

TG 13850v0908

Summary of Changes:

1) Present guide specification has a submittal requirement for fire alarm systems that is being interpreted that fire alarm equipment manufacturers must submit copies of their proprietary software and passwords to the State Government. A revision is proposed to delete this unenforceable requirement.

Fire Alarm Systems TECHNICAL GUIDE

TG 13850

1. COORDINATION ISSUES: (Not Used)

2. DESIGN ISSUES:

2.1 System Description: Indicate the location of all fire alarm system devices and riser locations on all floor plans. Provide both a fire alarm sequence of operation matrix chart and a fire alarm system riser diagram indicating all devices and zones.

2.2 Existing Fire Alarm System:

2.2.1 For projects using the existing fire alarm control panel (FACP), indicate on the plans or specifications the brand name, model number and operating voltage of the existing system.

2.2.2 Specify how the existing FACP must be upgraded and new voltage of existing system. Show new modules and changes in the modular system wiring diagram similar to the requirements for a new FACP.

2.2.3 Show how the new spare or existing zone/signal circuits will be used.

2.2.4 For projects requiring new and use of existing fire alarm control panels indicate and describe on the contract drawings the panels interface connections required.

2.2.5 Where an existing Fire Alarm System is present, verify whether the panel and devices can sound the three-pulse temporal pattern. If not, discuss the matter with your DAGS Project Coordinator and Central Services Division to determine whether the existing system should be upgraded or whether a variance should be sought from the Fire Department to maintain the existing signal pattern (e.g. march-time pattern).

2.3 Equipment Removal: Contact your DAGS Project Coordinator and Central Services Division to determine what action is appropriate for the salvaging of existing fire alarm equipment.

2.4 New Fire Alarm Systems: Central Services Division's preference is to use an Edwards Systems Technology (EST) Model EST-3 Fire Alarm System or a Simplex Model 4100 Fire Alarm System which are UL Listed or FM Approved.

2.5 FACP 120 VAC Power: The 120 VAC power shall be on a dedicated circuit. Address breaker type and size on the drawings.

2.6 Heat Detectors: Thermal Sensors (rate of rise with fixed temperature) manufactured by the addressable programmable [analog] equipment supplier or thermal sensors listed as compatible with the addressable programmable [analog] system shall generally be used.

However, whenever cold atmosphere conditions with moisture laden air exists, the heat detectors shall be rate compensated type.

2.7 Terminal Cabinets: Provide terminal cabinets on each floor where the fire alarm system supply riser is located and where the fire alarm return riser is located.

2.8 Fire Alarm Speakers: Locate speakers throughout the building with a maximum spacing of 1000 square feet per speaker. Where sound has to pass through more than one partition or wall to be heard in a space, provide an additional speaker.

2.9 Visual Alarms:

2.9.1 Visual alarms shall be designed in accordance with NFPA 72.

2.9.2 Locate strobes wall mounted in corridors no more than 15 feet from the end of a corridor with a 100 feet maximum distance between strobes. Where there is an obstruction to the viewing path in the corridors, such as a cross-corridor door or ceiling elevation change, consider the obstruction as defining a new corridor. Provide wall mounted strobes in rooms accessible to the public, such as conference rooms, restrooms, courtrooms, cafeterias, and auditoriums in accordance with NFPA 72.

2.10 Horns (Audible Devices): Where horns or bells are used for fire alarm notification, calculate the proper locations for these devices as detailed in "Designing Fire Alarm Audibility", which is contained in the Society of Fire Protection Engineers (SFPE) Handbook of fire Protection Engineering.

2.11 Electromagnetic Door Holder: Provide electromagnetic door holders only for cross-corridor doors and for doors likely to be propped open once construction is complete.

2.12 Below Grade Conduit and Wiring:

2.12.1 Use underground (below grade) distribution for fire alarm systems in new facilities and projects where the entire system will be upgraded.

2.12.2 The design consultant shall field verify the condition and capacity of existing conduits, including those below grade, that are proposed to be reused and to clearly indicate in the contract documents the requirements necessary for their re-use (e.g. address removal and replacement of existing wiring where pulling of new wiring will damage the existing wires).

2.12.3 Where required, splices within handholes are acceptable. However, splices will be made with a positive connection to a terminal strip and shall be made waterproof.

2.13 Conductor Color Code:

2.13.1 Include/show the DAGS standard color codes in the specifications and the Contractor's point-to-point wiring diagrams.

2.13.2 Assign cable conductors by the cable conductor number in circuit pairs uniformly, i.e., cable conductor number one and two used for a circuit becomes circuit pair number one.

2.13.3 Compare and match existing fire alarm cable conductor assignments when feasible and advantageous.

2.13.4 Exception for the Cables Above: For below grade cables when direct burial type cables are mandatory for installation, use other available colors for outer jacket when red outer

jacket and suitable direct burial type cables are not available. Black and Gray outer jacket are acceptable direct burial type cables.

2.13.4.1 Note: Red outer jacket is selected to differentiate the cable from the Data Bus (Network) Twisted Shielded Pair Cable which the color black was selected.

2.13.5 When the design mandates the use of a direct burial type cable which includes conductors with color code of green, white and gray, include a note in the specifications and the plans that the green, white and gray conductors shall not be used.

2.14 Panels for Supervision of Elevators and Elevator Shafts: All panels required for supervision of elevators and elevator shafts shall not be installed in the elevator machine room. ANSI/ASME safety code for elevators and escalators Rule 101.26 states that only equipment required for elevator operation are permitted in the elevator machine room. This requirement is strictly enforced by the Building Department's elevator inspectors.

3. DRAWING NOTES:

3.1 General:

3.1.1 The objective is to have a record of the installation in our contract file and minimize the number of drawings for review and retention in our Design Plan File.

3.1.2 Contract Fire Alarm Installation Drawings customarily include the Legend, Site Plan, Signal Plans (floor plans showing locations of fire alarm devices, panel and equipment), Fire Alarm Riser Diagram, Fire Alarm Sequence of Operations (Matrix), etc.

3.1.3 To comply with DPW requirements, the Fire Alarm Riser Diagrams must be sufficient to ensure a quality Fire Alarm design as well as provide information for bidding, installation, repair and maintenance. The Fire Alarm Riser Diagram must include the following information:

3.1.3.1 Locations of all panels and devices.

3.1.3.2 Minimum conduit sizes and conductor counts, cables, junction boxes, terminating cabinets, handholes, etc.

3.1.3.3 Sequence of Connections of all initiating circuits' and signaling circuits' devices so the sequence of circuit numbers, and sequence of connections of all devices can be readily determined and followed. End-of-line resistors must also be shown.

3.1.3.4 Initiating zones must be assigned for hardwired systems to each building or building clusters. For addressable systems, loop or loops must be shown. For addressable loop or loops, specify or provide system design installation requirements which will allow personnel to isolate open circuits and other problems by circuit segments within each floor and by floors with the minimum of effort and time. In addition, loop or loops segments must also be extended to all buildings in a manner to make isolating trouble easier.

Addressable systems allow T-Tapping and some do not. The designer can specify and show the segments discussed above. Require and confirm that the Contractor shows the actual connections for loops, i.e., sequenced or T-Tapped as as-built information (four wires for loops and two wires for T-Taps).

3.1.3.5 Installation Notes.

- 3.1.3.6 Conductor and cable conductor color codes and assignments by circuits with number of spares shown/specified, and cable conductor count which will equate to circuit pairs.
- 3.1.3.7 Statement that the minimum size of cable conductors and conductors must be reconfirmed by the Contractor subject to the minimum current requirements of the Contractor furnished fire alarm system components-devices. If the required conductor sizes differ from those shown in the contract drawings, the Contractor shall indicate the change on the Shop Drawings.
- 3.1.3.8 Statement that the Contractor shall determine the final cable conductor and above grade conductor size and count which must accommodate the Contractor furnished components-devices and the number of initiating (Or addressable loop or loops) and signaling circuits specified.

3.2 Installation Notes: Ensure that the following installation notes are included in the drawings:

- 3.2.1 Provide wire marking required by the NEC for all wire connections/terminations (fire alarm control panel, terminal cabinets, and main junction box) and indicated as follows:

VSC1-I = Visual Signal Circuit #1 - In
VSC1-O = Visual Signal Circuit #1 - Out

ASC1-I = Audio Signal Circuit #1 - In
ASC1-O = Audio Signal Circuit #1 - Out

IDC1-I = Initiating Device Circuit #1 - In
IDC1-O = Initiating Device Circuit #1 - Out

DRH2-I = Door Holder Circuit #2 - In
DRH2-O = Door Holder Circuit #2 - Out

COMM1-I = Communications Circuit #1 - In
COMM1-O = Communications Circuit #1 - Out

- 3.2.2 Provide wire nut connections for all devices with pigtails. All others shall be by screw or terminal block connections.
- 3.2.3 Provide note to the Contractor to provide size in ohms and rating in watts for all "end-of-line" resistors in the final as-built drawings.
- 3.2.4 Provide two feet of slack for all spare incoming conductors in fire alarm control panel, or the fire alarm system termination cabinet when provided. Secure wiring with cable ties to interior of the fire alarm control panel. (Goal is to provide maximum access to panel components and minimize congestion in the fire alarm panel(s).)
- 3.2.5 Install wire markers a minimum of 4 inches from their ends in a manner that will not permit accidental detachment. Provide a minimum of 6 inches of wire slack per NEC and/or a minimum of 6 inches of wire in a vibration loop. Provide a vibration loop for each wire termination to equipment terminals inside fire alarm control panels and other equipment.

- 3.3 **Slope Conduits to Drain at Handholes and Manholes:** Specify slope required to achieve drainage from underground conduits to handholes or manholes. Include this item on the plans; that is, provide for the lower or several of the lower handholes to have drainage in the event of flooding in the area.

3.4 Labeling of Cables: Provide note on the drawings stating that cables and conductors shall be labeled at all accessible locations, including handholes and manholes.

3.5 Initiating Circuits: List buildings and building groups assigned to initiating and signaling circuit zones on the drawings. Clusters of buildings in a single zone must not be more than 100 feet apart. The foregoing does not apply to addressable loops for addressable initiating devices; however, the loop or loops routing and segments should be systematically planned, specified and shown in the plans and specifications.

4. STANDARD DRAWINGS: (Not Used)

5. SPECIFICATION NOTES:

5.1 General:

5.1.1 Where numbers, symbols, words, phrases, clauses or sentences in this specification are enclosed in brackets [], a choice or modification must be made; delete inapplicable portion(s) carefully. If a choice or modification is not required for contract purposes, delete the brackets and insert the word "or" to leave the decision up to the Contractor. Where blank spaces occur in sentences, insert the appropriate data. Where entire paragraphs are not applicable, they should be deleted completely.

5.1.2 Verify that the titles of other sections of the project specification referred to in this section are identical; if they are not, make the necessary editorial changes.

5.1.3 Remove appropriate references to existing fire alarm equipment, if the project does not have an existing fire alarm system or if the existing system is to be replaced with a new system.

5.1.4 If there is no elevators in the building, remove all references to elevator recall and elevator shutdown.

5.1.5 For salvage of existing fire alarm equipment, check with your DAGS Project Coordinator and the local Central Services personnel for exact locations of delivery of such items.

5.2 Single Action Pull Station: The Fire Department will allow installation for covers over single action pull stations to adhere to the requirement of two allowable actions. Moving the cover is defined as one action, pulling the manual station is defined as another action for a total two actions allowed by Code.

6. GUIDE SPECIFICATIONS:

6.1 Section 13851 Addressable Fire Alarm System

6.2 Section 13852 Hard Wired Fire Alarm System

***SPECIFIER'S NOTE:** Blue colored italicized text is used for notes to the specifier and should be completely deleted from the final text. Where [Red colored italicized text in parentheses] is shown in this specification section, insert wording, numbers, etc. as appropriate and delete parentheses. Where <Red colored text in brackets> is shown, a choice is indicated. Make the appropriate choice and delete the brackets. Maintain footer notation with the current version used (e.g. TG13851 v07.02). Verify that section titles cross referenced in this Section correspond to this Project's specifications; Section titles may have changed.*

SECTION 13851 - ADDRESSABLE FIRE ALARM SYSTEM

PART 1 GENERAL

1.01 GENERAL CONDITIONS

- A. As specified in Section 00700.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Section 07840 - Firestopping: Firestopping requirements.
- B. Section 09900 - Painting: Painting of all conduits, raceways, ducts, cabinets, junction boxes, etc.
- C. Section 13930 - Wet-pipe Fire Suppression Sprinklers: Alarm initiating devices shall be installed with the sprinkler system.
- D. Section 16100 - Electrical Work: All power wiring including wiring to disconnect switches and breakers and wiring to all equipment.

1.03 PAYMENT PROCEDURES

- A. Permits, Tests and Inspections: Apply, secure and pay for all required permits, fees, licenses, tests, inspections and royalties necessary to accomplish the work. Schedule and coordinate required tests and inspections.

1.04 SCOPE

- A. System Description: This work includes designing and **<modifying existing> <and>** providing a new, complete, multiplex/addressable programmable **<analog>** fire alarm system as described herein and on the contract drawings for . The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. The system layout on the drawings is conceptual. A single fire alarm control panel is indicated **<with fire alarm power extender panels>**. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 72 **[and] []** except as modified herein. **<A single fire alarm control panel is indicated with terminal cabinets at each floor at each riser location. Where remote fire alarm control units are needed, they shall be provided at a terminal cabinet location. Each remote fire alarm control unit shall be powered from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.>**
- B. **<Existing Fire Alarm Equipment: Existing interior system was manufactured by [], and new equipment shall be compatible with and shall operate accurately and reliably with the existing system. Existing fire alarm equipment shall be maintained fully operational until the new equipment has been tested and accepted. As new equipment is installed, it shall be tagged "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the State it shall be placed in service and connected to the station fire alarm system. All new equipment shall have tags removed and the existing equipment shall be tagged "NOT IN SERVICE" until removed from the building.>**
- C. **<Equipment Removal: After acceptance of the new system by the State, all existing equipment not connected to the new system shall be removed, all unused exposed conduit shall be removed, and all damaged surfaces shall be restored.>**

The material shall be boxed and delivered to Central Services Division, Department of Accounting and General Services, 729 <Kakoi Street, Honolulu, Hawaii>.

1.05 APPLICABLE PUBLICATIONS

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

1. Code of Federal Regulations (CFR)
 - a. 47 CFR 90 Private Land Mobile Radio Service
 - b. 29 CFR 1910.36 Occupational Safety and Health Standards, Subpart E - Means of Egress, General Requirements
 - c. 29 CFR 1910.37 Occupational Safety and Health Standards, Subpart E, Means of Egress, General
2. American Society of Mechanical Engineers (ANSI/ASME)
 - a. ASME/ANSI A17.1 (1993) Safety Code for Elevators and Escalators
3. Factory Mutual Engineering and Research Corporation (FM)
 - a. FM P7825 (2001) Approval Guide
4. National Electrical Manufacturers Association (NEMA)
 - a. NEMA ICS 1 (1993) Industrial Control and Systems
5. National Fire Protection Association (NFPA)
 - a. NFPA 70 (1999) National Electrical Code
 - b. NFPA 72 (1999) National Fire Alarm Code
 - c. NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems
6. Underwriters Laboratories Inc. (UL)
 - a. UL 464 (1990) Audible Signal Appliances
 - b. UL 864 (1991; R 1994, Bul. 1995) Control Units for Fire-Protective Signaling Systems
 - c. UL 1449 (1985; Errata 1986, Bul. 1993, 1994, and 1995) Transient Voltage Surge Suppressors
 - d. UL FPED (2001) Fire Protection Equipment Directory
7. American Electricians Handbook by Croft (latest edition), McGraw-Hill
8. Practical Electrical Wiring by Herbert P. Richter and W. Creighton Schwan, McGraw-Hill
9. Copper Development, Inc.'s "Copper Building Wire Handbook"
10. National Electrical Safety Code
11. Local ordinances and regulations of the County
12. International Municipal Signal Association Inc. Specification No. 19-1 1991, polyethylene insulated, polyvinyl chloride jacket signal cable; and

13. Applicable instructions of the manufacturer for equipment and materials supplied for the project.

1.06 SUBMITTALS

A. Submit under provisions of Section 01330 - SUBMITTALS. Partial submittals will not be acceptable. Submit for approval six (6) complete sets of submittals as described below. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Do not commence work until the design of the system and the various components have been approved. The Contracting Officer will review and approve all submittals. Before work is commenced the shop drawings must be approved.

