

Section 16670

Lightning Protection System

SECTION 16670**LIGHTNING PROTECTION SYSTEM****PART 1 - GENERAL****1.1 Related Documents**

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Summary

This section specifies the furnishing of all labor, materials, appurtenances and inspections required for a comprehensive lightning protection system for this facility. The required lightning protection system shall include all new structures.

1.3 Reference Standards

Comply with the latest edition of the following reference standards.

1. NFPA No. 78 - Lightning Protection Code.
2. UL 96A - Master Labeled Lightning Protection System, Installation Requirements.

1.4 Submittals

1. Shop Drawings: Detailed plan drawings shall be prepared to 1:100 scale which indicate all work to be performed. Details of all component mounting and connections shall be included on separate detail drawings. Manufacturer's catalog numbers and generic identification shall be indicated for all components shown on the drawings. Drawings shall be on A0 Size plans and 3mm-high lettering.
2. Product Data: Submit complete descriptive information on all materials and installation methods.
3. Approvals: Secure formal approval of shop drawings and product data prior to ordering material. Secure approvals in sufficient time to allow installation of concealed system components without delaying the project.

1.5 Subcontractor

The subcontractor for the work covered by this specification shall be one that is recognized as being regularly engaged in the installation of lightning protection systems. The subcontractor must be listed by Underwriters' Laboratories, Inc., and must employ competent personnel fully qualified in the field of lightning protection.

PART 2 - PRODUCTS

2.1 General

The system furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems. Listing of the manufacturer in the lightning protection section of the current edition of Underwriters' Laboratories, Inc., Electrical Construction Materials List will be accepted as compliance with this requirement. Materials used in connection with the installation of the lightning protection system shall be approved for lightning protection systems by the Underwriters' Laboratories, Inc.. No combination of materials shall be used that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture. Where unusual conditions exist which would cause deterioration or corrosion of conductors, conductors with suitable protective coatings or oversize conductors shall be used. If a mechanical hazard is involved, the conductor size shall be increased to compensate therefore, or suitable protection shall be provided. The conductors may be protected by covering them with molding or tubing and preferably made of nonmagnetic material.

2.2 Conductors

All conductors shall be copper and of the grade ordinarily required for commercial electrical work generally designated as being 98 percent conductive when annealed. Conductor minimum sizes are listed in Tables 3-4 and 3-5 of NFPA 78 (25x3mm copper). Main conductor and secondary conductor cable sizes shall be the same.

2.3 Air Terminals

Air terminals shall be nickel-plated solid copper with tapered bullet point tips (in lieu of sharp point tips). Minimum air terminal size shall be 18mm diameter by 750mm long. Where air terminals longer than 750mm are required, solid copper rods of the appropriate length with threaded ends may be securely attached to the air terminals for extensions. Provide a three-leg tripod brace for each air terminal at an open roof location. Secure the triangular brace to the roof in a manner approved by the structural Engineer. All other air terminals shall have a bipod brace. Conductor connections to air terminals shall be bolted.

2.4 Ground Rods

Ground rods shall be copper-clad steel, 200mm diameter by 3m in length or longer.

2.5 Connectors

All below-ground and concealed connections shall be made with exothermic welded connections. Visible connections shall be made with cast bronze bolted pressure connectors which utilize stainless steel or silicon bronze bolts. Connectors shall include 101.6mm (4-inch) parallel clamps for conductors, bonding plate and heavy duty cross-run clamps.

2.6 Roof Penetration

Roof penetrations shall be accomplished with through-roof fittings specially designed for this purpose. Through-roof fittings shall utilize solid rods with appropriate hardware. Fittings shall incorporate a positive means for sealing around the rod.

PART 3 - EXECUTION

3.1 General

Install a complete lightning protection system consisting of air terminals, conductors, connectors, attachments, grounding and necessary appurtenances to comply with minimum requirements listed in the referenced standards and to meet the local jurisdiction codes requirements. The system shall be installed in a neat workmanlike manner and without interfering with other building systems.

3.2 Conductors

Downlead conductors are required. All downlead conductors must be installed in PVC conduit which is embedded in the concrete columns. Secure conductors to the roof or other structure at a maximum interval of 1 meter on center.

3.3 Air Terminals

Air terminal installations shall be designed and braced for 160 km winds with 200km gusts.

