PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Specification Sections and Drawings: The following Sections and Drawings contain requirements that relate to this Section:

1. Division 8 Section on Hardware for door closers/holders, electric door locks, and release devices that interface with the fire alarm system.
2. Division 14 Section "Elevator Controls".
3. Division 15 Sections on fire suppression systems.
4. Division 15 Section "HVAC Instrumentation and Controls".
5. Division 16 Section on raceways.
6. Mechanical Drawings.
7. Fire Protection Drawings.

1.2 SUMMARY

A. This Section specifies fire alarm systems, including requirements for system components typical of those below:

1. Manual pull stations.
2. Smoke detectors.
3. Duct smoke detectors.
4. Linear beam smoke detectors.
5. Heat detectors.
6. Indicating appliances.
7. Fire alarm control panel (FACP).
8. Output relays.
9. Wiring of water-flow and tamper switches, as installed by Division 15 sections hereof.

1.3 REFERENCES

A. The following publications or applicable portions thereof, are included as requirements of this Section:

1. NFPA 20, Standard for the Installation of Centrifugal Fire Pumps.
2. NFPA 70, National Electrical Code.
3. NFPA 72, National Fire Alarm Code.
4. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
5. UL 1971, Standard for Evacuation Notification Signals.
6. UL 38, Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems.
7. UL 268, Standard for Smoke Detectors for Fire Protective Signaling Systems.

8. UL 268A, Standard for Smoke Detectors for Duct Application.
9. UL 521, Heat Detectors for Fire Protection Signaling Systems.
10. UL 864, Standard for Control Units for Fire Protective Signaling Systems.
11. ANSI A17.1, Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks; American Society of Mechanical Engineers.
12. UBC, Uniform Building Code; International Conference of Building Officials.

1.4 DEFINITIONS

A. Refer to National Fire Alarm Code, NFPA 72, for required definitions.

B. Main FACP: This is an analog addressable fire alarm system that is the primary fire alarm control panel for the compound, located at 24 hour/day guard post. Responsible for protecting primary building, monitoring all sub FACP's, and communicating selected zone information with slave FACP.

C. Slave FACP: An independent conventional hard-wired fire alarm system that protects a designated area within primary building. Slave FACP exchanges selected zone information with main FACP. Main FACP maintains certain control aspects over the slave FACP such as, resetting slave indicating appliances after main FACP alarm initiation.

D. Sub FACP: A stand-alone analog addressable microprocessor fire alarm system having the ability to communicate to the Main Fire Alarm system through a communication network.

E. OBO/FPE: DOS's Overseas Building Operations/Fire Protection Engineering Division. For purposes of this Specification and referenced standards, OBO/FPE i s the authority having jurisdiction.

F. Pretesting and Commissioning: Activities to be performed by the factory-authorized service representative prior to final acceptance by OBO/FPE for Government. OBO/FPE will be present during commissioning to witness and certify successful operation of fire alarm systems.

G. Fire Protection Design Criteria (FPDC): Design and installation criteria for DOS facilities. Primary document for OBO/PE/DE/ADB/FPE; precedes and modifies Uniform Building Code (UBC).

H. Shielded Enclosures: Free standing, complete (6-sided) radio frequency enclosure (compartment) to be occupied by embassy personnel.

1.5 SYSTEM DESCRIPTION

A. General: Provide complete, Siemens MXL, fire detection and alarm system, with manual and automatic alarm initiation. Main FACP and its cumulative components shall comply with this specification. The slave FACP shall be non-microprocessor based conventional hard-wired system. All other systems shall be microprocessor based type providing they can properly be monitored and/or communicate with the Main FACP.

B. Main Fire Alarm Control Panel: The control panel and all system circuit interface panels (CIP's) shall be modular in construction and shall include, but not limited to; the hardware, software and firmware required to perform the following major system functions:

1. Environmental compensation for smoke detectors.

2. Capacity for up to 2040 intelligent input devices.
3. Sprinkler supervision. Refer to the fire protection specifications for requirements.
4. Fire pump monitoring (switch off, motor running, engine trouble, low pump room temperature).
5. Water supply monitoring (high and low water level and low water temperature in the fire protection water supply tank).
6. Intelligent/Analog detection.
7. Detector sensitivity read out.
8. Style Z notification circuits.
9. Ability to support conventional devices.
10. Minimum of 80 character backlit Alpha-numeric display.
11. Thermal strip printer.
12. Capability support and supervise remote printer.
13. Capability to provide a 32 character custom message.
14. Capability of providing multiple command stations.
15. Menu driven operator commands.
16. Provide minimum of 800 event history log.
17. Provide multiple levels of password protection.
18. Capability to provide integral 'walk-test' function.
19. Capability of providing alarm verification on initiating circuits.
20. Capability of providing serial annunciator driver input interface.
21. Capability of providing programmable sensor logic.
22. Door unlocking. Relays on each floor to affect and monitor unlocking of internal security/egress doors.

C. Slave Fire Alarm Control Panel: Provide a complete conventional, hard-wired, non-coded, zoned fire detection and alarm system, with manual and automatic alarm initiation. It shall be expandable and capable of providing zone or system dependent auxiliary form 'C' dry contact relays.

D. Sub Fire Alarm Control Panel: An independent and stand alone microprocessor based fire alarm system monitored by the main FACP through a style Z circuit supporting intelligent interface modules. The main FACP will not have any control functions of the sub FACP other than supervision of the sub FACP for alarm, trouble and supervisory conditions, but shall not impact normal operation if the main FACP defaults.

1.6 FUNCTIONAL DESCRIPTION

A. Priority of Signals: Automatic response functions shall be accomplished by first zone initiated. Alarm functions resulting from initiation by first zone shall note be altered by subsequent alarms. The highest priority shall be an alarm signal. Supervisory signals shall have second-level priority. Trouble signals shall have third-level priority. Signals of a higher-level priority shall take precedence over signals of lower priority, even though lower-priority condition may occur first. Alarm signals, regardless of priority or order received shall be annunciated. First level is highest priority; third level is lowest priority.

B. Non-interfering: Zone, power, wire, and supervise system so that a signal on one zone does not prevent the receipt of signals from another zone. Zones shall be manually resettable from the FACP after initiating devices are restored to normal. Analog loops shall be configured with loop isolators and wired in a manner that prevents a catastrophic wiring event in a smoke zone or on a floor from affecting the performance of other floors.

