.
 - 3. The ILCP grounding conductor shall be a No. 12 AWG Green Stranded wire having a maximum length of 28 feet to be run in as straight a line as practical and connected to a building ground electrode system (unified ground) per the (2011) National Electrical Code.
 - 4. The ILCP furnished shall have a line to line response time of less than one (1) nanosecond capable of accepting greater than 2,000 amps (35 joules each line) to earth. Shield to earth current shall be 5,000 amps maximum.
 - 5. The ILCP shall be protected by a high dielectric insulating material and of small enough size to mount in a standard 4" square 2-1/8" deep electrical box.
 - 6. Spark gap devices or devices incorporated in or installed within the fire alarm control panel in lieu of the specified ILCP are not acceptable.

- B. Provide Asco/Emerson/ Isolated Loop Circuit Protectors.

3.06 SEQUENCE OF OPERATIONS

UPON ALARM ACTIVATION OF ANY AREA SMOKE DETECTOR, HEAT DETECTOR, PULL STATION, SPINKLER/DELUGE WATER FLOW THE FOLLOWING SHALL OCCUR:

ALARM CONDITION

THE INTERNAL AUDIBLE DEVICE SHALL SOUND AT THE FIRE ALARM CONTROL PANEL AND ANNUNCIATOR PANEL ONLY.

THE DISPLAY SHALL INDICATE ALL APPLICABLE INFORMATION ASSOCIATED WITH THE ALARM CONDITION INCLUDING DEVICE ADDRESS, DEVICE TYPE, DEVICE LOCATION AND DATE/TIME.

THE FOLLOWING ACTIONS SHALL OCCUR SIMULTANEOUSLY:

ACTIVATE AUDIO/VISUAL DEVICES IN ALL BUILDINGS

ANNUNCIATE A PRE-RECORDED MESSAGE FROM THE VOICE EVACUATION PANEL WHERE SO EQUIPPED

SHUTDOWN AHU, GAS VALVE ONLY IF IT'S LOCATED IN THE BUILDING IN WHICH THE ACTIVATION OCCURRED

RELEASE ALL FIRE/SMOKE DOORS WITH MAGNETIC HOLD OPEN DEVICES ONLY IN THE BUILDING IN WHICH THE ACTIVATION OCCURRED

TRANSMIT ALARM SIGNALS TO THE CENTRAL MONITORING STATION

SUPERVISORY CONDITION

THE INTERNAL AUDIBLE DEVICE SHALL SOUND AT THE FIRE ALARM CONTROL PANEL AND ANNUNCIATOR PANEL.

THE DISPLAY SHALL INDICATE ALL APPLICABLE INFORMATION ASSOCIATED WITH THE SUPERVISORY ACTIVATION INCLUDING DEVICE ADDRESS, DEVICE TYPE, DEVICE LOCATION AND DATE/TIME.

THE FOLLOWING ACTIONS SHALL OCCUR SIMULTANEOUSLY:

TRANSMIT SUPERVISORY SIGNALS TO THE CENTRAL MONITORING STATION

TROUBLE CONDITION

THE INTERNAL AUDIBLE DEVICE SHALL SOUND AT THE FIRE ALARM CONTROL PANEL AND ANNUNCIATOR PANEL.

THE DISPLAY SHALL INDICATE ALL APPLICABLE INFORMATION ASSOCIATED WITH THE SUPERVISORY ACTIVATION INCLUDING DEVICE ADDRESS, DEVICE TYPE, DEVICE LOCATION AND DATE/TIME

TRANSMIT TROUBLE SIGNALS TO THE CENTRAL MONITORING STATION

NOTE: AS REQUIRED BY SCHOOL BOARD

DUCT DETECTORS MUST BE SHALL TRANSMIT SUPERVISORY ALARM.

DUCT/SMOKE DETECTOR SHALL BE SET AT 80/20 SENSESEVITY LEVEL

***** END OF SECTION *****