3.4 Antennae

All antennas and satellites shall be grounded.

3.5 Ground Rods

A counterpoise ground system shall be installed. The extent of the counterpoise ground system is indicated in the project drawings. Lightning protection system downleads shall be connected to the counterpoise loop. New ground rods shall comply with the requirements listed in specification Section A Ground System.

3.6 Connections

At the completion of the project, all bolted pressure connectors shall be checked for proper bolt torque.

3.7 Roof Attachments and Penetrations

Air terminals, conductors and appurtenances for the lightning protection system require attachment to building roof. Downleads may require penetration of roof surfaces. All attachments to or penetrations through roofs must be in strict accordance with the roof manufacturer's recommendations. The lightning protection contractor shall submit details of all roof attachments and penetrations to the structural Engineering for approval prior to installation. Once the lightning protection system installation is complete, the lightning protection contractor shall engage the appropriate roof manufacturer to inspect all roof attachments and penetrations on that manufacturer's roof. Subsequent to the inspection, the roof manufacturer shall furnish the Engineer with a letter indicating that all lightning protection system component roof attachments and penetrations are satisfactory and that such attachments and penetrations will not in any way reduce the manufacturer's warranty on the roof. Any fees for services or inspections provided by the roof manufacturer to accomplish the above related requirements shall be at the expense of the lightning protection contractor.

3.8 Cover-up Inspection

Prior to cover-up of concealed components and connections, notify the site Engineer, so that a cover-up inspection can be performed. Correct any deficiencies prior to concealment of components and connections.

3.9 Conflicts

In the event a conflict exists between this specification and any of the referenced standards, the requirements of this specification shall be regarded as secondary and the necessary corrections shall be made.

END OF SECTION

Section 16720

Fire Alarm System

SECTION 16720**FIRE ALARM SYSTEM****PART 1 – GENERAL****1.1 Related Documents**

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Summary

This section specifies the furnishing, installation, connection and testing of a complete, operative and coordinated 24 Volt, fire alarm system. The system shall include but not be limited to, alarm initiating devices, fire alarm control panel (FACP) alarm notification appliances, Reporting Terminals (RT), Liquid Crystal Display (LCD), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

1.4 Reference Standards

- A. The fire alarm system shall comply with requirements of NFPA 72, the system shall be electrically supervised and monitor the integrity of all conductors.
- A. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- B. The FACP and peripheral devices shall be manufactured 100% by a single manufacturer (or division thereof).
- D. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL listing.

1.4 Scope

- A. A intelligent reporting, microprocessor controlled fire detection and emergency voice alarm communication network shall be installed in accordance with the specifications and drawings.

1.4 Scope (cont'd)

B. Basic Performance:

1. Alarm and trouble signals from the FACP, NRT, and NLCD network nodes shall be digitally encoded by a listed electronic devices onto a NFPA Style 6 looped multiplex communication system.
2. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
3. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).
4. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z).
5. Power for initiating devices and notification appliances must be from the main fire alarm control panel, the transponder to which they are connected or to a Field Charging Power Supply (FCPS).
6. 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. 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.
8. Digitized electronic signals shall employ check digits or multiple polling.
9. Transponder devices are to consist of low current, solid-state integrated circuits, and shall be powered locally from a primary power and standby power source.
10. Two-way telephone communication circuits shall be arranged to allow communication between the fire alarm control panel at first basement floor and up to ten (10) remote telephone locations simultaneously.

C. Network - General

A node may be an intelligent Fire Alarm Control Panel (FACP), Network Reporting Terminal PC (NRT) or an Intelligent Network LCD Annunciator (INA). The network shall be capable of expansion to at least 103 nodes. Each network node address point shall be capable of processing a minimum of 1,980 analog addressable points. Each network node address shall be software assignable at each node. Systems which utilize a fixed network addressing scheme are not be suitable substitutes. There shall be NO limit to the types, mix, physical location or quantity of any node type below the overall limit of the network node capacity. In addition, each network node shall also act as a signal repeater to reshape and regenerate the network signal.