C. Signal Initiation: Manual or automatic operation of alarm-initiating or supervisory-operating device shall cause the FACP to transmit appropriate signals, to include but not limited to the following:

1. General alarm.
2. Fire-suppression system operation alarm. Refer to the fire protection specifications for requirements.
3. Smoke detector alarm.
4. Valve tamper supervisory.
5. Fire pump supervisory (switch off, motor running, engine trouble, low pump room temperature).
6. Door release.
7. Elevator recall.
8. Elevator shutdown and control circuit supervision (elevator, power shunt trip).
9. System trouble.
10. Fan shutdown.
11. High and low water level in the fire protection water supply tank.
12. Low water temperature in the fire protection water supply tank.
13. Sub-systems supervisory.
14. Special areas alarm.
15. Kitchen Hood system.

D. Silencing at FACP: Switches shall provide capability for acknowledgment of alarm, supervisory, trouble, and other specified signals at FACP; and capability to silence local audible signal, and to light a light-emitting diode (LED). The notification appliance audible shall sound until silenced, and the visual appliance shall operate until system reset. Subsequent zone alarms shall cause audible signal to sound again until silenced in turn by switch operation. Restoration to normal of an alarm, supervisory, and trouble conditions shall extinguish the associated LED.

E. Loss of primary power: In case of power loss, a sound trouble signal shall be indicated at the FACP. An emergency power light shall be illuminated at the FACP when system is operating on alternate power supply.

F. Annunciation: Manual and automatic operation of alarm, supervisory-initiating devices and trouble indications shall be annunciated on the FACP.

G. General Alarm: Provide system general alarm as follows:

1. Indicate general alarm condition at FACP.
2. Identify alarm device address, type and display alphanumeric description of device identifying its location. (Convention system shall indicate the zone of alarm with corresponding location).
3. Activate audible and visible notification appliances throughout building, including slave FACP audible and visual notification appliances.
4. Close fire and smoke doors on that floor that are held open by magnetic door holders.
5. Close fire and smoke dampers held open by magnetic hold open devices in zone of alarm and all adjacent zones.
6. Shut down air handling unit(s) serving zone of alarm event and in all adjacent zones. (Manual pull station alarms shall not respond to this requirement, only the manual pull station alarm in Post 1 shall affect air handling units shutdown).
7. Initiate control functions associated with the activated device (door holder release, elevator recall, unlock designated security doors affecting path of egress, etc. as required).

H. Manual station alarm: Operation shall initiate a general alarm.

I. Water-flow alarm switch: Operation shall initiate a general alarm, and unlock designated security doors on that floor that are in the pass of egress.

J. Smoke detectors: Zones with alarm verification shall cause the following:

1. Activation of listed "alarm verification" sequence at FACP and detector.
2. General alarm initiation when alarm is verified.
3. FACP indication cancellation and system reset when alarm is not verified.
4. If subsequent alarm signals are received during confirmation period, process alarm immediately by FACP.
5. Unlock security doors on that floor that are in the path of egress.

K. Duct smoke detectors: In addition to requirements listed in paragraph J, duct type smoke detectors shall:

1. Initiate a general alarm signal.
2. Shut down associated control equipment.

L. Heat Detectors: All heat detectors shall:

1. Initiate a general alarm signal.
2. Unlock security doors on that floor that are within the path of egress.

M. Slave system alarm: Initiates a building general alarm on the Main FACP and slave FACP.

N. Sub system alarm: Local general alarm condition only, and shall initiate an alarm notification signal at the Main FACP and shall identify the location of activation on the liquid crystal display (LCD).

O. Sprinkler control valve tamper switch: Operation and restoration shall initiate supervisory audible and visible "valve tamper" signal indication and location at FACP.

P. Engine driven Fire pump: Shall provide the following supervisory signals (audible and visual) at the Main fire alarm control panel.

1. Fire pump controller system trouble, including battery failure, over-speed, over-crank, high engine coolant temperature, and low oil pressure.
2. Fire pump run.
3. Selector switch position in 'off' position.
4. Low pump room temperature.

Q. Water level Supervisory: Operation, on sprinkler systems equipped with containers for water storage, supervisory (audible/visible) signal for:

1. Indicating that the required water level has been lowered.
2. Indicating that the required water level has been raised.

R. Water temperature: Supervisory (audible/visible) signal to indicate container exposure to freezing conditions that:

1. Indicate that the temperature has dropped to 5 degrees C.
2. Indicate restoration to proper temperature.

S. Elevator control systems: Activated by alarmed smoke detectors in elevator foyers, machine rooms and hoistways. Proper primary and secondary floors of recall shall be properly programmed. Fire alarm system shall provide necessary output relays to these systems, so as to initiate proper operation. Operational logic and power shall reside in these systems and not in the FACP.

1. In addition to regular smoke detector function, elevator lobby, hoistway and machine room detectors shall affect primary or secondary elevator recall.
2. In addition to regular alarm initiating requirements, heat detectors in elevator shafts and machine rooms shall affect power shunt trip to elevator controllers.

T. Elevator power shunt trip: Activate if the thermal detector in the elevator machine room is activated. The thermal detector shall have a lower RTI than the sprinkler heads in the elevator machine room. Elevator power shunt supervision per 3-9.4.4 and shall meet NFPA 72, paragraph 3-9.3.6.

U. Security door controls shall be activated by general alarm. The door release shall be specific to each floor and provide a message on the FACP upon fire alarm door release.

V. Network Communications: Network communication shall be XNet between buildings and MNet within buildings, unless otherwise approved by OBO/FBE.

W. Notification Appliances:

1. Bells shall be silenceable using the "Alarm Silence" function.
2. Strobes shall remain active when bells are silenced.

X. Function Keys: Program function keys for Main FACP as follows:

1. Alt1/F1 combination keys at RCC-1 shall initiate Marine Security Guard Drill Function.

   a. Main building notifications circuits operate.

1.7 FACP OPERATION SEQUENCE/INTERFACES:

A. Provide four independent FACP's: One serving as main, one slave FACP, and two sub FACP as follows:

1. Marine Security Guard 24 hour/day (MSG) Post 1, main FACP, (microprocessor based).
2. Special areas, slave FACP.
3. MSGQ, sub FACP.
4. Warehouse, sub FACP.
5. Pump room (Water Storage Tank building) shall be supported by a dedicated ALD and CSM circuit from Main FACP. Provide surge suppression as defined in Article 800 of the NEC).

B. When special area FACP is in alarm, a specific zone on special area FACP shall be annunciated. Concurrently an alarm condition shall be annunciated on the main FACP located at MSG Post 1. Both main and slave FACP shall sound their notification appliances. Main FACP shall be capable of silencing its notification appliances, but not slave's appliances; nor is it able to reset slave FACP. Main FACP shall identify the slave FACP as the source of the alarm. Slave FACP shall remain in alarm until slave FACP is reset. Upon resetting slave FACP, main FACP shall continue to register alarm condition from slave until main FACP is reset. No

retransmission of alarm signals (no "pinwheeling") when initiating device is in normal condition. Both slave and main FACP shall not require simultaneous reset to restore panel to normal.