1. Manufacturer's Catalog Data:

- a. Fire alarm control panel (FACP) **<Including Printers, Covers, Console Rack, Video Display Unit, etc.>**
- b. Manual fire alarm stations
- c. Batteries
- d. Battery charger
- e. Single **<Multi>** Station Smoke Sensors
- f. Heat detectors
- g. Smoke sensors
- h. Addressable interface devices
- i. **<Audiovisual alarms>**
- j. **<Visual alarms>**
- k. Graphical annunciator panel
- l. **<Horns>**
- m. **<Mini horns>**
- n. Fire alarm power extender panels
- o. Amplifiers
- p. Preamplifiers
- q. Tone Generators
- r. Voice evacuation speakers

2. Shop (Working) Drawings:

- a. Point-To-Point Wiring Diagrams: Drawings shall be job-specific. "Typical" or "generic" drawings are not acceptable. The diagrams shall include but not be limited to the following:
 - 1) Locations Of All System's Elements: Indicate all devices, junction boxes, handholes, and pass-through devices and entities where the cables and conductors can be accessed by personnel. Indicate the number of devices provided.

- 2) Also indicate the locations of all cable and conductor terminations and intermediate connections showing where they pass through without terminations/connections from and to equipment panels and/or devices.
 - 3) Labeling Of All Elements: All devices junction boxes, etc. shall be labeled by functional designations, locations and numbers such as building alphabet, room function and room number, and handhole number.
 - 4) Fire Alarm Wiring and Color Codes: All cable and conductor color codes, the wire marking system and marker designation as specified herein shall be shown.
- b. Equipment and/or Modular Systems Wiring Diagram: Wiring diagrams showing all equipment (control panel and annunciator in separate panel) modules, components and key internal cabinet wiring that should be accessed for tests and maintenance. Drawings shall include but not be limited to the following:
- 1) Equipment Modules and Components: The equipment modules and components layout (relative locations in proportion to the modules, components and cabinet/enclosure sizes) including the fire alarm control panel(s), battery cabinets, etc. The drawings shall also show the arrangement of modules, components, wiring and expansion space within the FACP cabinet.
 - 2) Input and Output Circuits Labeling: Label the input and output circuits by circuit designations specified herein.
 - 3) Internal - External Circuits Interface Information: Only information that interfaces with external circuits and internal equipment wiring need be shown. All external wiring and circuits shall be shown in the riser diagram and the Contractor furnished Point-To-Point Wiring Diagrams.

Changes in or deletion of the modular system wiring diagrams shall not require changes to the riser diagrams and the Contractor furnished Point-To-Point Wiring Diagrams and vice versa except for the panel deletion or change.

Provide a complete description of the system sequence of operation for all initiating, notification, and control devices via a sequence of operation matrix diagram.

Provide detailed drawings of the graphic annunciator.

Provide a complete list of device addresses and corresponding messages.

3. Design Data:
 - a. Standby battery capacity calculations shall list the type of devices and modules, quantities, unit amperage draw for standby and alarm conditions, total amperage draw and battery amp/hour rating.
 - b. Provide detailed voltage drop calculations for all notification appliance circuits and releasing device circuits.
 - c. Provide data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, and 25 percent spare capacity for initiating devices.

- d. Amplifier power calculations shall list the types and quantities of speakers, circuits, loads, and equipment power consumptions. All amplifiers shall be sized for service at 75 percent of their rated capacity for future expansion as necessary.
4. Guaranty.
5. Operations and Maintenance Manual: Provide five (5) bound copies of the Operations and Maintenance Manuals in three (3) hole binders with hard covers. The manuals shall be submitted to the Contracting Officer a minimum of two (2) weeks prior to the final test.
- a. The manual may be provided in several volumes if so approved by the Contracting Officer.
 - b. All drawings shall be folded to letter size by individual sheets so they can be retained in the manual.
 - c. The manual shall contain the following:
 - 1) Manufacturer's Printed Equipment/System Operations and Maintenance Manual, and Devices Brochures:
 - a) Start-up, operating, preventative maintenance, adjustment and troubleshooting procedures, and parts list.
 - b) System Control Diagrams.
 - c) Internal equipment wiring diagrams.
 - 2) Manufacturer's Representatives: The names, addresses and phone numbers of the fire alarm system manufacturer, the nearest manufacturer's representative, and the nearest supplier of the manufacturer's equipment and parts.
 - 3) Fire Alarm System Test Results: Provide completed test data sheets with the recorded measured data obtained during pre-final testing in the designated spaces and a printout of the equipment program. The test plan shall be developed in accordance with NFPA 72, Chapter 7. Submit the following information.
 - a) Test information applicable for the project.
 - b) Standard attendance signature sheets.
6. As-Built Drawings: Submit in accordance with Section 01300 - SUBMITTALS. Drawings shall provide a detailed description of system operation during alarm, supervisory, and trouble modes and shall include a complete list of all system addresses including input/output logic. Upon completion and before final acceptance of the work, submit complete set of as-built drawings of the system for record purposes. Drawings shall include all components and circuit diagrams complete with conductor color codes and a listing of initiating devices. Submit 24 by 36 inch drawings on reproducible vellum with title block similar to full size contract drawings.

~~7.—Fire Alarm System Documentation:~~

~~a.—List of device addresses and corresponding messages.~~

~~b.—Program listing.~~

~~e. List of all passwords for accessing the various protection levels.~~

1.07 QUALITY ASSURANCE

- A. Qualification of Installer: Installation shall be accomplished by an electrical contractor with a minimum of five years experience in the installation of fire alarm systems in the State of Hawaii. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system. Prior to installation, submit data for approval by the Architect/Contracting Officer showing that the Contractor has successfully installed addressable, programmable analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

SPECIFIER'S NOTES: This Article requires a National Institute for Certification for Engineering Technologies (NICET) engineering technician with a minimum Level-III certification in Fire Alarm Systems Program. This item should not be edited out as it replaces the requirement for the drawings to be stamped by a Licensed Professional Engineer.

- B. Qualifications of System Technician: Installation drawings, shop drawings, and "as-built" drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of work specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in Fire Alarm Systems program. Contractor shall submit data showing the name and certification of the technician at or prior to submittal of drawings.
- C. Regulatory Requirements: Devices and equipment for fire alarm service shall be listed by Underwriters Laboratories, Inc. or approved by the Factory Mutual System or listed by other nationally recognized testing laboratories.
- D. Requirements for Fire Protection Service: Equipment and material shall have been tested by Underwriters Laboratories, Inc. and listed in UL FPED or approved by Factory Mutual and listed in FM P7825. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL FPED or FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.
- E. Standard Products: Materials and equipment shall be standard new products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least one year prior to bid opening. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials.
- F. Modification of References: In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the County Building and Fire Departments.

1.08 GUARANTY AND CERTIFICATE

- A. The Contractor shall guaranty and certify in writing all work in this section for period of two (2) years. Should any equipment or material fail due to defective equipment, material

or workmanship within this period, the Contractor shall replace the item at no cost to the State.

- B. The two (2) year guaranty shall start at the end of thirty (30) consecutive days of trouble free operation after certification by the Fire Department and acceptance by the State whichever date is the latest.
- C. If the existing fire alarm system is inoperative or deficient and requires repair, the guaranty shall begin thirty (30) days after trouble free operation after the date the Contractor installed portion of the fire alarm system is tested to confirm that it is operational and meets contract requirements.

1.09 MAINTENANCE

- A. During the fire alarm system's two (2) year guaranty period, the Contractor shall supply complete maintenance and testing services for the entire fire alarm system in accordance with the manufacturer's instructions and NFPA 72. The system shall be tested and serviced every six (6) months for a minimum of four (4) times during the guaranty period. Reports prepared on Contractor-furnished standardized forms similar to the form in NFPA 72 shall be submitted to Central Services Division, Department of Accounting and General Services, **<729 Kakoi Street, Honolulu, Hawaii>**, each time a test and/or maintenance action occurs.
- B. During the two (2) year guaranty period, the Contractor shall, upon the receipt of notice from the State's representative, promptly make all repairs arising out of defective material, workmanship or equipment. The Contractor shall respond to such notices within 12 hours after receipt of the notice.
The local representative or supplier shall have direct access to replacement parts and a fire alarm repairman, either on his own staff or in a manufacturer's service center, to ensure the system can be restored to normal operation within two (2) days of system failure. All costs including air-fare, car rental, travel time, etc. shall be borne by the contractor.

It is understood that the State will undertake repairs if, following two (2) working days after receipt of such notice, the Contractor fails to make or undertake the repairs with due diligence. The expense in connection therewith shall be charged to the Contractor.

SPECIFIER'S NOTES: Central Services Division's preference is to use an Edwards Systems Technology (EST) Model EST-3 Fire Alarm System or a Simplex Model 4100 Fire Alarm System which are UL Listed or FM Approved. Verify system preferences with Central Services Division and insert list of acceptable systems into Part 2.

PART 2 – PRODUCTS

2.01 MANUFACTURER QUALIFICATIONS

- A. All components of each new system shall be furnished by a single manufacturer, shall be of current design and shall be in regular and recurrent production. Provide design, materials and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

2.02 SYSTEM DESIGN

- A. System Operation: System shall be a complete, supervised, noncoded, addressable multiplex fire alarm system conforming to NFPA 72. The return portion of the loop shall be remote from the supply portion of the loop. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually

reset and restored to normal. The system shall provide the following functions and operating features:

1. The FACP and fire alarm control units, if used, shall provide power, annunciation, supervision and control for the system.
2. Provide Class B, Style B, initiating device circuits.
3. Provide Class B, Style 4, signaling line circuits.
4. Provide Class B, Style Y, notification appliance circuits.
5. Provide electrical supervision for **<solenoid valves>** [_____]. Electrical supervision of wiring external to control panel for mechanical equipment shutdown and magnetic door holding circuits will not be required.
6. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel, and any extender panel(s).
7. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault which prevents the required operation of the system. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature which will silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke sensor in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.
8. Provide a notification appliance silencing switch which, when activated, will cause the notification appliances to cease operating, but not affect the liquid crystal display. This switch shall be overridden upon activation of a subsequent alarm.
9. Provide alarm verification capability for smoke sensors. **<Additionally, alarm verification shall be disabled on sensors used in cross zoned detection systems.>**
10. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, **<electronic equipment power shutdown,> <air handler shutdown,> <smoke control operation,> <elevator recall,> <door release,> and <door unlocking>** features. Operation of a switch shall indicate a trouble condition on the FACP display **<and printer output>**.
11. All alarm, supervisory, or trouble signals shall be automatically transmitted to other networked panels.
12. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
13. The system shall be field programmable. All programmed information shall be stored in non-volatile memory.
14. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.

15. The system shall sustain the maximum system capacity on the number of addressable devices which may be in alarm simultaneously.
16. Where the fire alarm system is responsible for initiating an action in another emergency control device or system, such as an **<HVAC system,> <electronic equipment power shutdown,> <atrium exhaust system,> <smoke control system,> and <elevator system,>**, the addressable fire alarm relay shall be within 3 feet of the emergency control device.
17. An alarm signal shall automatically initiate the following functions:
 - a. Transmission of an alarm signal to the other networked panels.
 - b. Visual indication of the device operated on the fire alarm control panel (FACP) **<and> <, video display unit (VDU),> <and on the graphic annunciator>**. Indication on the graphic annunciator shall be by floor, zone or circuit, and type of device.
 - c. Continuous actuation of all alarm notification appliances**<, except those in elevator cabs>**.
 - <d. Recording of the event via the system printer.>**
 - <e. Release of doors held open by electromagnetic devices.>**
 - <f. Operation of the <smoke control system> <atrium exhaust system>**.
 - <g. Release of power to electric locks on doors which are part of the means of egress.>**
- <18. Operation of the smoke sensors in the elevator machine room, elevator hoistway, and elevator lobby, except for the designated level, shall initiate elevator recall. Operation of the smoke sensors in the designated level elevator lobby shall recall the elevator to an alternate level.>**
19. Operation of a sprinkler waterflow switch in an elevator machinery room shall operate shunt trip circuit breaker(s) to shut down power to the elevators without intervention of the fire alarm control panel in accordance with ASME/ANSI A17.1 in addition to other requirements of this paragraph.
- <20. A supervisory signal shall automatically initiate the following functions:**
 - a. Transmission of an supervisory signal to the other networked panels.**
 - b. Visual indication of the device operated on the fire alarm control panel (FACP), <video display unit (VDU),> <and on the graphic annunciator>**.
 - c. Recording of the event via the system printer.>>**
21. A trouble condition shall automatically initiate the following functions:
 - a. Transmission of a trouble signal to the other networked panels.
 - b. Visual indication of the system trouble on the FACP, **<VDU,> <and on the graphic annunciator.>**
 - <c. Recording of the event via the system printer.>**

B. System Monitoring:

1. Valves: Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, valves at fire pumps, and valves at backflow preventers, whether supplied under this contract or existing, shall be monitored to ensure its proper position. Each tamper switch shall be provided with a separate address.

<2. Independent Fire Detection System: Each existing independent smoke detection sub-system, and kitchen fire extinguishing system shall be monitored both for the presence of an alarm condition and for a trouble condition. Each monitored condition shall be provided with a separate address.>

- C. Overvoltage and Surge Protection: Provide a factory approved surge suppressor at power inputs to control panels **<and power extender panels>**, on all signaling line circuits, and [] conforming to UL 1449. Suppressor shall be hybrid MOV type providing a maximum clamping voltage of 500 volts and a 150 joule minimum energy dissipation capacity.
- D. Fire Alarm Control Panel (FACP): Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. All operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. Each control unit shall provide power, supervision, control and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation. Visual indication of alarm, supervisory or trouble initiation on the fire alarm control panel shall be by liquid crystal display with a minimum of 40 characters.
<The control panel for the preaction sprinkler system shall be listed in UL FPED or FM P7825 for "Releasing Device Service". The control panel and the solenoid valve which activates the water control valves shall be compatible with each other. Compatibility shall be per specific UL listing or FM approval of the control equipment.>
 1. Cabinet: Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of all panels as well as all field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm Control Panel" and shall not be less than 0.75 inch high. Provide prominent rigid plastic or metal identification plates for all lamps, circuits, meters, fuses and switches. The cabinet shall be provided in a sturdy steel housing, complete with backbox, hinged steel door with cylinder lock, and **<surface> <flush>** mounting provisions. The cabinet shall be painted beige.
 2. Control Panel Modules: Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory or trouble condition. The alarm signals shall be different from the trouble signal. Connect all circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP.
 3. Silencing Switches: Provide an alarm silence switch at the FACP which will silence the audible signal but not affect the visual alarm indicator. Provide trouble and supervisory silencing switch which will silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm.