1.4 Scope (cont'd)**D. Basic System Operation**

1. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The FACP alarm LED on the FACP shall flash.
 - b. A local piezo-electric signal in the FACP shall sound.
 - c. The 80-character LCD display on the local FACP node and on the network displays shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.
 - d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
 - e. All system output programs assigned via control-by-event interlock programming 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 on either local outputs or points located on other network nodes.
2. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The FACP supervisory LED on the FACP shall flash.
 - b. A local piezo-electric signal in the FACP control panel shall sound.
 - c. The 80-character LCD display on the local FACP node and on the network displays shall indicate all information associated with the condition, including the type of point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.
 - d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
 - e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

1.4 Scope (cont'd)

D. Basic System Operation

3. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a. The FACP trouble LED on the FACP shall flash.
 - b. A local piezo-electric signal in the FACP control panel shall sound.
 - c. The 80-character LCD display on the local FACP node and on the network displays shall indicate all information associated with the condition, including the type of point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.
 - d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
 - e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

E. Network Communication

1. The network architecture shall be based on a Local Area Network (LAN), a firmware package which utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent. The network shall use a deterministic token-passing method. Collision detection and recovery type protocols are not acceptable substitutes due to life safety requirements. In addition, there shall be no master, polling computer, central file computer, display controller or other central element (weak link) in the network which, on failure, may cause complete loss of network communications or cause major degradation of network capability. There shall be no cascading of CPUs or master-slave relationships at the network level to facilitate network communications. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations. Each node/panel shall communicate on the network at a baud rate of not less than 312 KBPS (kilo bits per second).
2. Each network node address shall be capable of storing Cooperative-Control-By-Event (CCBE) equations. The CCBE shall be used to activate outputs on one network node from inputs on other network nodes. The CCBE equation shall support the following minimum boolean operators: AND, OR and NOT.

1.5 Submittals

A. General:

All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout and main control panel module layout, configurations and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation which gives the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm network on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

1.5 Submittals (cont'd)

E. Certifications:

Together with the shop drawing submittal, submit a certification from the equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the equipment manufacturer and trained on network applications.

1.6 Guaranty

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least Two (2) years from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during these Two years period shall be included in the submittal bid.

1.7 Applicable Publications

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

- A. The fire alarm system shall comply with requirements of NFPA 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.
- B. Local and State Building Codes.
- C. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 Approvals

- A. The system must have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc

FM Factory Mutual

MEA Material Equipment Acceptance (NYC)

CSFM California State Fire Marshal

Local Civil Defense Authorities

PART 2 – PRODUCTS**2.1 Equipment and Material, General**

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the equipment, shall be responsible for the satisfactory installation of the complete system.
- B. All equipment and components shall be installed in strict compliance with manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.
- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 Conduit and Wire

- A. Conduit:
 - 1. Conduit shall be in accordance with the National Electrical Code (NEC) and local requirements. All wiring shall be installed in conduit. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
 - 3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
 - 4. Conduit shall not enter any FACP, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
 - 5. Conduit shall be 3/4 inch (19.1 mm) minimum.

2.2 Conduit and Wire (cont'd)

B. Wire:

1. All fire alarm system wiring must be new, unless specified herein.
2. Wiring shall be in accordance with local and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 16 AWG (1.32 mm) for notification appliance circuits.
3. All wire and cable shall be listed and approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit (if any) shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. Wiring used for the signaling line circuit (SLC) multiplex communication loop shall be twisted and shielded and installed in conduit unless specifically excepted by the fire alarm equipment manufacturer.
6. All field wiring shall be completely supervised.

C. Network Media

1. General: The network shall be capable of communicating via wire. A wire network shall include a fail safe means of isolating the nodes in the unlikely event of complete power loss to a node. The fail safe design shall allow the network communications signal to bypass the failed node which allows the continuation of normal communications activity if specified wiring distances are maintained.
2. Twisted Pair (wire) Communication: The dedicated twisted pair shall utilize 12 to 24 AWG wire and support distances of up to 1,000 meter between nodes.

D. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their intended purpose.

- E. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
- F. The FACP(s) shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution Panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 4 mm². The FACP cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3 Fire Alarm Control Panels

- A. Each network FACP shall contain a microprocessor-based central processing unit (CPU). The FACP shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, transponders, local and remote operator terminals, printers, annunciators, emergency voice communication systems, and other system controlled devices.

Each FACP on the network 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 transponders.
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 terminal, panel display, and annunciators.