C. When main FACP is in alarm, the main FACP shall provide a signal to a dedicated zone on the slave FACP and the main FACP's and slave's indicating appliances shall sound. Slave FACP shall indicate that an alarm is received from the main FACP. Slave FACP shall not lock into alarm, only its indicating appliances shall be activated. Slave indicating appliances shall be controlled from main FACP alarm silence and reset capabilities. This shall be accomplished with modules internal to slave FACP. Slave FACP shall not be able to silence or reset slave indicating appliances during a main FACP initiated alarm. There shall be no indication on any sub-FACP.

D. Main FACP, upon receipt of an alarm (heat detector, smoke detector), FACP shall immediately start alarm verification procedure internal to its software. During confirmation period, if subsequent alarm signals are present, alarm signal shall be processed immediately by FACP. When FACP is in alarm condition, its indicating appliances shall be activated immediately. Appropriate, red LED zones shall be indicated. If no alarm is present during the confirmation period, the FACP shall return to normal condition. Slave FACP will not require an alarm verification capability.

E. MSGQ, Warehouse, and Pump Room shall provide only alarm, trouble and supervisory annunciation to the Main FACP. Alarm conditions in these buildings shall be local notification by building.

1.8 SUBMITTALS

A. General: Submit the following in compliance with General and Supplementary Conditions and Division 1 Specification Sections hereof.

B. Product data for system components. Include descriptive and technical literature, catalog cuts and installation instructions. Provide dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and UL listed data.

1. Operation and maintenance data: Provide data for inclusion in Operating and Maintenance Manual as specified in Division 1 section. Include manufacturers' data for each type product, including features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at Post. Provide names, addresses, and telephone numbers of service organizations that carry stock of repair parts for system furnished. Provide manufacturer's recommended maintenance schedule and procedures. Provide complete operating instructions. Provide repair and trouble shooting guide, which lists common causes for breakdowns, malfunctions, and recommended repairs. Provide record of field tests. Provide certification that the fire alarm system complies with the Contract Documents.
2. Floor plans: Provide floor plans of the building identifying the location of all fire alarm devices and device addresses.
3. Riser diagram: Provide riser diagram reflecting the number of devices on each circuit and end of line devices. Identify the room numbers.
4. Point to Point Wiring Diagram: Provide point to point wiring diagram reflecting all wiring to all devices, including number, size, type of conductors and size and type of conduit.

5. Battery calculations: Provide battery calculations that meet manufacturers and NFPA requirements. The battery supply must meet the demands of the system.

   a. Show all devices and system 'stand by' current draw per unit.
   b. Provide total 'stand by' current draw per total of each type of unit.
   c. Provide total 'alarm' current draw per total of each type of unit.
   d. Provide total battery calculation for 'stand by power.
   e. Provide total battery calculation for 'alarm' power.

6. Provide intended system layout with zone display and/or annunciator with the devices to be annunciated.
7. Sequence of operation: Provide sequence of operation covering unique features for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. A detailed matrix is acceptable. Manufacturer's standard descriptions for generic systems are not acceptable.
8. Product certifications: Provide product certification signed by manufacturers of fire alarm system components, certifying that products comply with indicated requirements.

C. Shop drawings will be submitted to Department of State, M/OBO/PE/DE/ADB FPE (Fi re Protection Engineering Division for) review and approval. Shop drawings shall not be smaller than 841 mm x 594 mm in size.

D. Provide Project record drawings (as-built) to include the following:

1. Identify and mark wires (wire counts), end of line devices, risers, conduit, junction, and pull boxes
2. Exact wiring counts.
3. Properly label all devices identifying the device address or zone and device number.
4. Label, number, and reference all conductors.
5. Number all junction/splice boxes with correct numbers.
6. Show the location of the riser and the size of the conduit leading into and out of the riser's junction boxes.
7. Drawings shall not be smaller than 841 mm x 594 mm in size.
8. Operating instructions to be mounted at FACP.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Contractor shall follow requirements defined in National Fire Alarm Code, NFPA 72, 1-5.1.3 and 1-5.1.4 System Design and Installation.

B. Components and Installation: Provide equipment and installation in compliance with NFPA 70, "National Electrical Code."

C. NFPA Compliance: Provide fire alarm and detection systems conforming to requirements of the following publications:

1. NFPA 72, "National Fire Alarm Code."

D. UL Listing and Labeling: Provide systems and equipment that are UL listed and labeled for Fire Service.

E. Single-Source Responsibility: Obtain fire alarm components from a single source listed under 2.1 Manufacturers, which assumes responsibility for compatibility of system components.

F. Equipment Availability: Engage a Manufacturer to provide equipment that is available over three year period from time of installation.

1.10 EXTRA MATERIALS

A. General: Furnish extra materials, matching products installed (as described below), packaged with protective covering for storage, and identified with labels clearly describing contents. Provide no less than one of each type.

B. Manual Stations: Furnish quantity equal to 15 percent of number of manual stations installed. Provide five (5) manual fire alarm box keys on the bottom of the main FACP as spares.

C. Lamps for Remote Indicating Lamp Units: Furnish quantity equal to 15 percent of number of units installed.

D. Strobe Units: Furnish quantity equal to 15 percent of number of units installed.

E. Smoke Detectors, Fire Detectors, and Heat Detectors: Furnish quantity equal to 15 percent of number of units of each type installed.

F. Detector Bases: Furnish quantity equal to 15 percent of number of units of each type installed.

G. Notification Appliances: Furnish quantity equal to 15 percent of number of units installed.

H. Device Programmer: Provide one FPI-32 device programmer.

I. Interface Modules: Provide quantity equal to 15 percent of number installed, but not less than two (2).

J. Printer Paper: Provide six (6) extra rolls.

K. Panel Information: Provide the following information at the main FACP:

1. Date(s) of installation.
2. Contractor installation team members.
3. Total number of initiating and audible devices as well as total number of zones for each.
4. A complete copy of the "Certificate of Completion".
5. OBO/FPE's telephone and fax numbers.
6. A "point of contact" sticker installed on the lower right corner of the main FACP panel door.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

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

1. Siemens (Cerberus Pyrotronics), Cedar Knolls, NJ.

   a. Main FACP = MXL.
   b. Sub FACP = MXL.
   c. Slave FACP = SYSTEM 3.
   d. Fire Optic Isolator = Fiberplex.