4. **<Fire Alarm Message: A fire alarm shall activate notification appliance circuits. Textual audible appliances shall produce a slow whoop tone for three cycles followed by a voice message which is repeated until the control panel is reset. Automatic messages shall be broadcast through speakers on appropriate floors, but not in stairs or elevator cabs. <The visual strobes and audible message shall automatically be broadcast on the floor of fire alarm origin, the floor immediately above the floor of fire alarm origin, and the floor immediately below the floor of fire alarm origin.> A live voice message shall override the automatic audible output through use of a microphone input at the control panel. When using the microphone, live messages shall be broadcast through speakers in stairs, in elevator cabs, and throughout a selected floor or floors. The system shall be capable of operating all speakers at the same time. The digitalized voice message shall consist of a non-volatile (EPROM) microprocessor based input to the amplifiers. The microprocessor shall actively interrogate all circuitry, field wiring and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power or any other malfunction which could render the digitalized voice module inoperative shall automatically cause the slow whoop tone to take over all functions assigned to the failed unit. Messages shall utilize a female voice and shall be as follows:**
 - a. **"May I have your attention, please. May I have your attention, please. A fire has been reported which may affect your floor. Please walk to the nearest exit and evacuate the building."**
 - b. **[_____]>**
5. **Memory:** Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS or EPROMS. The control panel shall have the ability to store a minimum of two hundred (200) events in a log stored in a battery-protected memory.
6. **Service Mode:** The FACP shall have a service mode to permit the arming and disarming of individual detection or output devices as well as manually operating output devices. Status of these devices shall be displayed upon command or printed on a printer. FACP shall remain 100 percent operational and capable of responding to an alarm condition while in the routine maintenance mode. The FACP shall automatically return to the normal mode after a predetermined time (1 hour) in the event the panel remains unattended in the service mode.
7. **Field Programmability:** Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory and trouble functions of both input and output. The system program configuration shall be menu driven. All system changes shall be password protected.
8. **Input/Output Modifications:** The FACP shall contain features which allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad **<and a keyboard>**. Any bypass or modification to the system shall indicate a trouble condition on the FACP, **<VDU> <and a printed output of the trouble condition>**.
9. **Resetting:** Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

10. Walk Test: The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

E. Electric Power:

1. Primary Power: Provide primary power for the FACP from the normal AC service to the building where shown on the drawings or [_____]. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices. Make the service connection for the FACP at the <location indicated> <main service switchgear> <emergency distribution panel where shown> <a main distribution panel where shown>. Provide a red and white engraved plastic sign permanently affixed to the FACP identifying the power service location, panel, and breaker.
2. Emergency Power Supply: Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.
 - a. Batteries: Provide rechargeable, maintenance-free, lead-acid gelled electrolyte sealed batteries as the source for emergency power to the FACP. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power. Batteries shall have lead bolt-on or wing-nut-type terminals. Batteries with fast-tab terminals are unacceptable. House batteries within the control panel. Separate cells to prevent contact between terminals of adjacent cells and between terminals and other metal parts. Batteries shall have a clear or transparent battery shell which clearly displays the liquid level within the battery.
 - b. Capacity: Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for <24> [] hours and audible and visual signal devices under alarm conditions for an additional <5> [] minutes.
 - c. Battery Charger: Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged the charger shall recharge them back to full charge within 48 hours. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

SPECIFIER'S NOTES: This Article should be deleted if a Voice Evacuation System is not required by code.

- F. Amplifiers, Preamplifiers, Tone Generators: Any amplifiers, preamplifiers, tone generators, digitalized voice drives and all other hardware necessary for a complete, operational textual audible circuit conforming to NFPA 72 shall be housed in a remote fire alarm control unit, terminal cabinet, or in the fire alarm control panel. The system shall automatically operate and control all building fire alarm speakers except those installed in the stairs and within elevator cabs. The speakers in the stairs and elevator cabs shall operate only when the microphone is used to deliver live messages. Each amplifier shall have two channels; one to broadcast a message and the other for paging.
 1. Construction: All amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient up to ten (10) times the highest rated voltage in the system.

2. Inputs: Each system shall be equipped with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.
3. Tone Generator: The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a temporal three pattern, and be constantly repeated until interrupted by either the digitalized voice message, the microphone input or the alarm silence mode as specified. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay. All audio circuits shall be synchronized.
4. Protection Circuits: Each amplifier shall be constantly supervised for any condition which could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator on the control panel, appropriate logging of the condition on the system printer and other actions for trouble conditions as specified.

SPECIFIER'S NOTES: This Article should be deleted if a video display unit is not required for each floor or zone, typically installed in fire command center of a high rise building.

G. <Video Display Unit:

1. **The Video Display Unit (VDU) shall be the secondary operator-to- system interface for data retrieval, alarm annunciation, commands and programming functions. The desk mounted VDU shall consist of a cathode ray tube (CRT) monitor and a keyboard. The VDU shall have a 12 inch minimum screen, capable of displaying 25 lines of 80 characters each. Communications with the FACP shall be supervised. Faults shall be recorded on the printer. Power required shall be 120 VAC, 60 Hz from the same source as the fire alarm control panel.**
2. **To eliminate confusion during an alarm situation, the screen shall have dedicated areas for the following functions:**
 - a. **Alarm and returns to normal**
 - b. **Commands, reports and programming**
 - c. **Time, day and date**
3. **Full English language shall be used throughout to describe all system activity and instructions. Full English language descriptors defining system points shall be 100 percent field programmable by factory trained personnel, alterable and user definable to accurately describe building areas.**
4. **Alarms and other changes of status shall be displayed in the screen area reserved for this information. The following information shall be provided in English:**
 - a. **Condition of device (alarm, trouble, or supervisory).**
 - b. **Type of device (manual pull or waterflow)**
 - c. **Location of device plus numerical system address.**

Upon receipt of alarm, an audible shall sound and the condition and point type shall flash until acknowledged by the operator. Returns to normal shall also be annunciated and shall require operator acknowledgement.

5. The system shall have multiple levels of priority for displaying alarms to conform with UL 864. Priority levels shall be as follows:
 - a. Level 1 - Fire Alarms
 - b. Level 2 - Supervisory Alarms
 - c. Level 3 - Trouble Signals
6. The system shall be provided with memory so that no alarm shall be lost. A highlighted message shall advise the operator when unacknowledged alarms are in the system.
7. Multiple levels of access shall be provided for operators and supervisors via user-defined passwords. The following functions shall be provided for each level:
 - a. Operator Level Access Functions
 - 1) Display system directory, definable by device.
 - 2) Display status of an individual device.
 - 3) Manual command (alarm device with an associated command shall use the same system address for both functions).
 - 4) Report generation, definable by device, output on either the VDU or printer, as desired by the operator.
 - 5) Activate building notification appliances.
 - b. Supervisory Level Access Functions
 - 1) Reset time and date.
 - 2) Enable or disable event initiated programs, printouts and initiators.
 - 3) Enable or disable individual devices and system components.
 - c. The above supervisory level functions shall not require computer programming skills. All changes to system programs shall be recorded on the printer and maintained in the control panel as a trouble condition.>

SPECIFIER'S NOTES: *Verify with using agency whether a graphic annunciator is desirable and edit section accordingly.*

H. <Graphic Annunciator:

1. **Graphic Annunciator Panel:** Provide a graphic annunciator which indicates the building floor plan, including the locations of all stairs and elevators. Stairs and elevators shall be identified by <letter> <number>. Alarm circuit boundaries shall be clearly marked on the floor plan. Annunciator shall include a north arrow, <location of the fire alarm control panel,> and a "you are here" indicator. The graphic annunciator shall be <a minimum size of 18 inches by 18 inches> <as indicated on the contract drawings>. Panel shall duplicate annunciation functions performed by the main fire alarm control panel. Fire alarm zone descriptions shall correspond to the fire alarm control panel zones and light when the corresponding fire alarm control panel zones are activated. Panel shall be <flush> <surface>-mounted.

2. **Indicating Lights:** Provide the graphic annunciator with individual LED indicating lights for each type of alarm and supervisory device. Provide an amber LED for indicating a system trouble condition and a separate amber LED for indicating a supervisory condition. Provide a green LED to indicate presence of power and a red LED to indicate an alarm condition. The actuation of any alarm signal shall cause the illumination of a device LED. System supervisory or trouble shall cause the illumination of a trouble LED. In addition to all of these LED indicators, provide normal power indicating LED. Provide a push button LED test switch. The test switch shall not require key operation. Annunciator LEDs shall only be extinguished by operation of the system reset switch on the FACP.
 3. **Material:** Construct the graphic annunciator faceplate of <smoked plexiglass> <bronze>. The LEDs shall be backlit. All control equipment and wiring shall be housed in a surface mounted backbox. The exposed portions of the backbox shall be <chrome plated> <bronze plated> with knockouts. The exposed portions of the back box shall be field or factory painted to match the FACP.
 4. **Programming:** Where programming for the operation of the proper LEDs is accomplished by a separate software program than the software for the fire alarm control panel, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.>
- I. **<System Printer:**
1. Provide a system strip printer to record all alarm, supervisory, and trouble conditions without loss of any signal or signals. Printout shall be by circuit, device, and function as provided in the FACP. Printer shall operate on a supervised 24 VDC power supply from the control panel. The printer shall be arranged as a module within the control panel or provide in a separate lockable cabinet.>

The printer shall have at least 40 characters per line and have a 96 ASCII character set. The printer shall have a microprocessor-controlled, bi-directional, logic seeking head <capable of printing 120 characters per second> utilizing a <9 by 7> dot matrix print head. Printer shall not contain internal software which is essential for proper operation.
 2. The printer shall preferable be mounted inside the FACP enclosure. If this is not possible, mount the printer in a suitable cabinet next to the FACP with the color matching the color of the FACP enclosure.
 3. When the FACP receives a signal, the alarm, supervisory, and trouble condition shall be printed. The printout shall include the type of signal, the circuit or device reporting, the date, and the time of the occurrence. The printer shall differentiate alarm signals from all other printed indications. When the system is reset this condition shall also be printed including the same information concerning device, location, date and time. Provide a means to automatically print a list of all existing alarm, supervisory, and trouble conditions in the system. In the event that a printer is off-line when an alarm is received, the system shall have a buffer to retain the data and it shall be printed when the printer is restored to service. The printer shall have an indicator to alert the operator that the paper has run out.>
- J. **Addressable Interface Devices:** The addressable monitor device shall provide an addressable input interface to the FACP for monitoring normally-open or normally-closed contact devices such as <alarm pressure switches>, waterflow switches, <valve supervisory switches>, fire pump monitoring, independent smoke detection systems, etc.

The addressable control device shall provide an addressable output interface to the FACP for control of elevator recall, door releasing, solenoid activation, etc.

1. Addressable Monitor Modules: Addressable Monitor Module shall be provided to connect supervised conventional initiating device or zone of supervised conventional initiating devices, including but not limited to water flow and alarm pressure switches, valve tamper switches, low pressure switches, manual release stations, and heat detectors, and other such devices. Monitor module shall mount in a 4 inch square, 2-1/8 inch deep electrical box and shall be capable of Style B supervised wiring to the initiating device. Monitor module shall provide address setting means switches and store an internal identifying code which the control panel shall use to identify the type of devices. Monitor module shall contain an integral LED that flashes each time the monitor module is polled.
2. Addressable Control Modules: Addressable Control Module shall be provided to connect supervised conventional notification device or zone of notification devices that require an external power supply, such as audio-visual alarms, to one of the (2) wire analog loop cards in a Style Z configuration. The control module shall be capable of operating as a relay (dry contact Form C), to control auxiliary functions. The module shall mount in a 4 inch square, 2-1/8 inch deep electrical box and shall be capable of Style B supervised wiring to the indicating or control device. The module shall provide address setting means switches and store an internal identifying code which the control panel shall use to identify the type of devices. Module shall contain an integral LED that flashes each time the module is polled.
3. Isolation Modules: Provide isolation modules to isolate wire-to-wire short circuits on a loop and limit the number of other modules or sensors that are incapacitated by the short circuit fault. Place isolator modules at signaling line circuit T-taps where the T-tap will contain more than 5 addressable devices, and located such that not more than 30 addressable devices are connected between isolation modules. If a wire-to-wire short occurs, the module shall automatically open the circuit. On repair of the short, the module shall automatically reconnect the isolated section of the signaling line circuit. The module shall mount in a 4 inch square, 2-1/8 inch deep electrical box. Module shall contain an integral LED that flashes each time the module is polled and illuminates steadily to indicate that a short has been detected and isolated.

K. Smoke Sensors:

1. Photoelectric Smoke Sensors: Provide addressable photoelectric smoke sensors as follows:
 - a. Provide analog photoelectric smoke sensors utilizing the photoelectric light scattering principle for operation. Smoke sensors shall be listed for use with the fire alarm control panel.
 - b. All components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the sensor chamber with a fine mesh metallic screen which prevents the entrance of insects or air born materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 - c. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with fixed wiring terminals. Terminate field wiring on the fixed terminals.
 - d. Sensors shall be equipped with screw terminals for each conductor.
 - e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system.

- f. Sensors shall include alarm LED which flashes under normal conditions, indicating that the sensor is operational and in regular communication with the control panel. LED to be placed into steady illumination by the control panel when the sensor is in alarm. Provide an output connection for an external remote alarm LED.
2. Ionization Type Smoke Sensors: Provide addressable ionization type smoke sensors as follows:
 - a. Provide analog smoke sensors which operate on the ionization principle and are actuated by the presence of visible or invisible products of combustion. Sensors shall not be humidity sensitive. The sensitivity of each sensor shall be field adjustable to compensate for operating conditions. Smoke sensors shall be listed for use with the fire alarm control panel.
 - b. All components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or air born materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 - c. Provide twist lock bases for the sensors. The sensors shall maintain contact with their bases without the use of springs. Provide companion mounting base with fixed wiring terminals. Terminate field wiring on the fixed terminals.
 - d. Sensors shall be equipped with screw terminals for each conductor.
 - e. The sensor address shall identify the particular unit, its location within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system.
 3. Duct Smoke Sensors: Sensors in ducts shall be **<photoelectric> <ionization>** type and listed by UL FPED or FM P7825 for duct installation. Duct sensors shall be provided with approved duct housing, mounted exterior to the duct, and shall be provided with perforated sampling tubes extending across the width of the duct. **<Activation of duct sensors shall cause actuation of the fire alarm control panel in the same manner as other alarm initiating devices.> <Activation of sensors shall cause shutdown of the associated air-handling unit, annunciation at the control panel, but shall not cause sounding of the building interior alarm devices.> <Sensor head shall contain amplifier switching circuitry. The amplifier switching circuit shall be entirely solid-state and operate with a nominal sensor line voltage of 24 volts dc.>**
 4. Single **<Multi>** Station Smoke Sensors: In sleeping rooms, 120-volt ac, **<single> <multi>** station ionization [photoelectric] type smoke sensors shall be installed as indicated. Each smoke sensor shall be UL FPED listed, produce 85 dBA at 10 feet (minimum), and provided with an integral alarm test device. Sensor installation and power supply shall be in accordance with NFPA 72. Primary source of electric power shall be a dependable commercial light and power source. Detector shall be provided with 9 VDC battery backup power. Sensor shall be hard wired into the electrical source and shall not be subject to loss of power by a wall switch. **<Multi station smoke detectors shall be wired such that activation of one detector shall cause all detectors within the unit to alarm.>**

L. Heat Detectors:

1. Thermal Sensors: Provide addressable rate of rise with fixed temperature heat detectors as follows:
 - a. Provide detectors designed for the rate of rise principal with an independent fixed temperature element. Temperature rating of detectors shall be **<135> []**

degrees F. unless ceiling temperatures require a higher temperature rating in accordance with NFPA 72. Rate of rise shall be **<15> []** degrees F.

- b. Provide detectors with a visual indicator to show that the detector has operated.
2. Rate Compensation Heat Detectors: Provide rate compensation heat detectors with addressable monitor modules as follows:
 - a. Provide detectors designed for detection of fire by rate compensation principal. Temperature rating of detectors shall be **<135> []** degrees F. unless ceiling temperatures require a higher temperature rating in accordance with NFPA 72. Detectors shall be equipped with screw terminals for each conductor. Provide detectors designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be hermetically sealed and of the automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise. Detector operation shall not be subject to thermal lag.
 - b. Provide detectors with a visual indicator to show that the detector has operated.
- M. Manual Stations: Provide addressable noncoded type with mechanical tool-less reset feature. Locate stations as indicated. Stations shall be **<semi-flush> <flush> <surface>**-mounted. **<Surface-mounted boxes shall be painted the same color as the alarm station.>** Provide each station with screw-type terminals of proper number and type to perform functions required. Break-glass-front stations and pull-lever, break-glass-rod type are not acceptable. **<Stations indicated as weatherproof shall be installed in cast metal, weatherproof housings with side-hinged access doors. Housings shall be painted red and labeled FIRE ALARM using permanently affixed, engraved, red and white plastic identification signs. Identification signs shall be affixed to the face of the housing cover; letters shall be a minimum of 0.75 inch high.>** **<Provide separate screw terminal for each conductor connected to the manual alarm station.>** **<Provide manual station guard covers equipped with tamperproof latch which may be opened for testing or resetting after the station has been operated for fire drills.>**

SPECIFIER'S NOTES: Central Services Division prefers that combination type audiovisual alarms not be utilized in schools. Verify type of notification appliances to be used and edit this Article accordingly. Designer shall review requirements from the Uniform Building Code and the Uniform Fire Codes to determine what the type of notification is required, i.e. horn type evacuation tones or voice system.