B. General FACP Operation

1. Each FACP node shall include a full featured operator interface control and annunciation panel which shall include a backlit Liquid Crystal Display (LCD), individual, color coded system status LEDs, and an alpha-numeric keypad for field programming and control of the node.
2. All programming or editing of the existing programing in the system shall be achieved without special equipment or interrupting the alarm monitoring functions of the fire alarm control panel.
3. The system shall include emergency voice communications utilizing distributed amplification and intelligence such that loss of operation by the main FACP will not result in the loss of evacuation signal throughout the balance of the building.
4. Each FACP node shall be capable of providing the following features:

Block Acknowledge for Trouble Conditions
Rate Charger Control
Control-By-Time (Delay, Pulse, time of day, etc.)
Automatic Day/Night Sensitivity Adjust (high/low)
Device Blink Control (turn of detector LED strobe)
Environmental Drift Compensation (selectable ON or OFF)
Smoke Detector Pre-alarm Indication at Control Panel
NFPA 72 Smoke Detector Sensitivity Test
System Status Reports
Alarm Verification, by device, with tally

- Multiple Printer Interface
- Multiple CRT Display Interface
- Non-Fire Alarm Module Reporting
- Automatic NFPA 72 Detector Test
- Programmable Trouble Reminder
- Upload/Download System Database to PC Computer
- One-Man Walk Test
- Smoke Detector Maintenance Alert
- Security Monitor Points
- Alpha-numeric Pager Interface
- On-line or Off-line programming

C. FACP Central Processing Unit (CPU):

1. Each FACP network node shall include a central processing unit. The 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.
2. Each CPU shall contain and execute all control-by-event interlock for specific local and network action to be taken if an alarm condition is detected by the system. Control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The central processing unit 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.

D. Loop Interface Board (LIB):

1. Loop interface boards shall be provided to monitor and control each of the Signaling Line Circuit (SLC) loops in the network node. The loop interface board shall contain its own microprocessor and shall be capable of operating in local mode in the case of a failure in the main CPU of the control panel. In local mode, the loop interface board shall detect alarms and activate output devices on its own SLC loop.
2. The LIB shall not require any jumper cuts or address switch settings to initialize SLC Loop operations.
3. The loop interface board shall provide power to, and communicate with, all of the intelligent detectors and addressable modules connected to its SLC Loop over a single pair of wires. This SLC Loop shall be capable of operation as NFPA Style 4, Style 6, or Style 7.
4. The LIB shall be able to drive two Style 4 SLC loops, each up to 3000 meters in length, for an effective loop span of 6000 meters.

2.3 Fire Alarm Control Panels (cont'd)

5. The loop interface board shall receive analog information from all detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The loop interface board software shall include software to automatically adjust and compensate for dust accumulation to maintain detector performance as it is affected by environmental factors. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
 6. The LIB shall communicate with each intelligent addressable detector and addressable module on its SLC loop and verify proper device function and status. Communication with up to 198 intelligent devices shall be performed every 6 seconds or less.
- E. Enclosures:
1. Control panels shall be housed in UL-listed cabinets suitable for surface or semi-flush mounting. Cabinets shall be corrosion protected, given a rust-resistant prime coat, and the manufacturer's standard finish.
 2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
 3. The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.
 4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.
- F. FACP nodes shall be designed so that it permits continued local operation of remote transponders under both normal and abnormal network communication loop conditions. This shall be obtained by having transponders operate as local control panels upon loss of network communication.
- G. FACP nodes shall be modular in construction to allow ease of servicing. Each CPU and transponder shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems which require use of external programmers or change of EPROMs are not acceptable.
- H. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients including RFI and EMI.
- I. Each transponder and peripheral device connected to the FACP node CPU shall be continuously scanned for proper operation. Data transmissions between network nodes, FACP CPUs, transponders, and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques. Failure of any transponder or peripheral device to respond to an interrogation shall be annunciated as a trouble condition.

2.3 Fire Alarm Control Panels (cont'd)

K. FACP Power Supplies:

1. Main power supplies shall operate on 230 VAC, 50Hz, and shall provide all necessary power for the FACP.
2. Each main supply shall provide 3.0 amps of usable notification appliance power, using a switching 24 VDC regulator.
3. The main power supply shall be expandable for additional notification appliance power in 3.0 ampere steps.
4. Each main power supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. It shall charge 60 Amp hour batteries within a 48-hour period.
5. The supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
6. It shall provide meters to indicate battery voltage and charging current.
7. The main power supply shall be power-limited per UL864 requirements.