2.2 MAIN FIRE ALARM CONTROL PANEL

A. Main Fire Alarm Control Panel: The control panel and all system circuit interface panels (CIP's) shall be modular in construction and shall include, but not limited to; the hardware, software and firmware required to perform the following major system functions:

1. Steel, satin black, baked enamel cabinet with indicator viewing window, removable hinged outer door with cylinder lock and dead front construction with the outer door open. The inner dead front doors shall be hinged for ease of system operation by firefighters and access by technicians for testing and maintenance modes.
2. System power supplies, including necessary transformers rectifiers, regulators, filters and surge protection required for system operation, with the capacity to power the system in a worst case condition with all devices in alarm and all local indicating appliances active without exceeding the listed ratings. All system devices shall display normal and alarm conditions consistently whether operating from normal power or reserve (standby) power.

   a. Surge protection shall be supplied at the power input to each cabinet. The surge suppression shall be of the phase to neutral (normal mode suppression). Phase to ground devices, MOV based devices and pure inductive devices shall not be considered acceptable. Protection shall also be furnished for SLC and NAC circuits where exiting and entering any structure, connected prior to any system devices within the structure.
   b. Standby power source shall meet the requirements for standby capacity as detailed in paragraph 1-5.2.6, NFPA 72, i.e. supervisory for 24 hours with local systems, central station and proprietary systems and 60 hours for auxiliary and remote station systems. Additionally, the supply shall be capable, at the end of this period of operating the system with all evacuation appliances active for a period of five minutes using conventional signaling or fifteen minutes using voice evacuation.
   c. Control panel and CIP power supply input and output voltages, battery charging currents and terminal voltages shall be displayed on the main control panel LCD display when requested via the panel service menu. It shall not be required to be at the cabinet being interrogated to measure service voltages.

3. NEC (NFPA 70) fire power limited (FPL) rating for all wiring exiting the control panel and CIP's. All wiring used between buildings, in concrete encased duct banks, shall be listed for wet locations.
4. System 16 bit core processor, with internal operating system to process incoming alarm signals and issue output commands required as a result of the alarm reception, by system programming or by manual commands. Total system response time shall not exceed 4 seconds on a system configured to the 2000 input address maximum capacity. All system processors shall be supervised by individual watchdog circuitry furnishing automatic restart after loss of activity. Systems with a single watchdog circuits for all processors shall not be acceptable unless supplied with a "hot" standby CPU.
5. Digital communication shall be Style 7 (Class A) communications using either DC digital or fiber optics technologies or combinations of both as required for the control panels to

communicate with up to 64 external network nodes including other local fire alarm systems, interface to building automation systems and Network Command Centers (NCCs).

a. Capability shall exist within the system to extend the network at any node. The system shall support a maximum of two network extension circuits in series on any system branch, extending the inherent distance limitations for network communications.
b. Communication protocol shall be of the CS/MACD (carrier sense, multiple access, collision detect) type. Communication techniques using token passing and requiring sensing of delays and re-generation of the token to re-establish network communications in the event of a fault shall not be acceptable.

6. NFPA 72 Style 7 operation analog signaling circuit with isolation capability for circuit survival in a shorted circuit mode, as required to communicate with 120 points consisting of a maximum of sixty intelligent analog alarm initiating and sixty intelligent controllable output devices.

a. Analog loops shall be configured with loop isolators and wired in a manner that prevents a catastrophic wiring event in a smoke zone or on a floor from affecting the performance of other floors.

7. Limited energy output circuits as required for operation of direct current audible or visual indicating appliances, leased line or city tie, or extinguisher system release shall be provided by controllable signal modules.

a. Outputs shall be programmable as device coded, zone coded, march time coded, temporal code 3, or continuous sounding and shall be configured as required for Style Z (Class A). These circuits shall be listed for sprinkler pre-action, deluge and FM-200 clean agent release and provide selection for silencable or continuous sounding.

8. Control of operations requiring switching functions, where required, shall be provided a software controllable relay module.

a. Relay coils shall be supervised when in the standby state.
b. Relay contacts shall be rated at 2 amperes minimum.

9. Mother boards shall be provided as the system bus, furnishing systems intra-cabinet communications to the various modules required for system operation and expansion.
10. System display/keyboard shall be usable at any network node and shall have the following capabilities, capacities, indicators and controls:

a. An 80 character back lighted alphanumeric super twist LCD display readable at any angle.

1) Thirty two character user defined custom messages shall describe the location of the active device.

b. The network system display shall have the capability to display a minimum of 6,000 custom messages activated as a result of alarms originated at other local panels resident on the external network. Systems unable to perform to this level shall supply PC based terminals displaying the required messages.

c. The system shall be capable of programming to allow troubles occurring and restored in the system to be automatically removed from the display queue.

d. As a minimum, an LED display for "ALARM", "AUDIBLES SILENCED", "SUPERVISORY", "TROUBLE", "SECURITY", "POWER ON" and "PARTIAL SYSTEM DISABLED".

e. Touch activated, audible feed-back, membrane switches for "ALARM ACKNOWLEDGE", "AUDIBLE SILENCE", "SUPERVISORY ACKNOWLEDGE", "TROUBLE ACKNOWLEDGE", "SECURITY ACKNOWLEDGE", "RESET", "DISPLAY HOLD" and "DISPLAY NEXT".

f. Touch activated, audible feed-back, membrane switch functions, programmable to perform a minimum of twelve custom designed and programmed functions such as drill or other special functions as required by the system user.

   1) The membrane switches shall also be used for the entry of multiple key sequences to be used for passcode protection inputs into logic strings, preventing un-authorized command entry.

g. Provide a ten digit keypad for passcode entry to perform programming and maintenance functions.

h. The system shall support a minimum of three supervised remote alpha-numeric command consoles as full function remote control points. Each supervised command console shall support printers, video display terminals, color video display terminals, CRT's and connected slave command consoles.

   1) Each system display shall be programmable, as a software function at the Fire Alarm Control Panel to be full function or display only, with it's own set of function commands, as described above. Selection in software shall also determine the display of either local only or global information.

i. Provide a real time clock with lithium battery for the maintenance of time through a full system power down, to ensure the accuracy of time labels in the historical events log.

j. Selective historical log, up to 800 events of all types shall be stored in flash memory and displayed, printed or downloaded by classification for selective event reports.

   1) The system shall allow selection of events to be logged, including inputs, as; alarms, troubles, supervisories, securities, status changes, walk tests and device verification, outputs as; audible control and output activation, actions as; reset, set sensitivity, arm/disarm, override, password, set time and acknowledge.
   2) Data format for downloading shall be adaptable to a database management program allowing custom report generation to track alarms, troubles and maintenance.
   3) Audible and visual indications shall be generated when memory is 80% and 90% full to allow downloading of data.
   4) Systems not supporting downloading of event history or requiring segregated storage for classifications of event history shall include a PC based, dedicated historical logging terminal together with hard drive storage and necessary software for system performance analysis and report generation.