N. Notification Appliances:

1. **<Audiovisual Alarms: Provide <flush> <recessed> <surface>**-mounted approved audiovisual alarm devices consisting of an electronic horn with a three pulse temporal pattern alarm signal suitable for use in an electrically-supervised circuit and top-or front-mounted integral flashing strobe light. Horn shall have a sound rating of at least 90 decibels at 10 feet. Strobe light shall provide a minimum of 15/75 candela or as indicated on the drawings and shall be powered from a supervised notification appliance circuit. All audible alarms shall be synchronized. All visual alarms shall be synchronized.>
2. **<Horns: Provide <surface> <semi-flush> mounted electronic horns suitable for use in an electrically supervised circuit. Horns shall have a minimum rating of 90 dBA at 10 feet. Output from the horn shall be the three pulse temporal pattern (Code 3). Where horns and strobes are provided in the same location, they may be combined into a single unit.>**
3. **<Visual Alarms: Provide <flush> <surface>**-mounted lamp assembly suitable for use in an electrically-supervised circuit. Provide lamps of the flashing

stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 15/75 candela or as indicated on the drawings. All visual alarms shall be synchronized.>

4. <Mini Horns: Provide <surface> <semi-flush> mounted electronic horns suitable for use in an electrically supervised circuit. Horns shall have a rating of 85 dBA at 10 feet. Output from the horn shall be the three pulse temporal pattern (Code 3). Where horns and strobes are provided in the same location, they may be combined into a single unit.>

SPECIFIER S NOTES: This Article should be used in lieu of horns where the Building Code requires a Voice Evacuation System. Fire alarm horns should be used if a Voice Evacuation System is not required by code.

5. Fire Alarm Speakers:
 - a. Provide fire alarm speakers conforming to UL 464 having a minimum of three (3) tap settings and separate terminations for each "in" and "out" connection. Tap settings shall include taps of 1/4, [] and 1 watt. Speakers shall utilize the [] watt tap in the system. Speakers shall have an output rating of 84 dBA at 10 feet as determined by the reverberant room test; data on peak output as determined in an anechoic chamber is not suitable. All speakers shall be capable of installation on standard 4 inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall mounted unit.
 - b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gauge and equipped with mounting holes and other openings as needed for a complete installation. All fabrication marks and holes shall be ground and finished to provide a smooth and neat appearance for each plate. Each plate shall be primed and painted.
6. Connections: Provide screw terminals for each notification appliance. Terminals shall be designed to accept the size conductors used in this project without modification.
- O. Fire Alarm Power Extender Panels: Fire alarm power extender panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a <flush> <surface>-mounted steel cabinet with hinged door and cylinder lock. The extender panel(s) shall have the necessary components and equipment required to provide a minimum of <four> [] supervised, Class B, Style Y, notification appliance circuits. Each appliance circuit shall be rated for 1.5 amperes at 24 volts DC. An alarm signal from the FACP will initiate the <four> [] notification appliance circuits to extend the alarm. Primary power for the panel shall be 3 amperes at 120 volts AC. Standby power shall be same as FACP and charger shall be housed integrally within the cabinet.
- P. System Wiring: Provide wiring materials under this section as specified in Section <16100 - ELECTRICAL WORK> with the additions and modifications specified herein.
 1. Wiring Within Cabinets, Enclosures, Boxes, Etc.: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure or cabinet. All conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with approved pressure type terminal blocks, which are securely mounted.
 2. Terminal Cabinets: Provide a terminal cabinet <at the base of any circuit riser,> <on each floor at each riser,> <and> where indicated on the drawings. Terminal

size shall be appropriate for the size of the wiring to be connected. All conductor terminations shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the terminal cabinet. Minimum size is 8 inches high by 8 inches wide.

SPECIFIER'S NOTES: Central Services Division prefers stranded in lieu of solid copper conductors for systems they will maintain. Verify type of conductors to be used and edit this Article accordingly.

3. Above Grade Alarm Wiring: Conductors shall be Type THHN/THWN. Type TW is not permitted. Signaling line circuits and initiating device circuit field wiring shall be twisted pair No. 18 to No. 12 AWG, depending on distance and per manufacturer's recommendations. Visual alarm signal and audible appliance circuits shall be single solid copper No. 14 AWG size conductors at a minimum. Speaker circuits shall be solid copper No. 16 AWG size conductors at a minimum. Wire size shall be sufficient to prevent voltage drop problems. Power wiring, operating at 120 VAC minimum, shall be No. 12 AWG solid copper having similar insulation. Provide wiring in electrical metallic tubing in dry locations not enclosed in concrete or where not subject to mechanical damage. Provide rigid conduit in all other locations. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. The use of flexible conduit not exceeding a 6 foot length shall be permitted in initiating device circuits. The minimum conduit size shall be 0.75 inch. Shielded wiring shall be utilized where recommended by the manufacturer. For shielded wiring, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP. T-taps are permitted in Style 4 circuits with interconnections occurring on terminal strips. Circuits to **<smoke control systems,>** **<fan shutdown systems,>** **<door locking systems,>** and [] shall terminate in terminal cabinets within 3 feet of the controllers for those systems. The completion of those circuits from the terminal cabinets to the appropriate system shall be provided under the appropriate Division.

SPECIFIER'S NOTES: Maintain existing color code scheme when connecting to existing equipment. If no color coding scheme exists, utilize DAGS standard color code.

4. Conductor Terminations: Color coding is specified under PART 3 - EXECUTION. Labeling of any circuit at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FACP and remote fire alarm control unit shall contain a laminated drawing which indicates each conductor, its label, circuit and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.
5. Below Grade Direct Burial Type Cables:
 - a. Below grade fire alarm wiring shall be direct burial unshielded multi-conductor type PVC-jacketed cable with #14 AWG and/or larger Type XHHW.
 - b. Multi-conductor cable shall be UL listed, Type TC cable conforming to National Electrical Code Article 340.
 - 1) Copper conductors shall be concentric stranded, class B (7 strands).
 - 2) Insulation shall be PVC or nylon with an overall PVC jacket.
 - 3) Cable Conductor number and color coding shall be as shown on the plans.
 - 4) Green, white, and gray colored conductors shall not be used.

- c. Below grade twisted pair or twisted shielded pair cable shall be direct burial TC type with minimum #18 AWG conductors.
6. Frame for School Campus Map and Operating Instructions: The frame material shall be welded stainless steel, with clear UV resistant plexi-glass. Instructions shall be typewritten. Drawings shall be done by computer. Hand lettering and drafting not acceptable.
7. Cable Markers:
 - a. Rectangular, commercially available polyethylene cable tags with prepunched holes at each corner for the attachment with self-locking ties.
 - b. Minimum 0.035-inch thick.
 - c. Average Tensile Strength: 4500 pounds p.s.i.
 - d. Non-corrosive, non-conductive, resistant to acids, alkalis, organic solvents, salt water and distortion-resistant in temperatures up to 300 degrees F.
 - e. White or yellow and machine printed with the phrase "Fire Alarm Cable - Buildings A to E" in black block letters 1/8" or larger in vertical height. Handwritten markers are not acceptable.
 - 1) The preprinting shall be permanent and shall not fade or dissolve.
 - 2) The tags shall be suitable for marking with black permanent markers. There shall also be space available for additional notes (for maintenance / service contractor use only).
8. Cable and Conductor Ties: One-piece, self-locking nylon ties having a minimum loop tensile strength of 175 pounds and resistance to the same conditions as cable marker.
9. Nameplates: Provide metallic and/or phenolic noncorrosive and non-heat sensitive nameplates for:
 - a. Fire Alarm Control Panel: The nameplates shall be factory installed, securely mounted inside the fire alarm panel with machine screws or glue, and shall also be accessible and visible. Information on the nameplates shall be 1/8" or larger lettering stamped or engraved with the following:
 - 1) Manufacturer's name and address.
 - 2) Model Number.
 - 3) Serial Number.
 - 4) Date of Manufacture.
 - 5) Manufacturer's drawing number (if available).
 - b. Subpanels and Modules: The nameplates shall be securely mounted on the Subpanels and/or module with machine screws or glue and include the following information:
 - 1) Subpanel and/or module model and/or type number.
 - 2) Catalog number.

10. Corrosion and Fungus Protection: Metallic equipment shall be coated with a rust inhibiting treatment and standard finish per the manufacturer's standard. Components shall be protected against corrosion and fungus (e.g. circuit boards shall be epoxy coated).

PART 3 – EXECUTION

3.01 EXAMINATION OF THE DRAWINGS AND SPECIFICATIONS

- A. Confirm and coordinate voltages and requirements of equipment furnished by other trades which will be connected to the fire alarm system. They include detectors and dampers, and any other equipment connected to the fire alarm system. Include the above information on the field-post as-built drawings.

3.02 EXAMINATION OF EXISTING SITE CONDITIONS

- A. Cabinets, panels, annunciators, outlets, pull stations, audio / visual devices and other equipment and devices shall be installed in the locations and heights shown on the drawings and/or as specified herein.
 1. The location of the equipment and devices shown on the plans are approximate. Before installing, the Contractor shall study adjacent construction, verify all dimensions and sizes of equipment at the job site and perform installation in what he considers the most logical manner.
 2. Any changes from the locations shown on the drawings must be approved by the Contracting Officer and shown on the "field-posted as-built" drawings.
 3. Any device may be relocated within 10'-0" before installation at the direction of Contracting Officer without additional charge to State.
- B. The Contractor shall determine the location of existing cables and record their route on the field-posted as-built drawings.

3.03 INSTALLATION

- A. Protect dissimilar metals with approved fittings and treatment.
- B. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a shingled layer of a pressure sensitive plastic tape, half-lapped. Do not use aluminum in contact with the earth.
- C. All metallic conduits and boxes shall be grounded with a green wire ground conductor.
- D. Equipment Installation: Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with NFPA 70, NFPA 72, [] and as modified herein.
 1. FACP: Locate the FACP where indicated on the drawings. [Surface] [Flush] mount the enclosure with the bottom of the cabinet 4 feet above the finished floor. All conductor terminations shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the FACP.
 2. Manual Stations: Locate manual stations where shown on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor.
 3. Notification Appliance Devices: Locate notification appliance devices where shown on the drawings. Mount assemblies on walls 80 inches above the finished floor or 6 inches below the ceiling whichever is lower.

<4. Smoke Sensors and Heat Detectors: Locate sensors/detectors <as shown on the drawings> on a 4 inch mounting box. Sensors/detectors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the sensor/detector at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. In the case of solid joist construction, the sensors/detectors shall be mounted on the bottom of the joists. On smooth ceilings, sensors/detectors shall be installed not over 25 feet apart in any direction. Closer spacing shall be used when recommended by the sensor/detector manufacturer or required by NFPA 72. In raised floor spaces, the smoke sensors shall be installed to protect 225 square feet per smoke sensor with a maximum spacing of 15 feet. Install smoke sensors no closer than 3 feet from air handling supply outlets. Heat detectors shall be installed in strict accordance with their UL listing. Heat detectors, provided to meet ASME/ANSI A17.1 requirements for elevator power disconnect, shall be located adjacent to each sprinkler head in the elevator machinery room.>

<5. Graphic Annunciator: Locate the graphic annunciator as shown on the drawings. <Surface> <Flush> mount the panel, with the top of the panel 6 feet above the finished floor or center the panel at 5-1/2 feet, whichever is lower.>

E. Cables and Conductors:

1. Below Grade Cable Installation: Cable shall be installed as indicated on the drawings.
 - a. Conduits shall be sloped as noted on the drawings to provide drainage at handholes and manholes.
 - b. Cables shall not be installed in the same ducts, conduits, handholes, etc. with non-fire alarm circuits.
 - c. Align and clean ducts and conduits before cable installation using mandrels, and scrapers and wire brushes. Arrange with the Contracting Officer to have an inspector present for conduit and duct cleaning, and cable installation.
 - d. Properly sized tensiometer and pulling devices shall be used for cable installation. Jerking of cables during the pulling installation process shall not be allowed.
 - 1) At the request of the Contracting Officer, the Contractor shall provide proof and date of calibration of the tensiometer and cable pulling devices used.
 - 2) Cable pulling tensions shall not exceed manufacturer`s recommended pulling tensions.
 - 3) Use cable lubricants and compounds that will neither change the physical characteristics nor increase the conductor insulation dielectric constants of the cable sheath.
 - e. Should the Contractor proceed with conduit cleaning and cable installation without having notified the Contracting Officer, if directed by the Contracting Officer, the Contractor shall remove the cable(s) for inspection and reinstall at no additional cost to the State.
 - 1) The Contractor may reinstall the removed cable if inspection and/or tests show no cable damage.
 - 2) If the cable is damaged, the Contractor shall install a new replacement cable at no additional cost to the State.

2. Above Grade Conductor Installation:
 - a. Conductors shall not be installed in the same conduits, ducts, junction boxes, etc. with non-fire alarm circuits. 120 volt AC fire alarm circuit conductors shall not be contained within the same multi-conductor cable nor installed with cables and other conductors in the same conduits, ducts, enclosures, junction boxes, etc. with 24 volt DC fire alarm circuits.
 - b. Conductors shall be installed in continuous lengths. Splices shall be made in above ground junction boxes by terminating wires with wirenut connections.
 - c. Cable pulling tensions shall not exceed manufacturers' recommended pulling tensions.
 - d. Wire-nut connectors: Permitted for connections in above grade locations only, in junction boxes and equipment and to devices that are not available or manufactured with screw-type connections.
3. Conductor Color Code: Conductors shall be provided with insulation color coded as follows:
 - a. Power Branch Circuit Conductors: Red (+), White (-) for 120 VAC. Black (+), Red (-), and White (neutral) for 240 VAC.
 - b. Initiating Device Circuit: Red (+), Black (-).
 - c. Audible Notification Appliance Circuit: Blue (+), Orange (-).
 - d. Visual Notification Appliance Circuit: Brown (+), Yellow (-).
 - e. Detector Power Supply or separate annunciator wiring color code: Violet (+), Black (-).
 - f. Tie Circuit:
 - 1) Red (+), Black (-) if used as an initiating circuit.
 - 2) Blue (+), White (-) if used as a signaling circuit.
 - g. Door Holder Circuit (DHC): Pink, Pink.
 - h. Multi-conductor cable green, white, and gray colors shall not be used.
- F. Cable and Conductor Terminations and Dress. The following requirements shall apply to terminal cabinets, junction and outlet boxes larger than 12" x 12":
 1. Electric equipment shall be installed in a neat and workmanlike manner in accordance with NEC 373-7, Space in Enclosures.
 2. Cable conductors or individual conductors shall be bundled, dressed and held together with cable straps, ties or lace and fanned in a manner that equipment terminals are visible and accessible, and allow the connections to be removed and reconnected without moving a large number of wires.
 - a. Conductors to screw type connectors shall be terminated with wire lugs or with approved cable termination connectors compatible with the specific termination.
 - b. A minimum of 6 inch excess length shall be provided for conductors from the bundles to the connectors using a vibration loop as described by NEC 300-14.