L. Field Charging Power Supply: The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.
2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
5. The FCPS include power limited circuitry, per UL standards.

2.3 Fire Alarm Control Panels (cont'd)

M. System Circuit Supervision:

1. Each FACP node shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and annunciate loss of communications with these devices. The FACP CPU shall continuously scan the above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information on the printer.
2. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.

N. Field Wiring Terminal Blocks

For ease of service, all wiring terminal blocks shall be the plug-in type and have sufficient capacity for 18 (0.75 mm²) to 12 AWG (3.25 mm²) wire. Fixed terminal blocks are not acceptable.

O. Emergency Two-Way Telephone Control Switches/Indicators

1. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
2. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

P. Operators Terminal:

Provide the following functions in addition to any other functions required for the system.

1. Acknowledge (ACK/STEP) Switch:
 - a. Activation of the control panel Acknowledge switch in response to a single new Alarm and/or trouble condition shall silence the local panel piezo electric signal and change the system alarm or trouble LED from flashing mode to steady-ON mode. If additional new alarm or trouble conditions exist or are detected and reported in the system, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.
 - b. Depressing the acknowledge switch shall also silence all remote annunciator piezo sounders.

2.3 Fire Alarm Control Panels (cont'd)

2. Signal Silence Switch:

Activation of the signal silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm activation. The selection of notification circuits and relays which are silenceable by this switch shall be fully field programmable within the confines of all applicable standards.

3. System Reset Switch:

Activation of the system reset switch shall cause all local electronically-latched initiating devices, software zones, output devices and circuits, to return to their normal condition.

If an alarm condition(s) still exists, or if they reoccur in the system after system reset switch activation, the system shall then resound the alarm conditions.

4. System Test Switch.

Activation of the system test switch shall initiate an automatic test of all intelligent/addressable detectors in the local system. The system test shall activate the electronics in each intelligent sensor, simulating an alarm condition and causing the transmission of the alarm condition from that sensor to the fire alarm control panel. The fire alarm control panel shall interpret the data from each sensor installed in the system. A report summarizing the results of this test shall be displayed automatically on the system LCD and on any CRTs or printers in the system.

5. Lamp Test Switch:

Activation of the lamp test switch shall sequentially turn on all LED indicators, system liquid crystal display and local piezo signal, and then automatically return the fire alarm control panel to the previous condition.

Q. Printer:

1. Printers shall be UL 864 listed and shall be an automatic type with code, time, date, location, category, and condition.
2. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desk top or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association (EIA) standard EIA-232D. Power to the printer shall be 120 VAC 60 Hz.
3. Thermal printers are not acceptable.

2.3 Fire Alarm Control Panels (cont'd)

4. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.
 - a. Fire Fighter's Telephone Circuits: Firefighter's telephone circuits may be added to the transponder in groups of up to 8 circuits.
 - b. Fire alarm speaker circuits: Fire alarm speaker circuits may be added to the transponder in groups of up to 8 circuits. Each circuit shall be capable of supervising the field circuit, and of transmitting up to 30 watts of audio power.

R. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits.
2. All local FACP node programming shall be accomplished through the FACP keyboard or through the video display terminal.
3. All field defined programs shall be stored in non-volatile memory.
4. The programming function shall be enabled with a password that may be defined specifically for the system when it is installed. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level is used for status level changes such as zone disable or manual on/off commands. A second (higher-level) is used for actual change of program information.

S. Specific System Operations

1. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent detectors in the FACP node from each system keypad or from the keyboard of the video terminal. Sensitivity range shall be within allowed UL limits.
2. Alarm Verification: Each of the intelligent addressable detectors in the system may be independently selected and enabled for alarm verification. Each FACP shall keep a count of the number of times each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

2.3 Fire Alarm Control Panels (cont'd)

3. System Point Operations
 - a. All devices in the FACP node may be enabled or disabled through the local keypad or video terminal.
 - b. Any FACP node output point may be turned on or off from the local system keypad or the video terminal.
4. Point Read: The FACP node shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point will be annunciated for the parameters listed:
 - a. Device Status
 - b. Device Type
 - c. Custom Device Label
 - d. Software Zone Label
 - e. Device Zone Assignments
 - f. Detector Analog Value
 - g. All Program Parameters
5. System Status Reports: Upon command from a password-authorized operator of the system, a status report will be generated, and printed, listing all local FACP system status.
6. System History Recording and Reporting: Each FACP node shall contain a history buffer that shall be capable of storing a minimum of 400 system events. Each local activation will be stored and time and date stamped with the actual time of the activation, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed, one event at a time, and the actual number of activations may also be displayed and or printed.