11. The system shall have capabilities allowing vectored reporting of Alarms, Supervisories, Security, Troubles and Status, to dedicated alphanumeric radio pagers. The information displayed on the pager shall identify the system, the device address, the state of the device and the alphanumeric description of the device location. The system shall have capabilities of up to eight classifications of remote reports.
12. Software and hardware shall be furnished to allow an authorized service provider the ability to communicate with the control panel via phone lines, running diagnostic reports, historical reports, recording system voltage levels and recording system sensitivity levels.

B. Furnish a firmware operating system, installed system software database and system software management tools as follows:

1. The system shall include a real time link to the system data base, historical event log, logic, and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state as an operating system performing all programmed functions upon power restoration. Systems requiring battery backed-up memory devices shall not be acceptable.
2. Provide a software defined logic module as required for each alarm initiation point, capable of controlling any combination of the system output functions using as logic factors; counting, verification, time, day, holiday, type of device, "and", "or", "not", "timer", "all", "any", flip-flop, D latch, and up to 32 levels of programming shall be possible.
3. Software logic modules and system database shall be programmed using a DOS compatible program on any IBM compatible computer. It shall be possible to program or edit the system database off site after downloading from the control panel.
4. Provide an environment compensating, software driven logic for adjusting the alarm threshold windows on detectors to compensate for contamination accumulation and keep detector response sensitivity constant. The software shall compensate for either over-sensitized or de-sensitized units, raising a system flag when a detector approaches the allowable limits of adjustment, indicating a requirement for servicing.

    a. Environment compensation values shall be stored in non-volatile memory allowing activation of all tracking functions within 90 seconds of system initiation from a "cold boot". During the boot sequence, alarms from detectors programmed with the feature shall be suppressed. When the full data history is active all devices shall be checked and any active alarms shall be displayed.
    b. A short term history log of the fire sensing chamber value and heat value for each detector in the system shall be maintained, allowing the detector to compare the fire characteristics of the programmed fires for the occupancy in which it is installed to verify a fire condition. The detector shall ignore deceptive transient phenomena, concentrating on the fire profile within the program. If the programmed fire profile is matched the detector shall report immediately, without verification periods or threshold settings. Systems requiring the fire control panel to determine the alarm condition shall not be acceptable. The detector shall match the hazard phenomenon to an internally stored fire profile as selected for the detector location.
    c. The system shall recognize that a detector has, over a period of time, accumulated contaminates to the point that further movement of the chamber adjustment would violate the detector listing. At this time the control panel shall display a "detector dirty" message at 80% and an "excessively dirty" message at 100% of the allowable contamination levels, identifying the detector and it's location. Upon cleaning or replacing, a new environmental log shall be established for the

detector. If the cleaning message is ignored, upon further contamination the panel shall re-display the message and post a trouble condition for that detector.

d. The control panel shall be able to recognize alarms from a detector at a very early stage in fire development, posting a pre-alarm condition and activating any control functions that have been programmed for this condition. Upon installation, the detector shall automatically learn of its' environment, posting the pre-alarm threshold above the resident background levels of atmospheric contamination.

e. The control panel shall recognize the difference between the integrated heat sensor and the smoke chamber in a fire detection device. It shall be capable of reporting either a smoke alarm or a heat alarm condition and initiate separate and distinct alarm scenarios for each, including audible signal zones and life safety control sequences. It shall also be capable of programming for earliest possible alarm reporting by comparing the fire profile based on all technologies within the detector and alert the system before any single threshold has been reached, based on the stored profile for the occupancy programmed.

5. The control panel alphanumeric display shall indicate by means of a dedicated yellow LED, when any system address is intentionally bypassed or disarmed.

6. Provide a thermal readout printer.

C. Fire Alarm System Power Supplies:

1. System primary power:

a. Primary power for the FACP and the secondary power battery chargers shall be obtained from a dedicated emergency power circuits. Circuit breakers shall be fitted with a suitable guard, requiring removal of a screw to open, and used only for fire alarm. Each circuit used for fire alarm purposes shall be permanently labeled for function.

b. Secondary power supply:

1) Provide sealed gelled electrolyte batteries as the secondary power supply for all fire alarm functions. The battery supply shall be calculated to operate loads in a supervisory mode for twenty four hours with no primary power applied and, after that time, operate in alarm mode for five minutes conventional evacuation notification or two hours voice evacuation notification. Fifteen minutes of all call paging will be considered the equivalent of two hours normal paging use. Batteries shall be sized at 130% of the calculated size to compensate for deterioration and aging during the battery life cycle. Battery calculations shall be submitted to justify the battery size.

2) Provide battery charging circuitry for each standby battery bank in the system. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries. All system battery charge rates and terminal voltages shall be read using the fire alarm control panel LCD display in the service mode, indicating directly in volts and amperes. Meters reading in percentage are not acceptable.

D. System intelligent alarm initiation devices shall be furnished and installed where indicated on the drawings including features as follows:

1. General design and operational features:

a. The devices shall be protected by software in both the logic circuitry and the communication circuitry against undesirable effects from proximate electrical and electronic devices such as hand held radios, cellular telephones, fluorescent light fixtures, variable frequency motor controllers and other sources of RF interference.

b. Devices shall be listed by the U.L. for sensitivity testing by means of the portable programmer/tester or by readout from the control panel. Address assignments shall be accomplished electronically and stored in EEprom memory. Devices requiring dip switches, rotary switches, staples and/or jumpers are not acceptable.

1) The reading of the device sensitivity shall yield a discreet voltage level or percent of obscuration level as selected in software for logging and tracking of status to determine maintenance and cleaning requirements.

2) Detectors not listed for sensitivity testing from the control panel shall not be deemed acceptable due to the additional maintenance expense involved in the required removal, calibrated smoke generation and testing as described by N.F.P.A. 72, 7-3.2.1.

3) Sensitivity testing performed from the control panel shall be logged by the system printer or stored in system memory as specified, as a permanent record of the performance of code mandated testing.

4) Devices shall be equipped with a red flashing LED indicator which shall indicate alarm activation, a green flashing LED indicator which shall indicate normal operation and a yellow flashing LED indicator which shall indicate internal trouble within the detection device by the detection device. The LED indicator shall operate at the rate of once every four seconds and be operational when the system is operating from reserve power as well as normal power.

5) Detectors shall be operational with addressable relay bases, addressable audible bases and remote indicating LED's, programmable by the control panel and controlled by the detector electronics. They shall be supplied and installed with one of these options where indicated on the drawings or required by the operational requirements of this specification.

6) Detector shall be readily disassembled without the requirement for special tools to gain access to the detection chamber for cleaning and maintenance.

7) Detectors shall be assigned a sensitivity level for alarm threshold by the central controller, if not programmed to respond to a specific fire occupancy profile, based on environment, time of day or other programmable functions as required by the system user and shall respond at that level whether in the on line mode or default mode.