- c. Conductors shall be labeled as specified herein.
 - 3. Cross-connected conductor pairs in junction and device outlet boxes or cabinets will not require bundling and cable straps, ties or lace but shall be neatly installed with a minimum of 6 inches of excess length so conductors can be easily traced between terminals. Label all conductors as specified herein.
 - 4. Cabinets, junction boxes, outlet boxes, other boxes, shall have sufficient space to accommodate all conductors installed in them without crowding.
 - 5. Completed work shall be uncrowded and uncluttered and shall allow accessibility without cutting and/or removing of any straps, ties, laces, cables, components, devices, brackets, modules, equipment and like items.
 - 6. Cables shall be secured to junction boxes, equipment cabinet backboards, console members or to other system components using cable clamps and wraps. Provide cable support posts as required to facilitate system installation.
- G. Cable and Conductor Identification System
- 1. Underground Cable Markers:
 - a. Provide markers at both ends of the cables and at all intermediate locations where the cables are accessible and visible.
 - b. Each marker shall be secured with two (2) nylon ties.
 - 2. Conductor Markers:
 - a. Provide markers at ends of each conductor connected to the control panels and terminal cabinets at each building.
 - b. Attach markers a minimum of four (4) inches from the ends of conductors in a manner that will not permit accidental detachment.
 - 3. Signaling Line Circuits: Signaling line circuits shall be labeled by zone number as shown on the drawings. Conductors shall be labeled in the fire alarm panel(s), the building's main fire alarm junction box and termination cabinet.
 - 4. Audible and Visual Notification Circuits: Notification circuits shall be labeled by signaling circuit number as shown on the drawings. Conductors shall be labeled in the fire alarm panel(s) and in the building's fire alarm termination cabinet.
- H. Framed School Campus Map: A framed map of the school campus drawn at a minimum scale of 1"=40', showing panels, the location of each pull station, and audio and visual alarm devices shall be printed on a white background, and permanently mounted adjacent to the main fire alarm annunciator-control panel.
- I. Framed Operating Instructions: A framed set of operating instruction printed on a white background or engraved Main Fire Alarm Panel Operating Instructions shall be provided. The framed instructions shall be permanently mounted adjacent to the main fire alarm annunciator-control panel.
- J. Field Touch-up Painting: Touch-up painted surfaces and fire alarm system components damaged during installation to match the existing or specified paint and color.
- K. **<Disconnection and Removal of Existing System: Fire alarm control panels and fire alarm devices disconnected and removed shall be turned over to the Central Services Division, Department of Accounting and General Services, <729 Kakaio Street, Honolulu, Hawaii>.**

1. The existing fire alarm and smoke detection system shall remain in operation at all times during the installation and commissioning of the new system. The Contractor shall take precautions to avoid any accidental activation of the existing fire alarm system. When making modifications to the existing systems, the Contractor shall minimize the time the existing system is out of service. Prior to any impairment of the existing system the Contractor shall notify the State and County Fire Department. The Contractor shall comply with 29 CFR 1910.36 and 29 CFR 1910.37. No impairment shall exceed 4 hours. The Contractor shall establish a fire watch to monitor the impaired area until the entire fire alarm system is returned to full operation. The Contractor shall schedule outages <30> [_____] days in advance. Once this new system is on-line and accepted by the State, remove the old system. As new equipment is installed, label it "NOT IN SERVICE". Upon acceptance, remove labels.
 2. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and elsewhere in the specification.
 3. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.>
- L. <Connection of New System: The following new system connections shall be made during the last phase of construction, at the beginning of the preliminary tests. New system connections shall include:
1. Connection of new control modules to existing magnetically held smoke door (hold-open) devices.
 2. Connection of new elevator recall smoke sensors to existing wiring and conduit.
 3. Connection of new system transmitter to existing fire alarm transmitter interface panel.

Once these connections are made, system shall be left energized and new audio/visual devices activated. Report immediately to the State, coordination and field problems resulting from the connection of the above components.>

- M. Firestopping: Provide UL listed firestopping for all holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section <07840 – FIRESTOPPING>.

3.04 TESTING

- A. Testing Of The New Fire Alarm System:
1. After completion of the fire alarm system's installation, turn on and leave the system on for a minimum of three (3) consecutive weeks to demonstrate that contract work operates, meets the requirements of the specifications and does not affect the operation of the entire fire alarm system.
 2. Upon successful completion of the three (3) week operational period, arrange with the Contracting Officer for a pre-final fire alarm system test and inspection. The test and inspection shall demonstrate that all the Contractor installed fire alarm system equipment, devices cables and conductors are operating acceptably and have been installed in accordance with this specification.

Accordingly, the test demonstrates that the system is ready for a final test of the overall fire alarm system.

Representatives at the prefinal test shall include the Contractor, fire alarm system manufacturer's representative, user, the user's facility maintenance agency personnel, F.A. system design consultant, and the Contracting Officer. Representatives at the Final test shall include all the foregoing representatives and the County Fire Department Inspector.

3. Preliminary Test Results: Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include a hard copy of printer output information from preliminary testing, i.e. download historical file so that all test data is available for State review.
 - a. Tests:
 - 1) Dielectric Strength and Insulation Resistance Tests: Test the dielectric strength and the insulation resistance of the system interconnecting wiring by means of an instrument capable of generating 500 volts dc and equipped to indicate leakage current in 1000 megohms. For the purpose of this test, the instrument shall be connected between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open circuited and all series-connected devices in place. The system shall withstand the test without breakdown and shall indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100 volts nor more than 550 volts. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test.
 - 2) Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test.
 - 3) Ground Resistance Tests: Measure the resistance of each connection to ground. Ground resistance shall not exceed 5 ohms. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test.
 - 4) Smoke Sensor Tests: Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke sensor. Clean the smoke sensors in accordance with the manufacturer's recommended procedures. **<Perform voltage activation sensitivity test on each sensor and record the results. Remove sensors with a sensitivity level above or below the UL accepted sensitivity range for that sensor and replace with new sensors.>** Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.
 - 5) Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests" of this section. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable to the State a minimum of 7 calendar days before the

formal acceptance test date required in the paragraph below. Without the submission of this report, the final acceptance test is automatically canceled.

b. Formal Acceptance Testing: Notify the State in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the O&M Manuals are submitted and the following are provided at the job site:

- 1) Marked-up red line drawings of the system as actually installed
- 2) Dielectric strength and insulation resistance test results
- 3) Loop resistance test results
- 4) Complete program printout including all input/output addresses
- 5) A diskette containing the entire software program for the system
- 6) A list of passwords permitting access by designated State employees to all levels of the software programs(s).

The final tests shall be witnessed by the County Fire Department or the Authority Having Jurisdiction (AHJ). At this time, any and all required tests shall be repeated according to the AHJ. Following acceptance of the system, as-built drawings and Operation and Maintenance (O&M) Manuals shall be submitted for review and acceptance. In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M Manuals are received.

c. Minimum System Tests: Test the system in accordance with the procedures outlined in NFPA 72, Chapter 7. The required tests are as follows:

- 1) Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.
- 2) Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
- 3) Test each initiating and indicating device and circuit for proper operation and response at the control unit.
- 4) Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
- 5) Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.
- 6) Determine that the system is operable under trouble conditions as specified.
- 7) Visually inspect all wiring.
- 8) Test the battery charger and batteries.

- 9) Verify that all software control and data files have been entered or programmed into the FACP. Hard copy records and two identical diskette copies of the software and data files shall be provided to the Contracting Officer.
 - 10) Verify that red-line drawings are accurate.
 - 11) Measure the current in circuits to assure there is the calculated spare capacity for the circuits.
 - 12) Measure voltage readings for circuits to assure that voltage drop is not excessive.
 - 13) Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke or test gas needed to activate the sensor.
 - 14) Measure the voltage drop at the most remote appliance on each notification appliance circuit.
4. Audio Tests:
- a. Provide test equipment and conduct audio test for the fire alarm system in and around the building and in areas where new audio alarm devices have been installed.
 - b. Audio measurements shall be made in classrooms and other rooms (e.g. equipment and storage rooms) and buildings with the doors in the open and closed position.
 - c. An audio test plan and proposed test equipment shall be submitted for review and approval with the test plans submittal in accordance with NFPA 72, Chapter 7.
 - d. The measured data shall be recorded on data sheets provided by the Contractor and shall be part of the test plan submission and records.
 - e. At the request of the Contracting Officer, the Contractor shall provide proof of instrument calibration and date of calibration.
 - f. Contractor shall be responsible for notifying the AHJ and Fire Department of formal acceptance testing.
5. In addition to satisfactory acceptance tests of the Contractor portion of the fire alarm system, where a new fire alarm system is tied into an existing system, the entire fire alarm system must be accepted and certified by the County Fire Department or AHJ before commencement of the specified two-year system warranty period with full maintenance responsibility.
- The tests must demonstrate that the entire campus (or facility) fire alarm system is operating in order to receive the Fire Department Certification.
6. If requested by the Contracting Officer, isolate the contract work from the overall system and demonstrate that the contract work does not affect the operation of the overall fire alarm system and shall repeat tests at no additional cost to the State.
- B. Concealed Work: Concealed work re-opened and re-closed at random during the formal inspection as requested by the Contracting Officer shall be done at no additional cost to the State.

- C. Testing Tools and Equipment: The Contractor shall provide the tools and equipment, including handheld radios, etc. necessary to accomplish the testing.

3.05 TRAINING

- A. Conduct training and instruction for the operating and maintenance staff, as designated by the Contracting Officer, on the operation of the fire alarm panel and system.
- B. The training session shall be conducted during normal business hours, and shall last as long as necessary to properly instruct the staff, but not less than 1-hour.
- C. Instruction shall include hands-on training in routine operations and queries (reading of normal status and trouble status) of the fire alarm system.
- D. Training shall be provided for the new fire alarm system and additional circuits and devices.
- E. If the main control panel and annunciator panel are of the central processing unit (CPU) type system, instruction shall include operations and query of system status, etc.; and hands-on training in the procedures and process for operations and obtaining system status, trouble and other functional information to determine when to call for repairs and how to report the type of trouble encountered.

END OF SECTION 13851

SECTION 13852 - HARD WIRED FIRE ALARM SYSTEM

PART 1 – GENERAL

1.01 GENERAL CONDITIONS

- A. As specified in Section 00700.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Section 07840 - Firestopping: Firestopping requirements.
- B. Section 09900 - Painting: Painting of all conduits, raceways, ducts, cabinets, junction boxes, etc.
- C. Section 13930 - Wet-pipe Fire Suppression Sprinklers: Alarm initiating devices shall be installed with the sprinkler system.
- D. Section 16100 - Electrical Work: All power wiring including wiring to disconnect switches and breakers and wiring to all equipment.

1.03 PAYMENT PROCEDURES

- A. Permits, Tests and Inspections: Apply, secure and pay for all required permits, fees, licenses, tests, inspections and royalties necessary to accomplish the work. Schedule and coordinate required tests and inspections.

1.04 SCOPE

- A. System Description: This work includes designing and **<modifying existing> <and>** providing a new, complete, programmable fire alarm system as described herein and on the contract drawings for [_____]. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. The system layout on the drawings is conceptual. A single fire alarm control panel is indicated **<with fire alarm power extender panels>**. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 72 **<and>** [_____] except as modified herein. **<A single fire alarm control panel is indicated with terminal cabinets at each floor at each riser location. Where remote fire alarm control units are needed, they shall be provided at a terminal cabinet location. Each remote fire alarm control unit shall be powered from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.>**
- B. **<Existing Fire Alarm Equipment: Existing interior system was manufactured by [] and new equipment shall be compatible with and shall operate accurately and reliably with the existing system. Existing fire alarm equipment shall be maintained fully operational until the new equipment has been tested and accepted. As new equipment is installed, it shall be tagged "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the State it shall be placed in service and connected to the station fire alarm system. All new equipment shall have tags removed and the existing equipment shall be tagged "NOT IN SERVICE" until removed from the building.>**
- C. **<Equipment Removal: After acceptance of the new system by the State, all existing equipment not connected to the new system shall be removed, all unused**

exposed conduit shall be removed, and all damaged surfaces shall be restored. The material shall be boxed and delivered to Central Services Division, Department of Accounting and General Services, <729 Kakoi Street, Honolulu, Hawaii>.>

1.05 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
1. Code of Federal Regulations (CFR)
 - a. 47 CFR 90 Private Land Mobile Radio Service
 - b. 29 CFR 1910.36 Occupational Safety and Health Standards, Subpart E - Means of Egress, General Requirements
 - c. 29 CFR 1910.37 Occupational Safety and Health Standards, Subpart E, Means of Egress, General
 2. American Society of Mechanical Engineers (ANSI/ASME)
 - a. ASME/ANSI A17.1 (1993) Safety Code for Elevators and Escalators
 3. Factory Mutual Engineering and Research Corporation (FM)
 - a. FM P7825 (2001) Approval Guide
 4. National Electrical Manufacturers Association (NEMA)
 - a. NEMA ICS 1 (1993) Industrial Control and Systems
 5. National Fire Protection Association (NFPA)
 - a. NFPA 70 (1999) National Electrical Code
 - b. NFPA 72 (1999) National Fire Alarm Code
 - c. NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems
 6. Underwriters Laboratories Inc. (UL)
 - a. UL 464 (1990) Audible Signal Appliances
 - b. UL 864 (1991; R 1994, Bul. 1995) Control Units for Fire-Protective Signaling Systems
 - c. UL 1449 (1985; Errata 1986, Bul. 1993, 1994, and 1995) Transient Voltage Surge Suppressors
 - d. UL FPED (2001) Fire Protection Equipment Directory
 7. American Electricians Handbook by Croft (latest edition), McGraw-Hill
 8. Practical Electrical Wiring by Herbert P. Richter and W. Creighton Schwan, McGraw-Hill
 9. Copper Development, Inc.'s "Copper Building Wire Handbook"
 10. National Electrical Safety Code
 11. Local ordinances and regulations of the County
 12. International Municipal Signal Association Inc. Specification No. 19-1 1991, polyethylene insulated, polyvinyl chloride jacket signal cable; and

13. Applicable instructions of the manufacturer for equipment and materials supplied for the project.

1.06 SUBMITTALS

A. Submit under provisions of Section 01330 - SUBMITTALS. Partial submittals will not be acceptable. Submit for approval six (6) complete sets of submittals as described below. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to furnish. Do not commence work until the design of the system and the various components have been approved. The State, the Contracting Officer, the County Building and Fire Departments will review and approve all submittals. Before work is commenced the shop drawings must be approved.

1. Manufacturer's Catalog Data:

- a. Fire alarm control panel (FACP) **<Including Printers, Covers, Console Rack, etc.>**
- b. Manual fire alarm stations
- c. Batteries
- d. Battery charger
- e. Single **<Multi>** Station Smoke Detectors
- f. Heat detectors
- g. Smoke detectors
- h. **<Audiovisual alarms>**
- i. **<Visual alarms>**
- j. Graphical annunciator panel
- k. **<Horns>**
- l. **<Mini horns>**
- m. Fire alarm power extender panels

2. Shop (Working) Drawings:

- a. Point-To-Point Wiring Diagrams: Drawings shall be job-specific. "Typical" or "generic" drawings are not acceptable. The diagrams shall include but not be limited to the following:
 - 1) Locations Of All System's Elements: Indicate all devices, junction boxes, handholes, and pass-through devices and entities where the cables and conductors can be accessed by personnel. Indicate the number of devices provided.

Also indicate the locations of all cable and conductor terminations and intermediate connections showing where they pass through without terminations/connections from and to equipment panels and/or devices.

- 2) Labeling Of All Elements: All devices junction boxes, etc. shall be labeled by functional designations, locations and numbers such as building alphabet, room function and room number, and handhole number.