The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
7. Automatic Detector Maintenance Alert: Each FACP node shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular intelligent detector will be annunciated on the system display, network display and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

2.4 Network Monitoring Devices

A. INTELLIGENT NETWORK ANNUNCIATOR

1. An intelligent network annunciator shall be provided to display all system intelligent points. The INA shall be capable of displaying all information for all 200,000 possible points on the network. Network display devices which are only capable of displaying a subset of network points shall not be suitable substitutes.
2. The INA shall include a minimum of 80 characters, backlit by a long life solid state LCD display. The network display shall mount in any of the network node fire alarm control panels. Optionally, the network display may mount in an attractive backbox designed for this use, or may mount in an industry standard 19-inch (482.6 mm) rack. The network shall support over 103 network display annunciators (not to exceed total node capacity) and shall connect to the network over either a wire or fiber interface.
3. The intelligent network annunciator shall have a history buffer capable of storing a minimum of 400 events in non volatile memory.
4. The INA shall include two optically isolated, 2400 baud, industry standard EIA-232 ports for UL864 listed printers and CRT's. These peripheral devices shall print or display network activity.
5. The intelligent network annunciator shall include five control switches for system wide control of signal Silence, Reset, Activate Signals (Drill), and Lamp Test (local). A means by which the controls switches are "locked out", such as a key, shall be available.
6. The INA shall include long life LEDs to display Power, Fire Alarm, Security Alarm, System Trouble, Supervisory, Signals Silenced, and CPU Failure.
7. The intelligent network annunciator shall include two software assignable passwords, up to five digits in length.
8. For time keeping purposes the INA shall include a time of day clock.
9. Each INA shall support up to 32 additional 80 character remote display annunciators for displaying network activity. These "Terminal Mode" displays will mimic the activity appearing on the corresponding INA.

2.5 System Components – Conventional

A. Programmable Electronic Sounders:

1. Electronic sounders shall operate on 24 VDC nominal.

2.5 System Components – Conventional (cont'd)

2. Electronic sounders shall be field programmable without the use of special tools, to provide slow whoop, continuous, or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet (3 meters) from the device.
3. Shall be flush or surface mounted as show on plans.

B. Strobe lights shall meet the requirements of UL and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.

C. Duct Smoke Detectors

Duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the composite supply/return air ducts(s), with properly sized air sampling tubes.

D. Projected Beam Detectors

1. The projected beam type shall be a 4-wire 24 VDC device.
2. The detector shall be listed to UL 268 and shall consist of a separate transmitter and receiver capable of being powered separately or together
3. The detector shall operate in either a short range (10-30 meters) or long range (30 – 100 meters) mode.
4. The temperature range of the device shall be -22 degrees F to 131 degrees F.
5. The detector shall feature a bank of four alignment LEDs on both the receiver and the transmitter that are used to ensure proper alignment of unit without special tools.
6. Beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses.
7. The unit shall be both ceiling and wall mountable.
8. The detector shall have the ability to be tested using calibrated test filters or magnet activated remote test station.

2.5 System Components – Conventional (cont'd)**E. Waterflow Indicator:**

1. Waterflow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Waterflow Switches shall have an alarm transmission delay time which is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45 seconds.
3. All waterflow switches shall come from a single manufacturer and series.
4. Waterflow switches shall be provided and connected under this section but installed by the mechanical contractor.
5. Where possible, locate waterflow switches a minimum of 30cm from a fitting which changes the direction of the flow and a minimum of One (1) meter from a valve.

F. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
7. Valve supervisory switches shall be provided and connected under this section and installed by mechanical contractor.

2.5 System Components – Conventional (cont'd)

G- Fire Man Telephone

1. The telephone cabinet shall be painted red and clearly labeled as cabinets shall be located where shown on drawings.
2. Handset cradle shall have a switch connection so that lifting cradle shall send a signal to the NET WORK ANNUCIATOR AT 1st BASEMENT FLOOR.
3. On activating the remote phone, the phone earpiece shall sound at the master handset is lifted.
4. The two-way emergency telephone system shall support a minimum of without degradation of the signal.
5. Provide one portable telephone handset.