E. Intelligent Device types shall include the following:

1. Fire Detectors:

a. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.

b. Low profile, white case shall not exceed 6.25 cm of extension below the finish ceiling.

c. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber.

d. Detectors shall be programmable as application specific, selected in software for a minimum of eleven specific environmental fire profiles unique to the installed location. These fire profiles shall eliminate the possibility of false indications

caused by dust, moisture, RFI/EMI, chemical fumes and air movement while factoring fire burn rates, ambient temperature rise, obscuration rate changes and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.

1) Detection technologies using time delays to verify the existence of an alarm condition shall not be considered acceptable.
2) The detector manufacturer shall have an installed base of a minimum of one million detectors using the technology employed to demonstrate the product acceptability.

e. Detectors shall be microprocessor based and be capable of reporting a pre-alarm condition, indicating a potential emergency situation, when reaching a value appropriate to the occupancy in which it is installed.
f. Detector electronics shall utilize surface mounted techniques and be conformal coated with a substance rendering the electronics impervious to stray conduction caused by dust and moisture. The coating shall remain stable to 57 degrees C.
g. Detector report shall incorporate information to allow the activation of three unique alarm control by event programs based on sensing of fire profile within the programmed environment, sensing of smoke exceeding the threshold, sensing of heat exceeding the threshold and upon sensing of a pre-alarm level indicating a developing emergency situation requiring investigation. A fourth condition shall cause a different unique response to the alarm condition reported when the fire profile recognized as the result of a combination of sensory information fits the fire profile desired even though no single sensory threshold has been reached.
h. Detector shall be listed for duct smoke sampling when mounted in a compatible housing and shall be specifically programmable as a duct smoke detector in the software database.
i. Detectors shall be photoelectric type.

2. Heat Detectors, intelligent:

a. Detectors shall be rated at 135 degrees and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal inertia inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 57 degrees C.
b. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
c. The detectors furnished shall have a listed spacing for coverage up to 83.6 square meters for use in environments as covered by Factory Mutual and UL (UQGS) and shall be installed according to the requirements of NFPA 72 for open area coverage.

3. Fire Detector Bases, Universal

a. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 100 mm square or octagonal electrical outlet box. Bases shall be supplied with the following features as required for performance to this specification:

1) Where selective localized control of electrical devices is required for system operation, furnish and install detector base with software programmed

addressable relay integral to the base. The relay shall switch electrical loads, as indicated on the drawings. Operation of the addressable control circuit shall be independent of the number of detectors and relays on the circuit or the number in an alarm state.

2) Where indicated on the drawings for installation, furnish detector base with integral approved audible evacuation alarm signal having an output of 85db. The audible signal shall be individually addressable and software programmed for operation.

3) Furnish a concealed security lock, preventing unauthorized removal, installed in the base in those areas requiring tamper resistant installation as indicated on the drawings.

4. Manual Stations

a. Provide single action manual stations where shown on the drawings, to be semi-flush mounted unless otherwise indicated on the drawings.

b. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control.

1) Station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring.

2) Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

5. Notification Appliances:

a. Visual appliances: Provide strobe light visual alarm signals which operate on a supervised 24 hour (24) volt D.C. circuit. The strobe lens shall comply with UL 1971. The light pattern shall be disbursed so that it is visible above and below the strove and from a 90 degree angle on both sides of the strobe. The strobe flash output shall be a minimum of 15 candela based on the UL 1971 test. The strobe shall have xenon flash tube.

b. Audible appliances: Provide surface mounted bells suitable for use in an electrically supervised circuit. Bells shall be 250 mm vibrating 24 VDC motor bell type with a sound output rating of at least 90 dba at 3,000 mm.

6. Remote Conventional Zone Module

a. Provide, for integration of compatible 2 wire and shorting style contact devices into the intelligent analog signaling circuit interface module with the following capabilities:

1) Communication interaction with the analog signaling circuit having the capability of reporting alarm or trouble conditions from the devices monitored.

2) Compatibility with conventional ionization and photoelectric and linear beam style smoke detectors, heat detectors, flame detectors and all listed contact type devices.

a) The system manufacturer shall have specifically listed heat, smoke, ionization, and linear beam detectors for use with the remote conventional zone module.

3) Module shall be equipped with terminal strip and pressure style screw terminals for the connection of the device and systems communications field

wiring. The module shall also have an on board alarm LED furnished with the cover plate.

4) Modules shall be installed where indicated on the drawings using industry standard 100 mm square electrical outlet boxes; flush, surface, weatherproof as required for the area indicated.

5) Module shall be listed for use with intrinsically safe devices in classified hazardous areas.

7. Conventional Interface Module

a. Furnish and install, for the monitoring of contact type initiation devices and for the control of electrical devices where required, intelligent analog signaling circuit interface module. Modules shall be supplied to meet the project requirements as follows:

1) A single circuit intelligent signaling circuit interface module for monitoring alarm, trouble, supervisory security or status contact type devices. The single circuit interface shall also be available as a free-standing unit with pigtail wire leads for direct mounting with contact devices.

2) Unit as above with form C software programmable control contacts for the management of specified electrical loads as required by this specification.

3) Dual circuit intelligent signaling circuit interface module for monitoring alarm, trouble, supervisory security or status contact type devices.

8. Intelligent Supervised Control Module

a. Furnish and install for the control of supervised relays, contactors, audible signal circuits, visual signal circuits, intelligent supervisory and control modules including features as follows:

1) Modules shall be available to supervise reverse polarity supervised indicating circuits utilizing 24VDC.

2) The module shall be suitable for semi-flush or surface mounting in a 50 mm deep, 100 mm square or double gang electrical outlet box having a depth of 87.5 mm.

3) All controlled circuits shall be power limited at 1.5A, produced by self-restoring thermal components. Units requiring circuit replacement for restoration of outputs are not acceptable.

a) Signal outputs shall be supported in either Style"Z" configuration.

b) The module shall report a trouble condition in the event of loss of the 24VDC signal operating supply voltage.

F. Slave Fire Alarm Control Panel: A 220vac conventional, hard-wired, non-coded, zoned fire detection and alarm system, with manual and automatic alarm initiation. It shall be capable of providing the following:

1. Expandable to accommodate future modifications.
2. Provide 'zone' or 'system' dependant auxiliary 2 amp SPDT contact relays.
3. Provide multiple alarm priorities.
4. Provide remote alarm and trouble silence.
5. Provide alarm verification.

G. Conventional Smoke Detectors

1. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
2. Low profile, white case shall not exceed 6.25 cm of extension below the finish ceiling.
3. The detector shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
4. Detector electronics shall utilize surface mounted techniques and be conformal coated with a substance rendering the electronics impervious to stray conduction caused by dust and moisture. The coating shall remain stable to 57 degrees C.
5. Detector shall be listed for duct smoke sampling when mounted in a compatible housing and shall be specifically programmable as a duct smoke detector in the software database. When used as a duct detector it shall support the use of a remote test switch and LED indicator.
6. Detectors shall be photoelectric type.

H. Conventional Heat Detectors

1. Detectors shall be rated at 135 degrees and 15 degrees per minute rate of rise. Detectors shall be constructed to compensate for the thermal inertia inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 57 degrees C.
2. The detectors furnished shall have a listed spacing for coverage up to 83.6 square meters for use in environments as covered by Factory Mutual and UL (UQGS) and shall be installed according to the requirements of NFPA 72 for open area coverage.

I. Manual Pull Stations

1. Provide single action manual stations where shown on the drawings, to be semi-flush mounted unless otherwise indicated on the drawings.
2. Manual stations shall contain the intelligence for reporting address, identity, alarm and trouble to the fire alarm control.

    a. Station shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring.
    b. Surface mounted stations where indicated on the drawings shall be mounted using a manufacturer's prescribed matching red enamel outlet box.

J. Notification Appliances:

1. Visual appliances: Provide strobe light visual alarm signals which operate on a supervised 24 hour (24) volt D.C. circuit. The strobe lens shall comply with UL 1971. The light pattern shall be disbursed so that it is visible above and below the strove and from a 90 degree angle on both sides of the strobe. The strobe flash output shall be a minimum of 15 candela based on the UL 1971 test. The strobe shall have xenon flash tube.

2. Audible appliances: Provide surface mounted bells suitable for use in an electrically supervised circuit. Bells shall be 250 mm vibrating 24 VDC motor bell type with a sound output rating of at least 90 dba at 3,000 mm. Bells shall maintain audibility at 15 db throughout, but shall not exceed 120 db output anywhere.

2.3 WIRE

A. Provide cable for initiating circuits which have solid copper conductor; power limited, low energy, fire protective signaling circuit cable, with a metallic shield and ground/drain conductor. Minimum conductor size for initiation devices shall be 1 mm2 and maximum conductor size shall be 2.5 mm2. Notification appliance circuits shall be 2.5 mm2 solid core conductor with metallic shield and ground/drain conductor. Communication network circuits shall be minimum 1 mm2, maximum 2.5 mm2, solid core, twisted, shielded pair. Cable used between buildings, in concrete encased duct banks, shall be listed for wet locations.

2.4 TAGS

A. Tags For Identifying Tested Components: Comply with NFPA 72.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installer Qualifications: Installer shall meet the requirements of the National Fire Alarm Code, NFPA 72, 1-5.1.3 and 1-5.1.4.

B. Install system in compliance with NFPA Standards referenced in Parts 1 and 2 of this Section.

C. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover. Identify location of disconnect on placard mounted on FACP cabinet door.

3.2 EQUIPMENT INSTALLATION

A. Manual Pull Stations: Mount semi-flush in recessed-back boxes with operating handles 1220 mm above finished floor, or as otherwise indicated.

B. Water-Flow Detectors and Valve Supervisory Switches: Connect as located by fire protection plans in Division 15 Sections.

C. Smoke Detectors: Install ceiling-mounted detectors where indicated, and at not less than 102 mm from a side wall to near edge. Install detectors located on wall at least 102 mm but not more than 305 mm below ceiling. Refer to drawings for location of detectors.

D. Combined Audible/Visual Alarm-Indicating Appliances: Install where indicated and at not less than 2300 mm above finished floor, nor less than 150 mm below ceiling. Install bells on flush-mounted back boxes, with device operating mechanism concealed behind grille. Combine audible and visual alarms at same location, into a single unit.

E. Visual Alarm-Indicating Devices: Visual appliances shall have their bottoms at heights above the finished floor of not less than 2000mm and no greater than 2400mm.

F. Fire Alarm Control Panel (FACP): Surface mount, with tops of cabinets not more than 1828 mm above finished floor.

G. Surge Protection: The fire alarm systems shall have surge protection listed for their supplied operating power. All wire exiting or entering a building shall have transient protection as per manufacturers requirements. No aerial wiring is allowed.

3.3 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways as specified in Division 16 Section "Raceways." Conceal raceways, except in unfinished spaces and as indicated.

1. All fire junction boxes shall be painted red in color and assigned a number and this shall be affixed to the box with the words "FOR FBO/FIR WIRE ONLY" and "BOX NO.". The number shall correspond to the floor the junction/pull box is located on; i.e. "BOX NO. 0" is in the basement, "BOX NO. 1" is the ground floor, "BOX NO. 2" is on the second floor, etc. If more than one junction/pull box is on a floor, the number shall be followed any letter; i.e., "BOX NO. 2A" is the second junction/pull box on the second floor, "BOX NO. 2B" is the third, etc.
2. All numbered junction/splice boxes shall be shown on the "as-built" drawings with their respective numbers.
3. As-built drawings shall show the location of the riser and the size of the conduit leading into and out of the riser's junction boxes.
4. All riser junction boxes shall have a wire listing in the inside cover and "as-built" for the zones serviced on that specific floor and shall be divided into three categories that include:

    a. The wire numbers used for that particular floor,
    b. Any space wires that are terminated in that particular junction box.

5. All riser junction boxes shall be 30.5 cm x 30.5 cm x 10.2 cm minimum and sized according to number of conductors contained.
6. All riser junction boxes shall be located in a controlled access environment to limit access to alarm system. If a controlled access environment is not feasible, junction box covers shall be hinged, hasped and locked.
7. All riser junction boxes shall be readily and easily accessible for maintenance personnel.
8. All terminations inside the junction box shall be made with spade lugs with the connections soldered. Terminal blocks with proper number of connection points shall be affixed inside the junction box for zone/signal line circuits (SLC)/notification appliance circuits (NAC) collections. Terminal board screws shall not be soldered but are to be torqued as recommended by the equipment supplier. The terminal strips shall be marked "FROM" which represents wire coming from FACP and "TO" which represents wires to specific zones. Each pair of wires shall be marked with zone/SLC/NAC it represents and numbers marked adjacent corresponding terminal lugs.
9. All junction box covers shall be painted red in color and have stenciled exterior lettering, in white or silver paint, in accordance with paragraph 3.3.A.1.

B. Conduit is required for all wire exiting the fire alarm control panel.

3.4 CONDUIT INSTALLATION

A. The conduit quantities, size, and routing shall be the responsibility of the installing contractor.

B. The number of conductors in any size conduit shall conform to 1999 National Electrical Code (NEC), Chapter 9, Tables 1 and 4, except for type FPL wire. FPL wire conduit fill shall be based on manual calculation using outside diameters listed by cable manufacturer.

C. Pull Boxes: Appropriate size pull boxes shall be installed such that there are no more than the equivalent of four quarter bends (360 degrees) between pull points.

D. Wiring Within Enclosures: Install conductors parallel with or at right angles to sides and back of enclosure. Bundle, lace, and train conductors to terminal points with no excess lengths. Connect conductors to terminal blocks where terminated, spliced, or interrupted in enclosure associated with fire alarm system. Mark each terminal according to wiring diagrams of system. Make connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, or outlet boxes, cabinets, or equipment enclosures, wherever circuit taps are made. Pig-tail or T-tap connections, to alarm-initiating devices or alarm-indicating appliances, are not acceptable.

F. System Wiring: For initiating circuits which have solid copper conductor; power limited, low energy, fire protective signaling circuit cable, with a metallic shield and ground/drain conductor. Minimum conductor size for initiation devices shall be 1 mm2 and maximum conductor size shall be 2.5 mm2. Notification appliance circuits shall be 2.5 mm2 solid core conductor with metallic shield and ground/drain conductor. Communication network circuits shall be minimum 1 mm2, maximum 2.5 mm2, solid core, twisted, shielded pair. All wiring shall be listed as 75-deg C insulation, in wet, damp, or dry locations. For line-voltage wiring, install 4 mm2 conductors with insulation rated 75-deg C minimum and comply with Art.760 of the NEC.

G. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color for alarm circuits wiring and a different color for supervisory circuits. Color-code audible alarm- indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

H. End of Line Device (EOLD): Locate EOLD as shown on drawings and in field on junction box of last initiating device or indicating appliance circuit.

3.5 GROUNDING

A. Ground equipment and conductor and cable shields. Shielded FPL cable shall have shields or drain wire tied through devices and junction boxes, isolated (insulated) from ground except at the FACP.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of Manufacturer's factory-authorized service representative, to supervise testing, and adjustment of system; system including master, slave, and sub fire alarm systems.

B. Pretesting: Upon completing installation of system, align, adjust, and balance system and perform complete start-up and pretesting. Determine, through pretesting, conformance of system to requirements of Contract Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning and damaged items with new, and retest until satisfactory performances and conditions are achieved. Prepare forms for systematic recording of acceptance test results. Tests shall be in accordance with procedures outlined in NFPA 72. As a minimum, pretests shall consist of the following:

1. Verify absence of unwanted voltages between circuit conductors and ground.
2. Megger test conductors, other than those intentionally and permanently grounded, with electronic components disconnected. Test for resistance to ground. Report readings less than 1.0 megohm for evaluation.

3. Test conductors for short circuits, utilizing an insulation-testing device.
4. With each circuit pair, short circuit at far end of circuit and measure circuit resistance with an ohmmeter. Record circuit resistance of each circuit on record drawings.
5. Verify that control unit is in normal condition, as detailed in manufacturer's operating and maintenance manual.
6. Test initiating and indicating circuits for proper signal transmission, under open circuit conditions. Open one connection each, at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission, conforming to style of wiring used.
7. Test each initiating and indicating device for alarm operation and proper response at control unit. Test smoke detectors with actual products of combustion. Test sensitivity of each initiating device with analog sensitivity equipment in accordance with NFPA 72. Use test equipment designed to allow anyone to test proper operation of detectors utilized. Retain equipment and special tools at site through the time period when pretesting work is to be completed.
8. Test system for specified functions according to Manufacturer's operating and maintenance manual. Systematically initiate specified functional performance items at each station including making every type of possible alarm and monitoring initiation and using every communication option. For each item, observe related performance at devices required to be affected by item under every system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
9. Test both primary power and secondary power. Verify, by test, that secondary power system is capable of operating system for the period and in manner specified.
10. Measure resistance Signal Line Circuits (SLC). Maximum line resistance for Style 7 circuit (both wires) is 100 ohms.
11. Measure resistance of communication network circuit. Maximum allowable line resistance is 80 ohms (both wires).

C. Report of Pretesting: After pretesting is complete, provide letter certifying installation is complete and fully operable; include names and titles of witnesses to pretests.

D. Retesting: Correct deficiencies indicated by tests, and completely retest work affected by such deficiencies. Verify by system tests that total system meets requirements and complies with applicable standards.

E. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results, in the form of a test log. All smoke detector sensitivity voltage measurements must be properly documented. Submit log upon satisfactory completion of tests.

F. Final Test Notice: Provide the Project Director a 21-day minimum notice in writing when system is ready for final acceptance testing (Commissioning).

3.7 CLEANING AND ADJUSTING

A. Detectors shall not be installed before controlled environments are established well after finished trim-out of the buildings interior spaces that are protected by the fire alarm system. Any devices compromised by construction debris and contamination from premature installation shall be discarded and replaced with new devices.

3.8 ACCREDITATION (PERFORMANCE TESTING FOR SYSTEM ACCEPTANCE AND COMMISSIONING)

A. Provide the services of Manufacturer's factory-authorized service representative during Commissioning activities. OBO/FPE's representative will be present during commissioning, and will witness final acceptance tests of fire alarm system; including master, slave, and sub fire alarm systems.

1. Test each initiating and indicating device for alarm operation and proper response at control unit. Test smoke detectors with actual products of combustion or cold smoke in accordance with Manufacturers recommendations.
2. Test operational (relay) logic of the fire alarm system for proper interface with: HVAC systems, elevator service, security door controls, and special areas and other fire alarm systems; so as to verify proper operation of systems.
3. Provide all pretesting documentation to OBO/FPE's representative.

B. Upon completion of commissioning for fire alarm system, provide 216 mm x 279mm notebook(s) containing following information:

1. Provide 6 copies of notebooks with floor plans of commissioned fire alarm device layout, device symbols, device addresses, identification numbers and room numbers. Conduit routing is not required. Arrange floor plans by building and floors, and indicate each of these; buildings tabbed accordingly.
2. These notebooks serve as graphic annunciation for FACP, reflecting system commissioned; and will be modified when changes to fire alarm system are made.

C. Provide certification documentation as defined and outlined in the National Fire Alarm Code, NFPA 72, 1-6.2.1 and 1-6.2.3.1.

3.9 TRAINING

A. Provide the services of Manufacturer's factory-authorized service representative to demonstrate and train Government maintenance personnel as specified below:

1. After completion of commissioning responsibilities train Government's maintenance personnel in procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintenance of system. Provide minimum of 8 hours' training.
2. Schedule training with the Project Director at least 21 days in advance.
3. Provide 6 copies of Manufacturer's standardized and comprehensive system operation and user's manuals covering equipment.
4. Provide 6 copies of instructions listing routine maintenance procedures and noting possible breakdowns. Provide repair and trouble shooting guide which lists common causes for breakdowns, malfunctions, and recommended repairs.

END OF SECTION 13851