- 3) Fire Alarm Wiring and Color Codes: All cable and conductor color codes, the wire marking system and marker designation as specified herein shall be shown.
- b. Equipment and/or Modular Systems Wiring Diagram: Wiring diagrams showing all equipment (control panel and annunciator in separate panel) modules, components and key internal cabinet wiring that should be accessed for tests and maintenance. Drawings shall include but not be limited to the following:
- 1) Equipment Modules and Components: The equipment modules and components layout (relative locations in proportion to the modules, components and cabinet/enclosure sizes) including the fire alarm control panel(s), battery cabinets, etc. The drawings shall also show the arrangement of modules, components, wiring and expansion space within the FACP cabinet.
 - 2) Input and Output Circuits Labeling: Label the input and output circuits by circuit designations specified herein.
 - 3) Internal - External Circuits Interface Information: Only information that interfaces with external circuits and internal equipment wiring need be shown. All external wiring and circuits shall be shown in the riser diagram and the Contractor furnished Point-To-Point Wiring Diagrams.

Changes in or deletion of the modular system wiring diagrams shall not require changes to the riser diagrams and the Contractor furnished Point-To-Point Wiring Diagrams and vice versa except for the panel deletion or change.

Provide a complete description of the system sequence of operation for all initiating, notification, and control devices via a sequence of operation matrix diagram.

Provide detailed drawings of the graphic annunciator.

- c. Design Data:
- 1) Standby battery capacity calculations shall list the type of devices and modules, quantities, unit amperage draw for standby and alarm conditions, total amperage draw and battery amp/hour rating.
 - 2) Provide detailed voltage drop calculations for all notification appliance circuits and releasing device circuits.
 - 3) Provide data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, and 25 percent spare capacity for initiating devices.
- d. Guaranty.
- e. Operations and Maintenance Manual: Provide five (5) bound copies of the Operations and Maintenance Manuals in three (3) hole binders with hard covers. The manuals shall be submitted to the Contracting Officer a minimum of two (2) weeks prior to the final test.
- 1) The manual may be provided in several volumes if so approved by the Contracting Officer.
 - 2) All drawings shall be folded to letter size by individual sheets so they can be retained in the manual.

- 3) The manual shall contain the following:
 - (a) Manufacturer's Printed Equipment/System Operations and Maintenance Manual, and Devices Brochures:
 - (1) Start-up, operating, preventative maintenance, adjustment and troubleshooting procedures, and parts list.
 - (2) System Control Diagrams.
 - (3) Internal equipment wiring diagrams.
 - (b) Manufacturer's Representatives: The names, addresses and phone numbers of the fire alarm system manufacturer, the nearest manufacturer's representative, and the nearest supplier of the manufacturer's equipment and parts.
 - (c) Fire Alarm System Test Results: Provide completed test data sheets with the recorded measured data obtained during pre-final testing in the designated spaces and a printout of the equipment program. The test plan shall be developed in accordance with NFPA 72, Chapter 7. Submit the following information.
 - (1) Test information applicable for the project.
 - (2) Standard attendance signature sheets.
- f. As-Built Drawings: Submit in accordance with Section 01300 - SUBMITTALS. Drawings shall provide a detailed description of system operation during alarm, supervisory, and trouble modes and shall include a complete list of all system addresses including input/output logic. Upon completion and before final acceptance of the work, submit complete set of as-built drawings of the system for record purposes. Drawings shall include all components and circuit diagrams complete with conductor color codes and a listing of initiating devices. Submit 24 by 36 inch drawings on reproducible vellum with title block similar to full size contract drawings.

~~g. Fire Alarm System Documentation:~~

~~1) Programming documentation.~~

~~2) List of all passwords for accessing the various protection levels.~~

1.07 QUALITY ASSURANCE

- A. Qualification of Installer: Installation shall be accomplished by an electrical contractor with a minimum of five years experience in the installation of fire alarm systems in the State of Hawaii. The services of a technician provided by the control equipment manufacturer shall be provided to supervise installation, adjustments, and tests of the system. Prior to installation, submit data for approval by the Architect/Contracting Officer showing that the Contractor has successfully installed interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

SPECIFIER S NOTES: This Article requires a National Institute for Certification for Engineering Technologies (NICET) engineering technician with a minimum Level-III certification in Fire Alarm Systems Program. This item should not be edited out as it

replaces the requirement for the drawings to be stamped by a Licensed Professional Engineer.

- B. Qualifications of System Technician: Installation drawings, shop drawings, and "as-built" drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of work specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in Fire Alarm Systems program. Contractor shall submit data showing the name and certification of the technician at or prior to submittal of drawings.
- C. Regulatory Requirements: Devices and equipment for fire alarm service shall be listed by Underwriters Laboratories, Inc. or approved by the Factory Mutual System or listed by other nationally recognized testing laboratories.
- D. Requirements for Fire Protection Service: Equipment and material shall have been tested by Underwriters Laboratories, Inc. and listed in UL FPED or approved by Factory Mutual and listed in FM P7825. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL FPED or FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.
- E. Standard Products: Materials and equipment shall be standard new products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least one year prior to bid opening. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials.
- F. Modification of References: In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the County Building and Fire Departments.

1.08 GUARANTY AND CERTIFICATE

- A. The Contractor shall guaranty and certify in writing all work in this section for period of two (2) years. Should any equipment or material fail due to defective equipment, material or workmanship within this period, the Contractor shall replace the item at no cost to the State.
- B. The two (2) year guaranty shall start at the end of thirty (30) consecutive days of trouble free operation after certification by the Fire Department and acceptance by the State whichever date is the latest.
- C. If the existing fire alarm system is inoperative or deficient and requires repair, the guaranty shall begin thirty (30) days after trouble free operation after the date the Contractor installed portion of the fire alarm system is tested to confirm that it is operational and meets contract requirements.

1.09 MAINTENANCE

- A. During the fire alarm system's two (2) year guaranty period, the Contractor shall supply complete maintenance and testing services for the entire fire alarm system in accordance with the manufacturer's instructions and NFPA 72. The system shall be tested and serviced every six (6) months for a minimum of four (4) times during the guaranty period. Reports prepared on Contractor-furnished standardized forms similar to the form in NFPA 72 shall be submitted to Central Services Division, State of Hawaii, Dept. of Accounting and General Services at **<729 Koko Street>**, each time a test and/or maintenance action occurs.

- B. During the two (2) year guaranty period, the Contractor shall, upon the receipt of notice from the State's representative, promptly make all repairs arising out of defective material, workmanship or equipment. The Contractor shall respond to such notices within 12 hours after receipt of the notice.

The local representative or supplier shall have direct access to replacement parts and a fire alarm repairman, either on his own staff or in a manufacturer's service center, to ensure the system can be restored to normal operation within two (2) days of system failure. All costs including air-fare, car rental, travel time, etc. shall be borne by the contractor.

It is understood that the State will undertake repairs if, following two (2) working days after receipt of such notice, the Contractor fails to make or undertake the repairs with due diligence. The expense in connection therewith shall be charged to the Contractor.

SPECIFIER'S NOTES: Central Services Division's preference is to use an Edwards Systems Technology (EST) Model EST-3 Fire Alarm System or a Simplex Model 4100 Fire Alarm System which are UL Listed or FM Approved. Verify system preferences with Central Services Division and insert list of acceptable systems into Part 2.

PART 2 – PRODUCTS

2.01 MANUFACTURER QUALIFICATIONS

- A. All components of each new system shall be furnished by a single manufacturer, shall be of current design and shall be in regular and recurrent production. Provide design, materials and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

2.02 SYSTEM DESIGN

- A. System Operation: System shall be a complete, supervised, manual ~~<and automatic,>~~ zoned, annunciated, fire alarm system conforming to NFPA 72. The return portion of the loop shall be remote from the supply portion of the loop. Provide separate circuits from the control panel to each zone of initiating devices as specified herein. Transmission of signals from more than one zone over a common circuit to the control panel is prohibited. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal. The system shall provide the following functions and operating features:
1. The FACP and fire alarm control units, if used, shall provide power, annunciation, supervision and control for the system.
 2. Provide Class B, Style B, initiating device circuits.
 3. Provide Class B, Style Y, notification appliance circuits.
 4. Provide electrical supervision for ~~<solenoid valves>~~ [_____]. Electrical supervision of wiring external to control panel for mechanical equipment shutdown and magnetic door holding circuits will not be required.
 5. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel, and any extender panel(s).
 6. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault which prevents the required operation of the system. The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature which will silence the audible

trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke detector in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.

7. Provide a notification appliance silencing switch which, when activated, will cause the notification appliances to cease operating, but not affect the liquid crystal display. This switch shall be overridden upon activation of a subsequent alarm.
8. Provide alarm verification capability for smoke detectors. **<Additionally, alarm verification shall be disabled on detectors used in cross zoned detection systems.>**
9. Provide switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, **<electronic equipment power shutdown,> <air handler shutdown,> <smoke control operation,> <elevator recall,> <door release,> and <door unlocking>** features. Operation of a switch shall indicate a trouble condition on the FACP display **<and printer output>**.
10. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
11. The system shall be field programmable. All programmed information shall be stored in non-volatile memory.
12. An alarm signal shall automatically initiate the following functions:
 - a. Visual indication of the device operated on the fire alarm control panel (FACP) **<and on the graphic annunciator>**. Indication on the graphic annunciator shall be by floor, zone or circuit.
 - b. Continuous actuation of all alarm notification appliances**<, except those in elevator cabs>**.
 - <c. Recording of the event via the system printer.>**
 - <d. Release of doors held open by electromagnetic devices.>**
 - <e. Operation of the <smoke control system> <atrium exhaust system>**.
 - <f. Release of power to electric locks on doors which are part of the means of egress.>**
- <13. Operation of the smoke detector in the elevator machine room, elevator hoistway, and elevator lobby, except for the designated level, shall initiate elevator recall. Operation of the smoke detector in the designated level elevator lobby shall recall the elevator to an alternate level.>**
- <14. Operation of a sprinkler waterflow switch in an elevator machinery room shall operate shunt trip circuit breaker(s) to shut down power to the elevators without intervention of the fire alarm control panel in accordance with ASME/ANSI A17.1 in addition to other requirements of this paragraph.>**
- <15. A supervisory signal shall automatically initiate the following functions:**
 - a. Visual indication of the device operated on the fire alarm control panel (FACP) **<and on the graphic annunciator>**.
 - <b. Recording of the event via the system printer.>>**

16. A trouble condition shall automatically initiate the following functions:

a. Transmission of a trouble signal to the other networked panels.

b. Visual indication of the system trouble on the FACP **<and on the graphic annunciator.>**

<c. Recording of the event via the system printer.>

B. System Monitoring:

1. Valves: Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, valves at fire pumps, and valves at backflow preventers, whether supplied under this contract or existing, shall be monitored to ensure its proper position.

2. Independent Fire Detection System: Each existing independent smoke detection sub-system, and kitchen fire extinguishing system shall be monitored both for the presence of an alarm condition and for a trouble condition.

C. Overvoltage and Surge Protection: Provide a factory approved surge suppressor at power inputs to control panels **<and power extender panels>**, and [] conforming to UL 1449. Suppressor shall be hybrid MOV type providing a maximum clamping voltage of 500 volts and a 150 joule minimum energy dissipation capacity.

D. Fire Alarm Control Panel (FACP): Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. All operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. Each control unit shall provide power, supervision, control and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation. **<The control panel for the preaction sprinkler system shall be listed in UL FPED or FM P7825 for "Releasing Device Service". The control panel and the solenoid valve which activates the water control valves shall be compatible with each other. Compatibility shall be per specific UL listing or FM approval of the control equipment.>**

1. Cabinet: Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of all panels as well as all field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm Control Panel" and shall not be less than 0.75 inch high. Provide prominent rigid plastic or metal identification plates for all lamps, circuits, meters, fuses and switches. The cabinet shall be provided in a sturdy steel housing, complete with backbox, hinged steel door with cylinder lock, and **<surface> <flush>** mounting provisions. The cabinet shall be painted beige.

2. Control Panel Modules: Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory or trouble condition. The alarm signals shall be different from the trouble signal. Connect all circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the FACP.

3. Silencing Switches: Provide an alarm silence switch at the FACP which will silence the audible signal but not affect the visual alarm indicator. Provide trouble and supervisory silencing switch which will silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm.

<4. Lamp Test Switch.>

- <5. Annunciator: Provide integral with the control panel. Provide separate alarm and trouble lamps for each zone (initiating circuit) as indicated below and [] spares, located on the exterior of the cabinet door or visible through the cabinet door. Lamps shall be Light Emitting Diode (LED) type. Zone modules for spare zones shall be provided in the control panel. Supervision will not be required provided a fault in the annunciator circuits results only in loss of annunciation and will not affect the normal functional operation of the remainder of the system. Each lamp shall provide specific identification of the <zone> <area> <device> by means of a permanent label. Provide engraved, silk screened, or machine-made labels. Handwritten labels are prohibited. In no case shall zone identification consist of the words "Zone 1", "Zone 2", etc., but shall consist of the description of the <zone> <area> <device>. <Visual indication of alarm, supervisory or trouble initiation on the fire alarm control panel shall be by liquid crystal display with a minimum of 40 characters.>**
 - <a. "May I have your attention, please. May I have your attention, please. A fire has been reported which may affect your floor. Please walk to the nearest exit and evacuate the building.">**

<b. [_____].>

6. **<Memory: Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS or EPROMS. The control panel shall have the ability to store a minimum of two hundred (200) events in a log stored in a battery-protected memory.>**
7. **<Service Mode: The FACP shall have a service mode to permit the arming and disarming of individual detection or output devices as well as manually operating output devices. Status of these devices shall be displayed upon command or printed on a printer. FACP shall remain 100 percent operational and capable of responding to an alarm condition while in the routine maintenance mode. The FACP shall automatically return to the normal mode after a predetermined time (1 hour) in the event the panel remains unattended in the service mode.>**
8. **<Field Programmability: Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory and trouble functions of both input and output. The system program configuration shall be menu driven. All system changes shall be password protected.>**
9. **<Input/Output Modifications: The FACP shall contain features which allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad <and a keyboard>. Any bypass or modification to the system shall indicate a trouble condition on the FACP, <VDU> <and a printed output of the trouble condition>.>**
10. **Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.**

11. **<Walk Test: The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.>**

E. Electric Power:

1. Primary Power: Provide primary power for the FACP from the normal AC service to the building where shown on the drawings or [_____]. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices. Make the service connection for the FACP at the **<location indicated> <main service switchgear> <emergency distribution panel where shown> <a main distribution panel where shown>**. Provide a red and white engraved plastic sign permanently affixed to the FACP identifying the power service location, panel, and breaker.
2. Emergency Power Supply: Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.
 - a. Batteries: Provide rechargeable, maintenance-free, lead-calcium or sealed lead acid batteries as the source for emergency power to the FACP. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power. Batteries shall have lead bolt-on or wing-nut-type terminals. Batteries with fast-tab terminals are unacceptable. House batteries within the control panel. Separate cells to prevent contact between terminals of adjacent cells and between terminals and other metal parts. Batteries shall have a clear or transparent battery shell which clearly displays the liquid level within the battery.
 - b. Capacity: Provide the batteries with sufficient capacity to operate the system under supervisory and trouble conditions, including audible trouble signal devices for **<24> []** hours and audible and visual signal devices under alarm conditions for an additional **<5> []** minutes.
 - c. Battery Charger: Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged the charger shall recharge them back to full charge within 48 hours. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

SPECIFIER S NOTES: Verify with using agency whether a graphic annunciator is desirable and edit section accordingly.

F. **<Graphic Annunciator:**

1. **Graphic Annunciator Panel: Provide a graphic annunciator which indicates the building floor plan, including the locations of all stairs and elevators. Stairs and elevators shall be identified by <letter> <number>. Alarm circuit boundaries shall be clearly marked on the floor plan. Annunciator shall include a north arrow, <location of the fire alarm control panel,> and a "you are here" indicator. The graphic annunciator shall be <a minimum size of 18 inches by 18 inches> <as indicated on the contract drawings>. Panel shall duplicate annunciation functions performed by the main fire alarm control panel. Fire alarm zone descriptions shall correspond to the fire alarm control panel zones and light when the corresponding fire alarm**

control panel zones are activated. Panel shall be <flush> <surface>-mounted.

2. **Indicating Lights:** Provide the graphic annunciator with individual LED indicating lights for each type of alarm and supervisory device. Provide an amber LED for indicating a system trouble condition and a separate amber LED for indicating a supervisory condition. Provide a green LED to indicate presence of power and a red LED to indicate an alarm condition. The actuation of any alarm signal shall cause the illumination of a device LED. System supervisory or trouble shall cause the illumination of a trouble LED. In addition to all of these LED indicators, provide normal power indicating LED. Provide a push button LED test switch. The test switch shall not require key operation. Annunciator LEDs shall only be extinguished by operation of the system reset switch on the FACP.
3. **Material:** Construct the graphic annunciator faceplate of <smoked plexiglass> <bronze>. The LEDs shall be backlit. All control equipment and wiring shall be housed in a surface mounted backbox. The exposed portions of the backbox shall be <chrome plated> <bronze plated] with knockouts. The exposed portions of the back box shall be field or factory painted to match the FACP.
4. **Programming:** Where programming for the operation of the proper LEDs is accomplished by a separate software program than the software for the fire alarm control panel, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.>

G. <System Printer:

1. Provide a system strip printer to record all alarm, supervisory, and trouble conditions without loss of any signal or signals. Printout shall be by circuit, device, and function as provided in the FACP. Printer shall operate on a supervised 24 VDC power supply from the control panel. The printer shall be arranged as a module within the control panel or provide in a separate lockable cabinet.
2. The printer shall have at least 40 characters per line and have a 96 ASCII character set. The printer shall have a microprocessor-controlled, bi-directional, logic seeking head <capable of printing 120 characters per second> utilizing a <9 by 7> dot matrix print head. Printer shall not contain internal software which is essential for proper operation.
3. The printer shall preferable be mounted inside the FACP enclosure. If this is not possible, mount the printer in a suitable cabinet next to the FACP with the color matching the color of the FACP enclosure.
4. When the FACP receives a signal, the alarm, supervisory, and trouble condition shall be printed. The printout shall include the type of signal, the circuit or device reporting, the date, and the time of the occurrence. The printer shall differentiate alarm signals from all other printed indications. When the system is reset this condition shall also be printed including the same information concerning device, location, date and time. Provide a means to automatically print a list of all existing alarm, supervisory, and trouble conditions in the system. In the event that a printer is off-line when an alarm is received, the system shall have a buffer to retain the data and it shall be printed when the printer is restored to service. The printer shall have an indicator to alert the operator that the paper has run out.>

H. Smoke Detectors:

1. Photoelectric Smoke Detectors: Provide photoelectric smoke detectors as follows:
 - a. Provide 2-wire photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation. Smoke detectors shall be listed for use with the fire alarm control panel.
 - b. All components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detector chamber with a fine mesh metallic screen which prevents the entrance of insects or air born materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 - c. Provide twist lock bases for the detectors. The detectors shall maintain contact with their bases without the use of springs. Provide companion mounting base with fixed wiring terminals. Terminate field wiring on the fixed terminals.
 - d. Detectors shall be equipped with screw terminals for each conductor.
 - e. Detectors shall be of the low voltage type rated for use on a 24 VDC system. The total number of detectors on any detection circuit shall not exceed 80 percent of the maximum number of detectors allowed by the control panel manufacturer for a single circuit.
 - f. Detectors shall include alarm LED which flashes under normal conditions, indicating that the detector is operational. LED to be placed into steady illumination when the detector is in alarm. Provide an output connection for an external remote alarm LED.
2. Ionization Type Smoke Detectors: Provide ionization type smoke detectors as follows:
 - a. Provide 2-wire smoke detectors which operate on the ionization principle and are actuated by the presence of visible or invisible products of combustion. Detectors shall not be humidity sensitive. The sensitivity of each detector shall be field adjustable to compensate for operating conditions. Smoke detectors shall be listed for use with the fire alarm control panel.
 - b. All components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen which prevents the entrance of insects or air born materials. The screen shall not inhibit the movement of smoke particles into the chamber.
 - c. Provide twist lock bases for the detectors. The detectors shall maintain contact with their bases without the use of springs. Provide companion mounting base with fixed wiring terminals. Terminate field wiring on the fixed terminals.
 - d. Detectors shall be equipped with screw terminals for each conductor.
 - e. Detectors shall be of the low voltage type rated for use on a 24 VDC system. The total number of detectors on any detection circuit shall not exceed 80 percent of the maximum number of detectors allowed by the control panel manufacturer for a single circuit.
 - f. Detectors shall include alarm LED which flashes under normal conditions, indicating that the detector is operational. LED to be placed into steady illumination when the detector is in alarm. Provide an output connection for an external remote alarm LED.

3. Duct Smoke Detectors: Detectors in ducts shall be **<photoelectric> <ionization>** type and listed by UL FPED or FM P7825 for duct installation. Duct detectors shall be provided with approved duct housing, mounted exterior to the duct, and shall be provided with perforated sampling tubes extending across the width of the duct. **<Activation of duct detectors shall cause actuation of the fire alarm control panel in the same manner as other alarm initiating devices.>**

<Activation of detectors shall cause shutdown of the associated air-handling unit, annunciation at the control panel, but shall not cause sounding of the building interior alarm devices.>
 4. Single **<Multi>** Station Smoke Detectors: In sleeping rooms, 120-volt ac, **<single> <multi>** station ionization **<photoelectric>** type smoke detectors shall be installed as indicated. Each smoke detector shall be UL FPED listed, produce 85 dBa at 10 feet (minimum), and provided with an integral alarm test device. Detector installation and power supply shall be in accordance with NFPA 72. Primary source of electric power shall be a dependable commercial light and power source. Detector shall be provided with 9 VDC battery backup power. Detector shall be hard wired into the electrical source and shall not be subject to loss of power by a wall switch. **<Multi station smoke detectors shall be wired such that activation of one detector shall cause all detectors within the unit to alarm.>**
- I. Heat Detectors:
1. Thermal Detectors: Provide rate of rise with fixed temperature heat detectors as follows:
 - a. Provide detectors designed for the rate of rise principal with an independent fixed temperature element. Temperature rating of detectors shall be **<135> []** degrees F. unless ceiling temperatures require a higher temperature rating in accordance with NFPA 72. Rate of rise shall be **<15> []** degrees F.
 - b. Provide detectors with a visual indicator to show that the detector has operated.
 2. Rate Compensation Heat Detectors: Provide rate compensation heat detectors as follows:
 - a. Provide detectors designed for detection of fire by rate compensation principal. Temperature rating of detectors shall be **<135> []** degrees F. unless ceiling temperatures require a higher temperature rating in accordance with NFPA 72. Detectors shall be equipped with screw terminals for each conductor. Provide detectors designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be hermetically sealed and of the automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise. Detector operation shall not be subject to thermal lag.
 - b. Provide detectors with a visual indicator to show that the detector has operated.
- J. Manual Stations: Provide noncoded type with mechanical tool-less reset feature. Locate stations as indicated. Stations shall be **<semi-flush> <flush> <surface>**-mounted. **<Surface-mounted boxes shall be painted the same color as the alarm station.>** Provide each station with screw-type terminals of proper number and type to perform functions required. Break-glass-front stations and pull-lever, break-glass-rod type are not acceptable. **<Stations indicated as weatherproof shall be installed in cast metal, weatherproof housings with side-hinged access doors. Housings shall be painted red and labeled FIRE ALARM using permanently affixed, engraved, red and white plastic identification signs. Identification signs shall be affixed to the face of the housing cover; letters shall be a minimum of 0.75 inch high.>** **<Provide separate screw terminal for each conductor connected to the manual alarm station.>** **<Provide manual station guard covers equipped with tamperproof latch which may**

be opened for testing or resetting after the station has been operated for fire drills.>

SPECIFIER S NOTES: Central Services Division prefers that combination type audiovisual alarms not be utilized in schools. Verify type of notification appliances to be used and edit this Article accordingly.

K. Notification Appliances:

1. **<Audiovisual Alarms: Provide <flush> <recessed> <surface>-mounted approved audiovisual alarm devices consisting of an electronic horn with a three pulse temporal pattern (Code 3) alarm signal suitable for use in an electrically-supervised circuit and top-or front-mounted integral flashing strobe light. Horn shall have a sound rating of at least 90 decibels at 10 feet. Strobe light shall provide a minimum of 15/75 candela or as indicated on the drawings and shall be powered from a supervised notification appliance circuit. All audible alarms shall be synchronized. All visual alarms shall be synchronized.>**
2. **<Visual Alarms: Provide <flush> <surface>-mounted lamp assembly suitable for use in an electrically-supervised circuit. Provide lamps of the flashing stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 15/75 candela or as indicated on the drawings. All visual alarms shall be synchronized.>**
3. **<Horns: Provide <surface> <semi-flush> mounted electronic horns suitable for use in an electrically supervised circuit. Horns shall have a minimum rating of 90 dBA at 10 feet. Output from the horn shall be the three pulse temporal pattern (Code 3). Where horns and strobes are provided in the same location, they may be combined into a single unit.>**
4. **<Mini Horns: Provide <surface> <semi-flush> mounted electronic horns suitable for use in an electrically supervised circuit. Horns shall have a rating of 85 dBA at 10 feet. Output from the horn shall be the three pulse temporal pattern (Code 3). Where horns and strobes are provided in the same location, they may be combined into a single unit.>**
5. Connections: Provide screw terminals for each notification appliance. Terminals shall be designed to accept the size conductors used in this project without modification.

L. Fire Alarm Power Extender Panels: Fire alarm power extender panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a **<flush> <surface>-mounted** steel cabinet with hinged door and cylinder lock. The extender panel(s) shall have the necessary components and equipment required to provide a minimum of **<four> [_____]** supervised, Class B, Style Y, notification appliance circuits. Each appliance circuit shall be rated for 1.5 amperes at 24 volts DC. An alarm signal from the FACP will initiate the **<four> [_____]** notification appliance circuits to extend the alarm. Primary power for the panel shall be 3 amperes at 120 volts AC. Standby power shall be same as FACP and charger shall be housed integrally within the cabinet.

M. System Wiring: Provide wiring materials under this section as specified in Section **<16100 - ELECTRICAL WORK>** with the additions and modifications specified herein.

1. Wiring Within Cabinets, Enclosures, Boxes, Etc.: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure or cabinet. All conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring

diagrams of the system. Make all connections with approved pressure type terminal blocks, which are securely mounted.

2. Terminal Cabinets: Provide a terminal cabinet **<at the base of any circuit riser,>** **<on each floor at each riser,>** **<and>** where indicated on the drawings. Terminal size shall be appropriate for the size of the wiring to be connected. All conductor terminations shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the terminal cabinet. Minimum size is 8 inches high by 8 inches wide.

SPECIFIER'S NOTES: Central Services Division prefers stranded in lieu of solid copper conductors for systems they will maintain. Verify type of conductors to be used and edit this Article accordingly.

3. Above Grade Alarm Wiring: Conductors shall be Type THHN/THWN. Type TW is not permitted. Initiating device circuit field wiring shall be single solid copper conductor No. 18 to No. 12 AWG, depending on distance and per manufacturer's recommendations. Visual alarm signal and audible appliance circuits shall be single solid copper No. 14 AWG size conductors at a minimum. Wire size shall be sufficient to prevent voltage drop problems. Power wiring, operating at 120 VAC minimum, shall be No. 12 AWG solid copper having similar insulation. Provide wiring in electrical metallic tubing in dry locations not enclosed in concrete or where not subject to mechanical damage. Provide rigid conduit in all other locations. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. The use of flexible conduit not exceeding a 6 foot length shall be permitted in initiating device circuits. The minimum conduit size shall be 0.75 inch. Circuits to **<smoke control systems,>** **<fan shutdown systems,>** **<door locking systems,>** and [] shall terminate in terminal cabinets within 3 feet of the controllers for those systems. The completion of those circuits from the terminal cabinets to the appropriate system shall be provided under the appropriate Division.

SPECIFIER'S NOTES: Maintain existing color code scheme when connecting to existing equipment. If no color coding scheme exists, utilize DAGS standard color code.

4. Conductor Terminations: Color coding is specified under 3. EXECUTION. Labeling of any circuit at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet and FACP shall contain a laminated drawing which indicates each conductor, its label, circuit and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.
5. Below Grade Direct Burial Type Cables:
 - a. Below grade fire alarm wiring shall be direct burial unshielded multi-conductor type PVC-jacketed cable with #14 AWG and/or larger Type XHHW.
 - b. Multi-conductor cable shall be UL listed, Type TC cable conforming to National Electrical Code Article 340.
 - 1) Copper conductors shall be concentric stranded, class B (7 strands).
 - 2) Insulation shall be PVC or nylon with an overall PVC jacket.
 - 3) Cable Conductor number and color coding shall be as shown on the plans.
 - 4) Green, white, and gray colored conductors shall not be used.
 - c. Below grade twisted pair or twisted shielded pair cable shall be direct burial TC type with minimum #18 AWG conductors.

6. Frame for School Campus Map and Operating Instructions: The frame material shall be welded stainless steel, with clear glass. Instructions shall be typewritten. Drawings shall be done by computer. Hand lettering and drafting not acceptable.
7. Cable Markers:
 - a. Rectangular, commercially available polyethylene cable tags with prepunched holes at each corner for the attachment with self-locking ties.
 - b. Minimum 0.035-inch thick.
 - c. Average Tensile Strength: 4500 pounds p.s.i.
 - d. Non-corrosive, non-conductive, resistant to acids, alkalis, organic solvents, salt water and distortion-resistant in temperatures up to 300 degrees F.
 - e. White or yellow and machine printed with the phrase "Fire Alarm Cable - Buildings A to E" in black block letters 1/8" or larger in vertical height. Handwritten markers are not acceptable.
 - 1) The preprinting shall be permanent and shall not fade or dissolve.
 - 2) The tags shall be suitable for marking with black permanent markers. There shall also be space available for additional notes (for maintenance / service contractor use only).
8. Cable and Conductor Ties: One-piece, self-locking nylon ties having a minimum loop tensile strength of 175 pounds and resistance to the same conditions as cable marker.
9. Nameplates: Provide metallic and/or phenolic noncorrosive and non-heat sensitive nameplates for:
 - a. Fire Alarm Control Panel: The nameplates shall be factory installed, securely mounted inside the fire alarm panel with machine screws or glue, and shall also be accessible and visible. Information on the nameplates shall be 1/8" or larger lettering stamped or engraved with the following:
 - 1) Manufacturer's name and address.
 - 2) Model Number.
 - 3) Serial Number.
 - 4) Date of Manufacture.
 - 5) Manufacturer's drawing number (if available).
 - b. Subpanels and Modules: The nameplates shall be securely mounted on the Subpanels and/or module with machine screws or glue and include the following information:
 - 1) Subpanel and/or module model and/or type number.
 - 2) Catalog number.
10. Corrosion and Fungus Protection: Metallic equipment shall be coated with a rust inhibiting treatment and standard finish per the manufacturer's standard. Components shall be protected against corrosion and fungus (e.g. circuit boards shall be epoxy coated).

PART 3 – EXECUTION

3.01 EXAMINATION OF THE DRAWINGS AND SPECIFICATIONS

- A. Confirm and coordinate voltages and requirements of equipment furnished by other trades which will be connected to the fire alarm system. They include detectors and dampers, and any other equipment connected to the fire alarm system. Include the above information on the field-post as-built drawings.

3.02 EXAMINATION OF EXISTING SITE CONDITIONS

- A. Cabinets, panels, annunciators, outlets, pull stations, audio / visual devices and other equipment and devices shall be installed in the locations and heights shown on the drawings and/or as specified herein.
 - 1. The location of the equipment and devices shown on the plans are approximate. Before installing, the Contractor shall study adjacent construction, verify all dimensions and sizes of equipment at the job site and perform installation in what he considers the most logical manner.
 - 2. Any changes from the locations shown on the drawings must be approved by the Contracting Officer and shown on the "field-posted as-built" drawings.
 - 3. Any device may be relocated within 10'-0" before installation at the direction of Contracting Officer without additional charge to State.
- B. The Contractor shall determine the location of existing cables and record their route on the field-posted as-built drawings.

3.03 INSTALLATION

- A. Protect dissimilar metals with approved fittings and treatment.
- B. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a shingled layer of a pressure sensitive plastic tape, half-lapped. Do not use aluminum in contact with the earth.
- C. All metallic conduits and boxes shall be grounded with a green wire ground conductor.
- D. Equipment Installation: Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with NFPA 70, NFPA 72, [] and as modified herein.
 - 1. FACP: Locate the FACP where indicated on the drawings. **<Surface> <Flush>** mount the enclosure with the bottom of the cabinet 4 feet above the finished floor. All conductor terminations shall be labeled and a drawing containing all conductors, their labels, their circuits and their interconnection shall be permanently mounted in the FACP.
 - 2. Manual Stations: Locate manual stations where shown on the drawings. Mount stations so that their operating handles are 4 feet above the finished floor.
 - 3. Notification Appliance Devices: Locate notification appliance devices where shown on the drawings. Mount assemblies on walls 80 inches above the finished floor or 6 inches below the ceiling whichever is lower.

<4. Smoke Detectors and Heat Detectors: Locate detectors <as shown on the drawings> on a 4 inch mounting box. Detectors located on the ceiling shall be installed not less than 4 inches from a side wall to the near edge. Those located on the wall shall have the top of the detector at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. In the case of solid joist construction, the detectors shall be mounted on the bottom of the joists. On smooth ceilings, detectors shall be installed not over 25 feet apart in any direction. Closer spacing shall be used when recommended by the detector

manufacturer or required by NFPA 72. In raised floor spaces, the smoke detectors shall be installed to protect 225 square feet per smoke detector with a maximum spacing of 15 feet. Install smoke detectors no closer than 3 feet from air handling supply outlets. Heat detectors shall be installed in strict accordance with their UL listing. Heat detectors, provided to meet ASME/ANSI A17.1 requirements for elevator power disconnect, shall be located adjacent to each sprinkler head in the elevator machinery room.>

<5. Graphic Annunciator: Locate the graphic annunciator as shown on the drawings. <Surface> <Flush> mount the panel, with the top of the panel 6 feet above the finished floor or center the panel at 5-1/2 feet, whichever is lower.>

E. Cables and Conductors:

1. Below Grade Cable Installation: Cable shall be installed as indicated on the drawings.
 - a. Conduits shall be sloped as noted on the drawings to provide drainage at handholes and manholes.
 - b. Cables shall not be installed in the same ducts, conduits, handholes, etc. with non-fire alarm circuits.
 - c. Align and clean ducts and conduits before cable installation using mandrels, and scrapers and wire brushes. Arrange with the Contracting Officer to have an inspector present for conduit and duct cleaning, and cable installation.
 - d. Properly sized tensiometer and pulling devices shall be used for cable installation. Jerking of cables during the pulling installation process shall not be allowed.
 - 1) At the request of the Contracting Officer, the Contractor shall provide proof and date of calibration of the tensiometer and cable pulling devices used.
 - 2) Cable pulling tensions shall not exceed manufacturer's recommended pulling tensions.
 - 3) Use cable lubricants and compounds that will neither change the physical characteristics nor increase the conductor insulation dielectric constants of the cable sheath.
 - e. Should the Contractor proceed with conduit cleaning and cable installation without having notified the Contracting Officer, if directed by the Contracting Officer, the Contractor shall remove the cable(s) for inspection and reinstall at no additional cost to the State.
 - 1) The Contractor may reinstall the removed cable if inspection and/or tests show no cable damage.
 - 2) If the cable is damaged, the Contractor shall install a new replacement cable at no additional cost to the State.
2. Above Grade Conductor Installation:
 - a. Conductors shall not be installed in the same conduits, ducts, junction boxes, etc. with non-fire alarm circuits. 120 volt AC fire alarm circuit conductors shall not be contained within the same multi-conductor cable nor installed with cables and other conductors in the same conduits, ducts, enclosures, junction boxes, etc. with 24 volt DC fire alarm circuits.
 - b. Conductors shall be installed in continuous lengths. Splices shall be made in above ground junction boxes by terminating wires with wirenut connections.

- c. Cable pulling tensions shall not exceed manufacturers' recommended pulling tensions.
 - d. Wire-nut connectors: Permitted for connections in above grade locations only, in junction boxes and equipment and to devices that are not available or manufactured with screw-type connections.
3. Conductor Color Code: Conductors shall be provided with insulation color coded as follows:
- a. Power Branch Circuit Conductors: Red (+), White (-) for 120 VAC. Black (+), Red (-), and White (neutral) for 240 VAC.
 - b. Initiating Device Circuit: Red (+), Black (-).
 - c. Audible Notification Appliance Circuit: Blue (+), Orange (-).
 - d. Visual Notification Appliance Circuit: Brown (+), Yellow (-).
 - e. Detector Power Supply or separate annunciator wiring color code: Violet (+), Black (-).
 - f. Tie Circuit:
 - 1) Red (+), Black (-) if used as an initiating circuit.
 - 2) Blue (+), White (-) if used as a signaling circuit.
 - g. Door Holder Circuit (DHC): Pink, Pink.
 - h. Multi-conductor cable green, white, and gray colors shall not be used.
- F. Cable and Conductor Terminations and Dress. The following requirements shall apply to terminal cabinets, junction and outlet boxes larger than 12" x 12":
- 1. Electric equipment shall be installed in a neat and workmanlike manner in accordance with NEC 373-7, Space in Enclosures.
 - 2. Cable conductors or individual conductors shall be bundled, dressed and held together with cable straps, ties or lace and fanned in a manner that equipment terminals are visible and accessible, and allow the connections to be removed and reconnected without moving a large number of wires.
 - a. Conductors to screw type connectors shall be terminated with wire lugs or with approved cable termination connectors compatible with the specific termination.
 - b. A minimum of 6 inch excess length shall be provided for conductors from the bundles to the connectors using a vibration loop as described by NEC 300-14.
 - c. Conductors shall be labeled as specified herein.
 - 3. Cross-connected conductor pairs in junction and device outlet boxes or cabinets will not require bundling and cable straps, ties or lace but shall be neatly installed with a minimum of 6 inches of excess length so conductors can be easily traced between terminals. Label all conductors as specified herein.
 - 4. Cabinets, junction boxes, outlet boxes, other boxes, shall have sufficient space to accommodate all conductors installed in them without crowding.

5. Completed work shall be uncrowded and uncluttered and shall allow accessibility without cutting and/or removing of any straps, ties, laces, cables, components, devices, brackets, modules, equipment and like items.
 6. Cables shall be secured to junction boxes, equipment cabinet backboards, console members or to other system components using cable clamps and wraps. Provide cable support posts as required to facilitate system installation.
- G. Cable and Conductor Identification System
1. Underground Cable Markers:
 - a. Provide markers at both ends of the cables and at all intermediate locations where the cables are accessible and visible.
 - b. Each marker shall be secured with two (2) nylon ties.
 2. Conductor Markers:
 - a. Provide markers at ends of each conductor connected to the control panels and terminal cabinets at each building.
 - b. Attach markers a minimum of four (4) inches from the ends of conductors in a manner that will not permit accidental detachment.
 3. Initiating Device Circuits: Initiating device circuits shall be labeled by zone number as shown on the drawings. Conductors shall be labeled in the fire alarm panel(s), the building's main fire alarm junction box and termination cabinet.
 4. Audible and Visual Notification Circuits: Notification circuits shall be labeled by signaling circuit number as shown on the drawings. Conductors shall be labeled in the fire alarm panel(s) and in the building's fire alarm termination cabinet.
- H. Framed School Campus Map: A framed map of the school campus drawn at a minimum scale of 1"=40', showing panels, the location of each pull station, and audio and visual alarm devices shall be printed on a white background, and permanently mounted adjacent to the main fire alarm annunciator-control panel.
- I. Framed Operating Instructions: A framed set of operating instruction printed on a white background or engraved Main Fire Alarm Panel Operating Instructions shall be provided. The framed instructions shall be permanently mounted adjacent to the main fire alarm annunciator-control panel.
- J. Field Touch-up Painting: Touch-up painted surfaces and fire alarm system components damaged during installation to match the existing or specified paint and color.
- K. **<Disconnection and Removal of Existing System: Fire alarm control panels and fire alarm devices disconnected and removed shall be turned over to the Central Services Division, Department of Accounting and General Services, <729 Kakoi Street, Honolulu, Hawaii>.**
1. **The existing fire alarm and smoke detection system shall remain in operation at all times during the installation and commissioning of the new system. The Contractor shall take precautions to avoid any accidental activation of the existing fire alarm system. When making modifications to the existing systems, the Contractor shall minimize the time the existing system is out of service. Prior to any impairment of the existing system the Contractor shall notify the State and County Fire Department. The Contractor shall comply with 29 CFR 1910.36 and 29 CFR 1910.37. No impairment shall exceed 4 hours. The Contractor shall establish a fire watch to monitor the impaired area until the entire fire alarm system is returned to full operation. The Contractor shall**

schedule outages <30> [] days in advance. Once this new system is on-line and accepted by the State, remove the old system. As new equipment is installed, label it "NOT IN SERVICE". Upon acceptance, remove labels.

2. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and elsewhere in the specification.

3. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.>

L. <Connection of New System: The following new system connections shall be made during the last phase of construction, at the beginning of the preliminary tests. New system connections shall include:

1. Connection of new relay modules to existing magnetically held smoke door (hold-open) devices.

2. Connection of new elevator recall smoke detectors to existing wiring and conduit.

3. Connection of new system transmitter to existing fire alarm transmitter interface panel.

Once these connections are made, system shall be left energized and new audio/visual devices activated. Report immediately to the State, coordination and field problems resulting from the connection of the above components.>

M. Firestopping: Provide UL listed firestopping for all holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section <07840 – FIRESTOPPING>.

3.04 TESTING

A. Testing Of The New Fire Alarm System:

1. After completion of the fire alarm system's installation, turn on and leave the system on for a minimum of three (3) consecutive weeks to demonstrate that contract work operates, meets the requirements of the specifications and does not affect the operation of the entire fire alarm system.

2. Upon successful completion of the three (3) week operational period, arrange with the Contracting Officer for a pre-final fire alarm system test and inspection. The test and inspection shall demonstrate that all the Contractor installed fire alarm system equipment, devices cables and conductors are operating acceptably and have been installed in accordance with this specification.

Accordingly, the test demonstrates that the system is ready for a final test of the overall fire alarm system.

Representatives at the prefinal test shall include the Contractor, fire alarm system manufacturer's representative, user, the user's facility maintenance agency personnel, F.A. system design consultant, and the Contracting Officer. Representatives at the Final test shall include all the foregoing representatives and the County Fire Department Inspector.

3. Preliminary Test Results: Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include a hard copy of printer

output information from preliminary testing, i.e. download historical file so that all test data is available for State review.

a. Tests:

- 1) Dielectric Strength and Insulation Resistance Tests: Test the dielectric strength and the insulation resistance of the system interconnecting wiring by means of an instrument capable of generating 500 volts dc and equipped to indicate leakage current in 1000 megohms. For the purpose of this test, the instrument shall be connected between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open circuited and all series-connected devices in place. The system shall withstand the test without breakdown and shall indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100 volts nor more than 550 volts. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test.
 - 2) Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test.
 - 3) Ground Resistance Tests: Measure the resistance of each connection to ground. Ground resistance shall not exceed 5 ohms. The tests shall be witnessed by the State Inspector and test results recorded for use at the final acceptance test.
 - 4) Smoke Detector Tests: Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke detector. Clean the smoke detectors in accordance with the manufacturer's recommended procedures. **<Perform voltage activation sensitivity test on each detector and record the results. Remove detectors with a sensitivity level above or below the UL accepted sensitivity range for that detector and replace with new detectors.>** Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.
 - 5) Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests" of this section. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable to the State a minimum of 7 calendar days before the formal acceptance test date required in the paragraph below. Without the submission of this report, the final acceptance test is automatically canceled.
- b. Formal Acceptance Testing: Notify the State in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the O&M Manuals are submitted and the following are provided at the job site:
- 1) Marked-up red line drawings of the system as actually installed
 - 2) Dielectric strength and insulation resistance test results

- 3) Loop resistance test results
- 4) Complete program printout including all input/output addresses
- 5) Programming documentation
- 6) A list of passwords permitting access by designated State employees to all levels of the system.

The final tests shall be witnessed by the County Fire Department or Authority Having Jurisdiction (AHJ). At this time, any and all required tests shall be repeated according to AHJ. Following acceptance of the system, as-built drawings and Operation and Maintenance (O&M) Manuals shall be submitted for review and acceptance. In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M Manuals are received.

- c. Minimum System Tests: Test the system in accordance with the procedures outlined in NFPA 72, Chapter 7. The required tests are as follows:
 - 1) Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.
 - 2) Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 3) Test each initiating and indicating device and circuit for proper operation and response at the control unit.
 - 4) Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 - 5) Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.
 - 6) Determine that the system is operable under trouble conditions as specified.
 - 7) Visually inspect all wiring.
 - 8) Test the battery charger and batteries.
 - 9) When applicable, verify that all software control and data files have been entered or programmed into the FACP. Hard copy records and two identical diskette copies of the software and data files shall be provided to the Contracting Officer.
 - 10) Verify that red-line drawings are accurate.
 - 11) Measure the current in circuits to assure there is the calculated spare capacity for the circuits.
 - 12) Measure voltage readings for circuits to assure that voltage drop is not excessive.

13) Disconnect the verification feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.

14) Measure the voltage drop at the most remote appliance on each notification appliance circuit.

4. Audio Tests:

- a. Provide test equipment and conduct audio test for the fire alarm system in and around the building and in areas where new audio alarm devices have been installed.
- b. Audio measurements shall be made in classrooms and other rooms (e.g. equipment and storage rooms) and buildings with the doors in the open and closed position.
- c. An audio test plan and proposed test equipment shall be submitted for review and approval with the test plans submittal in accordance with NFPA 72, Chapter 7.
- d. The measured data shall be recorded on data sheets provided by the Contractor and shall be part of the test plan submission and records.
- e. At the request of the Contracting Officer, the Contractor shall provide proof of instrument calibration and date of calibration.
- f. Contractor shall be responsible for notifying the AHJ and Fire Department of formal acceptance testing.

5. In addition to satisfactory acceptance tests of the Contractor portion of the fire alarm system, where a new fire alarm system is tied into an existing system, the entire fire alarm system must be accepted and certified by the County Fire Department or AHJ before commencement of the specified two-year system warranty period with full maintenance responsibility.

The tests must demonstrate that the entire campus (or facility) fire alarm system is operating in order to receive the Fire Department Certification.

6. If requested by the Contracting Officer, isolate the contract work from the overall system and demonstrate that the contract work does not affect the operation of the overall fire alarm system and shall repeat tests at no additional cost to the State.

B. Concealed Work: Concealed work re-opened and re-closed at random during the formal inspection as requested by the Contracting Officer shall be done at no additional cost to the State.

C. Testing Tools and Equipment: The Contractor shall provide the tools and equipment, including handheld radios, etc. necessary to accomplish the testing.

3.05 TRAINING

A. Conduct training and instruction for the operating and maintenance staff, as designated by the Contracting Officer, on the operation of the fire alarm panel and system.

B. The training session shall be conducted during normal business hours, and shall last as long as necessary to properly instruct the staff, but not less than 1-hour.

C. Instruction shall include hands-on training in routine operations and queries (reading of normal status and trouble status) of the fire alarm system.

- D. Training shall be provided for the new fire alarm system and additional circuits and devices.
- E. If the main control panel and annunciator panel are of the central processing unit (CPU) type system, instruction shall include operations and query of system status, etc.; and hands-on training in the procedures and process for operations and obtaining system status, trouble and other functional information to determine when to call for repairs and how to report the type of trouble encountered.

END OF SECTION 13852