2.6 System Components, Intellight

A. Addressable Devices - General

1. Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches.
2. Addressable devices which use a binary address setting method, such as a Dip switch, are not an allowable substitute.
3. Detectors shall be analog and addressable, and shall connect with two wires to the FACP signaling line circuit.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA 72, Chapter 7.

2.6 System Components, Intellight (cont'd)

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
8. 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.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices 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. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
12. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

B. Addressable Pull Box (manual station)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. 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.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual stations shall be constructed of Lexan 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 (44 mm) or larger.

2.6 System Components, Intellight (cont'd)

C. Analog Photoelectric Smoke Detector

1. The 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.

D. Analog Ionization Smoke Detector

1. The 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.

E. Analog Thermal Detectors

1. Thermal detectors shall be Analog addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

F. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
3. The IDC zone shall be suitable for Style D or Style B 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.
4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

G. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The two-wire monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box or with an optional surface backbox.

2.6 System Components, Intellight (cont'd)

3. The IDC zone may be wired for Class A or B (Style D or Style B) 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.

H. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.
2. The control module shall mount in a standard 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box, or to a surface mounted backbox.
3. The control module NAC may be wired for Style Z or Style Y (Class A/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 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.
4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.
5. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

I. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

2.6 System Components, Intellight (cont'd)

4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

J. Serially Connected Annunciator Requirements

1. The annunciator shall communicate to the fire alarm control node or INA via an EIA 485 (multi-drop) two wire communications loop. The FACP node shall support two 6,000 ft (1828.8 m). EIA-485 wire runs. Up to 32 annunciators, each configured up to 64 points, may be connected to connections, for a system capacity of 2,048 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. An optional (UL 864 listed) version shall allow the EIA-485 circuit to be transmitted over Fiber optics.
3. Annunciator switches may be programmed for system control such as, global acknowledge, global signal silence, global system reset, and on/off control of any control point in the system.
4. An optional module shall be available utilizing annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 2,048 remote contacts.

K. LCD Alphanumeric Display Annunciator:

1. The alphanumeric display annunciator shall be a supervised, back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions from either the network node or complete network, via the INA.
3. Up to 32 LCD annunciators may be connected to a specific (terminal mode) EIA 485 interface. LCD annunciators shall not reduce the annunciation capacity of the system. Each LCD shall include vital system wide functions such as, system acknowledge, silence and reset.
4. LCD display annunciators shall mimic the local control panel 80-character display or network annunciator and shall not require special programming.

2.7 Batteries and External Charger

A. Battery:

1. Batteries shall be 12 volt, Gell-Cell type.
2. The battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure.
3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills and leakage shall not be required.

PART 3 - EXECUTION

3.1 Installation

- A. Installation shall be in accordance with the NEC, NFPA 72, local codes, as shown on the drawings, and as recommended by the equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual Pull Stations shall be suitable for surface mounting or semiflush mounting and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (1219 mm) above the finished floor.

3.2 Typical Operation

- A. Actuation of any manual station, smoke detector, heat detector or waterflow switch shall cause the following operations to occur unless otherwise specified:
 1. Activate all programmed speaker circuits.
 2. Actuate strobe units until the panel is reset.
 3. Light the associated indicators corresponding to active speaker circuits.
 4. Where required, return all elevators to the primary or alternate floor of egress.

3.2 Typical Operation (cont'd)

5. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.
6. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.
7. Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as appropriate.
8. Activation of any sprinkler system low pressure switch, on valve tamper switch, shall cause a system supervisory alarm indication.

B. HVAC/Smoke Control System Operation:

1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.
2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.
3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.
4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.
5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic annunciators if the project requires such.

3.3 Test

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system.

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all flow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.
- G. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
- H. Ground initiating device circuits and verify response of trouble signals.
- I. Ground signaling line circuits and verify response of trouble signals.
- J. Ground notification appliance circuits and verify response of trouble signals.
- K. Check alert tone and prerecorded voice message to all alarm notification devices.
- L. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.
- M. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- N. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.4 Final Inspection

At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.5 Inspection

- A. Instruction shall be required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION