SECTION 28 31 00

ADDRESSABLE DEVICE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The Conditions of the Contract and applicable requirements of Division 1, “General Requirements” and Section 26 01 00, "Basic Electrical Requirements", govern this Section.

1.2 DESCRIPTION OF WORK:

A. General: The extent of fire alarm system work is as shown and scheduled and includes, but is not limited to, providing a system with the following functions and operations:

1. Provide a complete distributed microprocessor based, 24 volt dc, closed circuit, electrically supervised, addressable device multiplexed fire alarm, and communication system to be wired, tested, and left in first class operating condition. The system shall include, but not be limited to, a control panel with reserve standby power, voice communications system, firefighters' HVAC system override, annunciators, manual alarm stations, ceiling smoke sensors, duct smoke sensors, heat sensors, addressable input and output devices, sprinkler water flow switches, valve supervisory switches, audible and visual alarm indicating devices, raceways, wiring and all hardware and software as required to effect an operational system as herein specified. Each alarm device shall be individually addressable.

2. The system shall operate as a non-coded, continuous sounding system which will sound alarm devices until manually silenced, as herein specified.

3. The fire alarm system shall tie into the existing University of Houston Fire Alarm network. Individual point control, individual point monitoring, and, remote system control (Acknowledge/Silence/Reset) shall be required at existing True Site Workstations. Fire alarm graphics will not be required, per University of Houston standard.

1.3 STANDARDS:

A. Products shall be designed, manufactured, tested, and installed in compliance with the latest edition of the following standards:

1. National Fire Protection Association Standards:
   a. NFPA 70 National Electrical Code.
   b. NFPA 72 Installation, Maintenance and Use of Protective Signaling Systems.
   c. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
   d. NFPA 101 Life Safety Code.
   e. NFPA 13 Sprinkler Systems.

2. Underwriters' Laboratories, Inc. Requirements and Listing for use in Fire Protective Signaling Systems as follows:
   a. UL 864 Control Panels.
   b. UL 268 Smoke Detectors - Systems.
   c. UL 268A Duct Smoke Detectors.
   d. UL 217 Smoke Detectors - Single/Multiple Station.

e.	UL 521	Heat Detectors.
f.	UL 228	Door Holders - Closers.
g.	UL 464	Audible Signaling Appliances.
h.	UL 1638	Visual Signaling Appliances.
i.	UL 38	Manual Alarm Stations.
j.	UL UOJZ.	Fire Alarm control unit

3. International Building Code, latest edition and the requirements of state and local authorities having jurisdiction.
4. Comply with requirements of the Americans with Disabilities Act of 1990.
5. State of Licensed refers to State of Texas.
6. AHJ refers to University of Houston Fire Marshal's Office.

1.4 QUALITY ASSURANCE:

A. Manufacturers: The equipment specified herein is that of SimplexGrinnell, and constitutes the style of operation, quality of construction, features and physical size limitations required for this project.

B. UL and FM-listing: All fire alarm system components shall be UL and FM listed for fire alarm use. The UL listing shall be under category UOJZ to assure that the entire system has been tested as an integral life safety system.

C. All equipment furnished shall be the current standard products of a single manufacturer and shall bear the label of the Underwriters' Laboratories for use in fire alarm system designed in compliance with the requirements of NFPA codes. Raceways, wiring and terminations shall be accomplished in compliance with the requirements of the National Electric Code, Article 760.

D. The system as installed shall, upon completion, be certified by a state licensed fire alarm technician to the Owner as being installed in compliance with the specification, the requirements of all state and local codes, and as being operational and free from defects.

E. All system equipment supplied shall be listed by the Underwriters' Laboratories for NFPA 72 system use, and all applicable NFPA Codes.

F. The installing contractor shall be authorized and designated representative of the fire alarm system manufacturer to sell, install and service the manufacturer's equipment and shall stock the required spare parts to keep the system in operation. The installing contractor shall maintain a staff of specialists for technical assistance and system maintenance.

G. The installing contractor must be licensed by the State Fire Marshal to sell, install, and service fire alarm system as required by Texas Insurance Code Chapter 6002 & 28 TAC the Fire Alarm Rules.

H. The installing contractor shall have on his staff a minimum of five fire alarm technicians who are licensed by the State Fire Marshal's office for such purpose and under whose supervision installation, final connections and check out will take place, as required by the Texas Insurance Code.

I. The installing contractor or equipment supplier shall have a staff a minimum of one certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. [In lieu of a NICET-certified state licensed fire alarm planner, the contractor or supplier may provide design by a professional engineer registered in Texas who has demonstrated a thorough understanding of fundamental

systems and practices as they pertain to life safety and to fire protection, detection, alarm, control and extinguishment.]

J. The equipment supplier shall provide 24 hour, 365 days per year emergency service with qualified and state-licensed service technicians.

K. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing microprocessor and multiplex fire alarm systems for at least 8 years and shall have proof of experience in the installation and maintenance of the type of fire alarm system specified herein.

L. The manufacturer or his representative shall maintain within 50 miles of the installation, a staff of factory trained, state licensed fire technicians, together with all support parts necessary for maintenance of the system.

M. Where approved in writing by the system manufacturer and installing contractor, the Electrical Contractor may install all conduit and boxes. The system wiring shall be pulled in by the installing contractor. All system connections, device installation, system start-up and testing shall be performed by the installing contractor. Rough-in by the electrical contractor shall not in any way affect the system manufacturer's and installing contractor's full responsibility for the installed fire alarm system.

N. The manufacturer shall submit legal documentation indicating that the purchased fire alarm equipment will be provided with parts, and support for 10 years after the acceptance by the Owner.

O. Plenum cable is acceptable where allowed by NEC and Authority Having jurisdiction (AHJ). All wiring shall be listed for limited energy fire alarm use and rated for 300 volts minimum.

P. The complete combination fire alarm system shall comply with NFPA 72 National Fire Alarm and Signaling Code and the University of Houston Design Guidelines and Standards. Modifications required to provide compliance shall be made at no cost to the Owner. Where Contract Document requirements are in excess of Code requirements are permitted under the Code, the Contract Documents shall govern.

1.5 SUBMITTALS:

A. Shop Drawings submittals shall include, but not be limited to, the following:

1. A written description of the system operation (written in this specification format), with all exception and/or deviations clearly highlighted or identified.

2. A block diagram showing system components, wire runs, wire counts and wire sizes.

3. A control panel layout diagram showing the location of all modules and wiring and interconnection schematics.

4. Calculations justifying battery size, power supply size, amplifier size, and wiring sizes based on worst case occurrence.

5. Manufacturer's descriptive literature for all panels, modules and peripheral equipment describing size, color, finish, capacity and electrical characteristics.

6. A complete listing of all associated software showing the relationship of alarm points, control outputs, control inputs and indicators.

7. An alarm matrix showing alarm and control function for an alarm in each device/zone.

8. Scaled floor plan drawings locating and naming each device/zone and showing wiring and conduit sizes from each device back to the transponders.
9. A complete riser/wiring diagram showing zoning and addressing and wiring and conduit sizes from the CPU to all remote terminal units, graphics terminals, CRT displays, printers, and other system devices.
10. Completely identified and marked catalog cuts of all associated equipment and devices, with all non-applicable items crossed out, or applicable devices clearly highlighted and/or identified.
11. Complete and detailed point-to-point wiring diagrams for all devices in the system.
12. Complete Bill of Material for all equipment.
13. A copy of the form to be used for final tests, 100% audit and checkout shall be submitted for approval.
14. Additional information as required in Section 26 01 00.
15. Stamped and signed by designer and submitted to AHJ.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Deliver fire alarm system components in factory-fabricated containers.

B. Store in a clean, dry space and protect from the weather.

C. Handle control and annunciator panels carefully to avoid damage to material components, enclosure and finish.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. General: Provide the required fire alarm system products in the sizes and capacities required or indicated, complying with the manufacturer's published product information of standard materials and components, designed and constructed for the applications indicated.

2.2 FIRE COMMAND CENTER:

A. Controls shall be provided in the Fire Command Center to provide the following functions:

1. The fire alarm system Control Panel, Voice Communications System, and Firefighters' HVAC System Override Panel.
2. A fire alarm system single-mode/multi-mode fiber network communication cards to tie in existing fire alarm network to report point information to the existing True Site Workstations.
3. Provisions for the fire alarm system to automatically unlock the Fire Command Station access doors and other locked building access doors (electric locks by Hardware Contractor).
4. Emergency Power System and Transfer Switch Annunciator Panels with signal and status indicators (furnished and installed by the Electrical Contractor).
5. Internal batteries with automatic charger of sufficient size to power the fire alarm system per NFPA 72.
6. Elevator selector controls and status indicator panel (furnished and installed by the Elevator Contractor).

7. Room light fixture with integral battery pack or on emergency power (furnished and installed by the Electrical Contractor).

8. Fire pump status indicator panels (furnished and installed by the Fire Protection Contractor).

9. Emergency Generator key type start control.

2.3 SYSTEM OPERATION:

A. Activation of an "intelligent" smoke detector shall cause the following operations and indications (refer to other paragraphs in this section for additional operations and indications):

1. When an "intelligent" smoke detector senses an abnormal level of smoke, the loop interface module shall automatically initiate a "check" mode. Four consecutive samples shall be made of the prospective detector. Upon completion of four consecutive smoke trouble conditions, the detector is considered "checked" and the system goes directly into an alarm mode, unless the verification mode is activated for the detector.

2. Alarm verification shall be programmable by detector(s) to initiate a verification sequence after the "check" procedure and the Fire Alarm Control Panel shall be permited with permission from AHJ. The system common alarm LED on the Fire Alarm Control Panel shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.

3. An alpha-numeric LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time of alarm. Location and zoning messages shall be custom field-programmed to respective premises.

4. Appropriate status change message(s) shall be transmitted to the True Site Workstations located at Police Dispatch and Fire Alarm Shop.

5. Activate all audible alarm zones on the floor of alarm, the floor above and the floor below with a prerecorded alarm message.

6. Flash all visual alarm signal zones on the floor of alarm, the floor above and the floor below.

7. Activate addressable output relays to unlock all locked security doors.

8. Activate addressable output relays to unlock electric door strikes at the Fire Command Center.

B. Activation of any addressable manual pull station, beam smoke detector, sprinkler waterflow switch or "intelligent" heat detector shall cause the following operations and indications (refer to other paragraphs in this section for additional operations and indications):

1. Cause all operations and indications described in Paragraph 2.3/A.3 through 2.3/A.9 to occur.

C. Activation of an elevator machine room or shaft heat detector shall cause the following operations and indications:

1. Cause all operations and indications described in Paragraph 2.3/A.3 through 2.3/A.9 to occur.

2. Initiate via an addressable output relay, the shunt tripping of power to each elevator machine.

D. Stairwell pressurization fans shall be started via addressable output relays with status verification via differential pressure switch and addressable input whenever any sprinkler waterflow switch or any two smoke detectors on a single floor are activated. The alpha-numeric display shall indicate stair pressurization fan operation and the firefighters HVAC override panel shall show fan status.

E. Elevator recall shall be initiated via addressable output relays when any smoke detector elevator lobby, in the elevator machine room or in elevator shafts is activated. Elevator recall shall be indicated on the alpha-numeric display and shall be as follows:

1. Passenger and Freight Elevators shall recall to the First Floor for alarms on all levels above the First Floor.

2. Passenger and Freight Elevator shall recall to the First Floor for all alarms below the First Floor.

3. Passenger and Freight Elevator shall alternately recall to the Second Floor for all alarms if the first floor smoke detectors indicate a problem.

4. Activate relay to provide signal to elevator cab that smoke detector in the machine room or elevator shaft is in alarm.

F. Smoke doors on floors Ground through Six shall be closed by opening of the addressable output relay powering their magnetic hold open devices whenever the smoke detector on either side of the door is activated or the building smoke exhaust system of the floor is activated.

G. Air handling units shall be shutdown via addressable output relay whenever the unit duct smoke detector is activated or the building smoke exhaust system on the floor served by the unit is activated.

H. Closure of a supervised OS&Y or PIV valve sensed via a supervisory switch or loss of supervisory air pressure in a dry-pipe sprinkler system, sensed via a pressure switch shall cause the following operations and indications:

1. The system common alarm LED on the Fire Alarm Control Panel shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.

2. An alpha-numeric LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field-programmed to respective premises.

3. Appropriate status change message(s) shall be transmitted to all graphics terminals, CRT displays, and printers.

I. Fire Pump Controllers shall be monitored by the fire alarm system for fire pump run, fire pump phase reversal, fire pump loss of power, fire pump low pressure and fire pump isolating switch open. The presence of an alarm or trouble condition shall cause the following operations and indications.

1. The system common alarm or trouble LED on the Fire Alarm Control Panel shall flash. The internal audible trouble device shall sound. Acknowledging the alarm or trouble condition shall silence the audible trouble device and revert the flashing common alarm or trouble LED to a steady state.

2. An alpha-numeric LCD Display shall indicate all applicable information associated with the alarm or trouble condition including: zone, device type,

device location, and time of alarm or trouble. Location and zoning messages shall be custom field-programmed to respective premises.

3. Appropriate status change message(s) shall be transmitted to the True Site Workstations located at Police Dispatch and Fire Alarm Shop.

J. The presence of a ground condition or an open circuit on any alarm initiation circuit or a ground condition, open circuit or short circuit on any alarm indicating circuit, blockage, lens contamination or physical misalignment of any beam type smoke detector, a trouble condition at a fire suppression system panel or other trouble condition shall cause the following actions and indications:

1. The system common trouble LED on the Fire Alarm Control Panel shall flash. The internal audible trouble device shall sound. Acknowledging the trouble condition shall silence the audible trouble device and revert the flashing common trouble LED to a steady state.

2. An alpha-numeric LCD Display shall indicate all applicable information associated with the trouble condition and its location. System trouble diagnostics shall assist in defining the trouble condition. Unacknowledged alarms/messages shall have priority over any trouble displays and take precedence on the LCD annunciator. Trouble conditions will be stored in memory for future recall/ display.

3. Appropriate status change message(s) shall be transmitted to the True Site Workstations located at Police Dispatch and Fire Alarm Shop..

K. All designated "nonsilenceable" auxiliary control functions shall remain in operation (even upon silencing of audible alarms) until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).

L. Provisions shall be included within the Fire Alarm Control Panel for the following manual controls in addition to those previously mentioned:

1. Disconnect audible signalling while testing.

2. Temporary software bypass of selected alarm points.

3. Software assignment of selected alarm points to alarm verification function as a method of tracking alarms caused by environmental factors or maintenance requirements. Waterflow switches, smoke detectors, and valve supervisory switches shall be assigned to the verification group to eliminate nuisance alarms.

4. Any zone may be enabled or disabled remotely via the True Site Workstation.

2.4 SYSTEM DEVICES:

A. System devices shall be located as shown on the Drawings. The Contractor shall refer to all the drawings to determine where devices are to be located. All system devices shall be numbered with a unique number. The numbering system shall include the building area, type of device, and device number. This numbering system shall be shown on each submitted floor plan drawing, fire alarm riser diagram and be tabulated. The tabulation shall be included in each O&M Manual submitted to the Owner.

2.5 SYSTEM ZONING:

B. The system shall employ "intelligent" heat and smoke detectors and addressable interface devices capable of being recognized and annunciated at the main control panel and CRT terminals on an individual basis. All devices shall be field-

programmed into software zones for the purpose of general area identification and annunciation. However, each device shall also be annunciate identified on an individual basis including exact location and device type. All zoning/device location information shall be totally field-programmable to exact job requirements. Devices shall be zoned as follows:

1. Manual pull stations, area smoke and heat detectors and sprinkler water flow and pressure switches shall be zoned by floor.
2. Elevator lobby, machine room and shaft smoke detectors shall be zoned by elevator group.
3. HVAC equipment supply air and return air smoke detectors shall be zoned by floor.
4. Fire suppression system(s), fire pump monitoring and similar functions shall each be zoned separately.

C. Initiating and monitored devices shall include, but not be limited to, the following:

1. Manual pull stations.
2. Ceiling smoke detectors.
3. Duct smoke detectors.
4. Ceiling heat detectors.
5. Beam smoke detectors.
6. Addressable input devices.
7. Sprinkler flow and pressure switches.
8. Valve supervisory switches.
9. Fire suppression system panels.
10. Fire pump controllers.

D. The system shall utilize remote transponder panels for distributed voice communications. Remote transponder panels shall communicate with the main CPU via the RUI data loop and be capable of being intermixed on the same loop as intelligent heat and smoke detection and control modules.

E. Output devices shall include, but not be limited to, the following:

1. Ceiling alarm speakers.
2. Wall and ceiling alarm speakers/visual signals.
3. Visual alarm devices.
4. Addressable interface relays.
5. Magnetic door holders.
6. True Site Workstations.

2.6 SYSTEM CONFIGURATION:

A. System equipment shall include, but not be limited to an operator's control/system control panel, remote transponder panels, True Site Workstation, HVAC override, battery backup, alarm indicating devices, door hold opens and output relays and other devices required to provide a complete and working system.

B. The system control unit shall be connected to remote transponder panels on a looped signaling line circuit. The wiring of the loop shall be so arranged that additional transponder panels may be inserted in the loop without requiring additional wires to be installed between transponder panel and the system control unit. In additional, loops shall be so arranged that any wiring fault on a loop shall not disable more than 250 initiating devices. A single open ground or multiple opens in different wires at the same location shall not prevent receipt of alarm signals from that loop.

C. The system shall be of the active multiplex/addressable type wherein each initiating device shall be repetitively scanned, causing a signal to e transmitted to the control unit that indicates the individual initiating device circuit installation wires are intact. Loss of such a signal at the system control unit shall resulting a trouble indication as specified hereinafter for the particular indicating device affected. All indicating devices in the system shall transmit their normal, trouble or actuated status signals in no less than 5 second intervals.

D. Each individual smoke detector shall be of the analog type so that the system can be used to read smoke levels on a real time basis from selected smoke detectors for maintenance and diagnostic purposes. All smoke detectors and other initiating devices shall be individually indicated at the main control panel, the color graphics unit and each DGP, when changing to an alarm or trouble state.

2.7 FIRE ALARM SYSTEM CENTRAL EQUIPMENT:

A. General: The Fire Alarm Control Panel shall be modular in design utilizing distributed solid state microprocessors and be capable of future expansion. The microprocessor-based CPU shall be completely field-programmable. CPU module shall provide for programmable nonvolatile RAM memory utilizing integral lithium-based memory IC chips. Each panel module shall be independent employing its own microprocessor circuitry for reliability and independent operation in case of main CPU failure. The system control unit shall have capacity for the required active detection and output points with space for future use and expansion. The control unit shall be listed to the latest UL 864 Standard. All circuitry shall be UL listed for power-limited application and use positive temperature coefficient devices for current limiting. The panel shall be provided with keylock hinged door to access system controls/switches. The panel door shall be provided with a transparent window for viewing all alarm, trouble indicators, and LCD annunciator. The control unit shall be designed for semi-flush mounting.

B. Central Processing Unit Module (CPU): The CPU shall communicate with monitor and control all other modules in the panel via internal serial communications techniques.

1. Removal, disconnection, or failure of any control panel module shall be detected and reported by the CPU.

2. The CPU shall contain and execute all custom control-by-event programs for specified events if a fire situation is detected in the system. Such programs shall be held in nonvolatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.

3. The CPU module shall contain a real-time clock circuit to time/date stamp system events and execute custom time control programs. Time control program events shall be terminated in a fire conditions.

C. Display Interface Board (DIA): The DIA shall provide all touchpad controls and indicators used by the system operator and may also be used to program all control panel and system parameters.

1. The DIA shall contain, and display, custom alphanumeric labels for all intelligent detectors and addressable modules. Such label information shall be stored in field-programmable nonvolatile memory.
2. The DIA shall provide an 80 character alphanumeric Liquid Crystal Display (LCD).
3. The DIA shall provide five Light-Emitting Diodes (LEDs) for ac power, system alarm, system trouble, display trouble, and disable.
4. The DIA shall provide status readouts, manual control action, and entry of any alphabetic or numeric information. The keypad shall include means to enter passwords to prevent unauthorized manual control or programming.

D. Serial Interface Board (SIB): The SIB shall provide the following interfaces:

1. Two ports for remote printer/CRT devices (RS-232c).
2. Two ports for future local printer (RS-232c).

E. IDNet Module: IDNet module shall be provided to monitor and control multiple loops of addressable initiating and control devices, up to 250 devices per loop. Allow at least 10% spare capacity per loop for future expansion.

1. The IDNet shall communicate and provide power to all devices on its Style 4 loop over a single pair of wires. For dynamic Style 4 supervision the loop may be branch-circuited or "t-tap" connections may be made off of the loop. Loop wiring shall be twisted shielded pair of up to 10,000' in length.
2. The IDNet shall receive digital information from all "intelligent" detectors and shall process this information to determine normal, alarm, trouble and sensitivity conditions. The analog information shall also be used for automatic test and determination of maintenance requirements.
3. The IDNet module shall individually monitor all "intelligent" detectors for analog sensitivity variation initiating a “Near Dirty” and a “Dirty” trouble signal. The system shall adjust alarm sensitivity threshold of the detectors sensitivity, in this case to ensure that false alarms are not created due to dirty detectors, nor reducing the overall alarm threshold.
4. The IDNet shall communicate continuously with each "intelligent" detector and addressable module on its loop and verify its proper function and individual status. Communication with up to 250 such devices per loop.

F. Modular Network Card: The modular network card shall be provided to allow the voice communications system and network information to direct communications through this fire alarm system and future fire alarm systems.

G. Control Switches: Provide the following control switches at the Fire Alarm Control Panel.

1. Acknowledge switch.
2. Signal silence switch.
3. System reset switch.
4. System test switch..

H. Nonlock Walk Test: The system shall include a special nonlock "walk test" mode where each initiating device is manually placed in alarm. The control panel pulses the system audible devices on detection of each such alarm and automatically resets the panel, permitting a single serviceman to functionally test the entire system.

I. Automatic Detector Test: The system shall include a special automatic detector test features which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. In addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually or by zone from the main control panel. Results of the test are then indicated on the LCD display. A printout of all test data shall be capable via the system printer at either existing True Site Workstation.

J. Special System Reports: The system shall have the ability to generate and print, upon command, system and point status reports.

1. Selection of "system" read status provides the operator with global system programming information including: alarm verification, SLC loop styles, number of SLC loops, number of software zones, number of auxiliary power supplies, signal silence inhibit.

2. Selection of "point" read status provides the operator with selected individual point programming data including: point status (normal, alarm, trouble, disabled, etc.), address, type I.D., control by event, custom alphanumeric label, verification status, alarm threshold level, sensitivity, silenceable/ nonsilenceable, SLC loop number, and device number.

K. System Diagnostics: The system shall include special software to detect, diagnose, and report failures and isolate such failures to a printed circuit board level.

1. Each module via its resident, independent processor shall periodically perform independent self-test routines as a self-operational/performance test. Any irregularities are reported via the LCD display and trouble indicators.

2. A lamp test function shall be provided to test all system indicators including the LCD display. This function shall also test the panel trouble device for proper operation.

3. A keypad test function shall also be provided allowing the user to interactively confirm that all keys are functional and operating correctly.

4. The system shall include independent "Watch-Dog" timer software to detect and report failure of any microprocessor circuit, memory, or software. The function of this safe-guard software/circuitry is to then restart the respective processor and maintain proper operation of the system. In addition, the master CPU has control over a hardwired reset terminal which can perform a system-wide restart.

L. Field Programming: The system shall be 100% field-programmable or programmable from the True Site Workstations.

1. All programs shall be stored in nonvolatile RAM memory, with a dual partition to allow for switching between partitions to avoid necessity for panel being off-line during programming.

2. Programming shall be accomplished only after entering an appropriate and preselected five digit password security code.

3. All programming functions shall be initiated via special system "prompting" menus via the system main CPU. The system shall be capable of direct English language programming and prompting and not require complex digital equations or special formulations.

4. The system shall provide a means to "review" all programmed functions..

5. Any addressable indicating circuit or auxiliary addressable relay shall be programmed to activate on alarm of a single initiating device or a combination of initiating devices.

M. Event History: The main fire alarm panel shall have the resident ability to store a separate alarms for alarm, trouble, and supervisory events in independent history logs.

1. Event history shall include all system alarms, troubles, operator actions (i.e. acknowledge, silence, reset, program entry, etc.), unverified alarms, circuit/point alterations, component failures.

2. Events shall be time and date stamped and be capable of being recorded and/or reviewed without purging the history file.

3. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via five digit password security code.

4. Event recording shall automatically overwrite the oldest event(s) in memory.

N. Power Supply: The power supply for the panel and all fire alarm peripherals shall be integral to the control panel.

1. The power supply shall provide all control panel and peripheral power needs with filtered power as well as 3 amperes of regulated 24 volt dc power for external audio/visual devices. The audio/ visual power may be increased as needed by adding additional modular expansion power supplies.

2. All power supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all external signaling lines, including initiating circuits and indicating circuits.

3. All circuitry shall be UL listed for power-limited application and use positive temperature coefficient devices for current limiting. Fuses or other thermal overload type protection shall be unacceptable.

4. The system shall derive its primary operating power from a 120 volt ac, single phase, 60 Hz supply. There shall also be a 24 volt battery standby power source with internally supervised batteries and automatic charger, capable of operating the entire system for a minimum of 24 hours in the supervisory mode and then be capable of operating the alarm devices for a minimum of 15 minutes.

5. The power supply unit shall contain suitable overvoltage protection to prevent any malfunction or damage which might occur from line power surges (lightning).

6. Upon loss of main power, the power supply unit shall automatically revert to battery power and the system shall remain fully operational.

7. When the ac power is restored, the control unit shall automatically revert to normal operation without requiring any manual restarting procedures.

8. The battery shall be automatically charged by a built-in short-circuit-proof charger.

9. The charging current shall be automatically controlled according to the battery's ambient temperature.

10. After a full discharge, the system shall be able to recharge the batteries completely within 24 hours.

11. The connection to the battery shall be automatically switched off when the voltage drops below 19 volts to protect battery cells from damage to deep discharge.

12. Sealed lead acid batteries shall be used for emergency power source.

13. The entire power supply charger circuits including fuses shall be supervised both positive and negative ground fault supervision, battery/charger fail condition, ac power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required. Any malfunction, or blown or missing fuses shall result in a fault indication on the control unit.

2.8 VOICE COMMUNICATION PANEL:

A. General: The voice communications panel shall be modular in design, intergral to the main fire alarm control panel, utilizing solid state microprocessor circuitry, and be capable of future expansion. The control panel shall be of dead front construction and have specified communications circuits with space for future use and expansion. The primary voice communications panel shall be located in the Fire Command Center. A labeled "take command" switch shall be provided in the voice communications panel in the Fire Command Center which shall direct control of the paging system to the Fire Command Center. A labeled LED indicator shall be provided in each voice communications panel to indicate its' operational status.

B. Communications Controls: The communications control panel shall incorporate the following controls and indicators:

1. All call select switch with LED indicator.

2. General alarm select switch with LED indicator.

3. Audio trouble LED indicator.

4. Manual tone/message select switches with LED indicators.

5. Communications pilot/status LED indicator.

6. Communication zone select switches with LED select indicators.

7. Communications monitor speaker with volume control.

8. Dynamic paging microphone.

C. Paging:

1. The microprocessor based one way paging system shall be provided with a means to selectively and simultaneously activate voice, tones or digitized messages to any or all zones in the system via electronic membrane touchpad controls. In addition, visual indication by zone will be provided for zones selected.

2. Each audio/speaker circuit will be totally supervised for opens, shorts or grounds with direct shorts prohibiting selection of the respective zone.

3. All audio circuits shall be power limited per the latest UL and NEC Standards.

4. All speaker circuits shall be wired in parallel.

5. Each speaker zone shall be provided with an amber trouble LED for circuit trouble conditions and an active/on LED indicator.

6. Alarm/Paging zones shall be provided as follows:

a. One zone for each building level.

b. One zone for each elevator bank (to include all elevator cabs in respective bank).

c. One zone per suppression (Sapphire) hazard.

D. Communication Electronics:

1. The voice communications center shall be a microprocessor based, supervised, multi-function, audio generator. The communications generator shall contain:

a. Voice communications CPU.

b. Nonvolatile RAM memory.

c. Communications configuration dip switches.

d. Two custom digitized message circuits.

e. Up to four selectable tone generator/oscillators.

2. Each sub-circuit of the communications center shall be fully supervised and failure of any tone oscillator or digital message generator shall revert the system to the default standby generator. Any system/sub-system failure shall be indicated audibly and visually by a system trouble condition.

3. The system shall have the ability to provide any combination of standard digitized factory programmed messages, custom field programmable digitized messages, and/or alarm tones. Capability for multiple messages shall be standard with messages capable of being selected manually and/or via control-by-event program. Custom message programming shall be capable of being performed at the main fire alarm communications panel and without the need of special programming/recording apparatus or off site programming. Mechanical tape decks/drives shall not be deemed acceptable.

E. Amplifiers:

1. The system shall provide distributed amplification via the system remote transponders. The system shall be capable of amplifier expansion capacity as required.

2. Each amplifier shall be continuously monitored electronically for proper output level. Each amplifier shall be capable of being properly adjusted for correct output level.

3. Each unit shall be equipped with NORMAL level LED and ABNORMAL level LED diagnostic indicators.

4. Each amplifier shall provide 100 watts of 75 VRMS power and be capable of being assigned to one or more audible circuits.

5. Each unit shall be equipped with its own individual power/pilot LED, audio input trouble LED, battery input trouble LED, and amplifier trouble/fail LED. Any fault or trouble condition shall be annunciated audibly and visually via a system trouble condition.

6. The system shall provide automatic standby amplification for any amplifier in the system, with one spare amplifier per panel/transponder. Transfer from any faulty amplifier to the standby unit shall be fully automatic.

F. Alarm Tone: The fire alarm alert tone shall be a slow whoop tone with standby default tone in the event the primary oscillator fails. Transfer to default tone oscillator shall be automatic upon primary oscillator failure. Transfer to default tone shall also be automatic upon failure of any digitized voice message.

2.9 FIREFIGHTER'S TELEPHONE SYSTEM:

A. Shall not be required by University of Houston Fire Marshall (AHJ).

2.10 FIREFIGHTERS' HVAC OVERRIDE:

A. The emergency communications panel shall provide complete firefighters' manual control override and status for building smoke control systems and be integral to the main fire alarm control panel.

B. Each auxiliary function shall be capable of being activated or deactivated manually by selection of the respective circuit via the electronic touchpad controls. The system shall provide ability to shutdown or start designated emergency fans and have the ability to override and reverse any automatic start/ shutdown function. Each firefighters' auxiliary control circuit shall be supervised.

C. Each controlled fan and system shall incorporate a supervised "confirmed status" LED indicator. Status indicator shall be annunciated when the fan or system is in the "on mode".

D. All necessary interface between the fire alarm/communications system and firefighters' override controls shall be provided herein as required. The firefighters' override controls shall be completely interfaced with the building Control and Automation System. The firefighters' override system shall be wired as a low voltage 24 volt dc system.

E. Firefighters' HVAC override controls and confirmed status indicators shall be as follows:

1. Status indicators for each of the two stairwell pressurization fans. Status indication shall be from a dry contact in the fan starter.

2. On/Off/Auto control by unit for the outside air handling unit and each of the exhaust fans. Status indication shall be from a dry contact in the air handling unit starter.

3. Off/Auto control unlock all electrically secured doors. Status indication shall be provided from system software.

4. Close/Auto control to close all held open doors and fire/smoke shutters. Status indication shall be provided from system software.

2.11 REMOTE TRANSPONDER PANELS:

A. Remote transponder/control panels shall be distributed remotely throughout the facility as required. Transponders shall provide input/output interface between all field devices/equipment and main system CPU.

B. All functions of the transponder unit(s) shall be field-programmable via the main system CPU and incorporate nonvolatile RAM memory. Each unit shall be capable of operating independently in default mode should communication with the main CPU be disrupted. Transponders shall be capable of operating on the system SLC intelligent loop in conjunction with intelligent field devices.

C. The transponder shall include a resident microprocessor based CPU control module interfacing the main system CPU with respective I/O modules served by the resident/local CPU. The local CPU shall provide each transponder with common status indicators, pilot/status LED, common alarm LED, and common trouble LED. Each CPU module shall include local silence, reset, trouble display, lamp test, and reset capability. Each control module shall provide dual Form C common alarm and trouble contacts as well as a local alarm/trouble Piezo sounder.

D. Each transponder shall be capable of providing audio power supervision/annunciation, power supply supervision/annunciation, and supervision of

all associated I/O modules. Each transponder shall be field programmable for alarm verification. Selection of alarm verification shall provide each associated zone/ input module with the automatic ability to verify all smoke detector initiated alarm signals before initiating any event initiated output functions. The system shall have the ability to electronically differentiate between smoke detector alarms and contact/shorting device alarms and will NOT allow the verification sequence to occur from signals initiated from pull stations, flow switches, heat sensors, etc.

E. All transponder mapping/addressing shall be accomplished via the transponder CPU module.

F. Transponders shall be provided with zone initiation input modules as required. Each module shall provide eight Style B or four Style D initiating zone circuits. Each zone shall be capable of intermixing two-wire smoke detectors and contact type devices on the same circuit. Each zone shall assume a designated and distinct address I.D. within the system. The transponder shall monitor the status of each zone module and zone circuit for normal, alarm and trouble, and report any status or change thereof to the main system control panel/CPU. Each zone shall be equipped with status and trouble LED indication. Each zone shall be field programmable for alarm, water flow, supervisory, or non-alarm/status configuration.

G. Transponders shall be provided with zone alarm output modules as required. Each module shall provide eight Style Y or four Style Z indicating appliance circuits. Each indicating circuit shall be capable of being field programmed as conventional alarm, audio, and/or telephone circuits. Output circuits shall be power limited. Each output zone shall assume a designated and distinct address within the system and be field programmable for control by event actuation. The transponder shall monitor the status of each alarm output module and each associated circuit for normal, activation, and trouble, and report any status or change thereof to the main system control panel/CPU.

H. Each alarm output circuit/zone shall be field programmable for silenceable or nonsilenceable operation. Specified control circuits shall be supervised via alarm output circuits and shall be programmed for nonsilenceable operation.

I. Transponders shall be provided with auxiliary output/control relay modules as required. Each module shall be capable to provide eight SPDT (or four DPDT) field programmable output circuits. Output circuits shall be power limited. Each output shall be rated at 2 amps, 24 volts dc. Each circuit shall assume a designated and distinct address within the system and be field programmable for control by event actuation. Designated control circuits shall be provided with software assignable manual control switch as herein specified. The transponder shall monitor the status of each output module and associated circuit for normal, activated, and trouble conditions. Each circuit shall be equipped with an individual status LED indicator.

J. The power supply for the panel and all fire alarm peripherals shall be integral to the control panel. The power supply shall provide all control panel and peripheral power needs with filtered power as well as 3.0 amperes of unregulated 24 volt dc power for external audio/visual devices. The audio/visual power may be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all external signaling lines, including initiating circuits and indicating circuits. All circuitry shall be UL listed for power-limited application.

K. Input power shall be 120 volt ac, 60 Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide both positive and negative ground fault supervision, battery/charger fail condition, ac power fail indicators.

L. Transponder shall be housed in key-locked steel cabinet painted in baked enamel finish. Cabinet door shall provide transparent glass window for viewing transponder indicators and controls. Cabinets shall be provided with conduit knockouts on sides and top for versatility in installation. The cabinet(s) shall be capable of accommodating multiple transponder units in a single enclosure.

2.12 TRUE SITE WORKSTATION:

A. System shall be annunciated and controlled for the two existing True Site Workstations. Fire Alarm graphics will not be required per University of Houston Standards.

2.13 CATHODE RAY TUBE (CRT) DISPLAY/KEYBOARDS:

A. Will not be required.

2.14 PRINTERS:

A. Will not be required.

2.15 REMOTE ANNUNCIATORS:

A. Will not be required, except where shown on plans. Main fire panel will serve as the building primary annunciator.

B. Graphic Annunciator:

1. Will not be required.

2.16 SMOKE AND HEAT SENSORS/DETECTORS

A. Intelligent "Ceiling-mounted" Photoelectric Smoke Sensors: Analog photoelectric smoke sensors shall be provided where indicated on the Drawings.

1. The intelligent photoelectric smoke sensors shall connect via two wires to one of the intelligent control panel loops.

2. The sensors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

3. The sensor shall also provide a "Near Dirty" and “Dirty” feature whereby the detector shall initiate a trouble condition should the units sensitivity approach the outside limits of the normal sensitivity window.

4. The sensor shall be provided with extensive RF and EMF noise reduction circuitry.

5. The sensor shall employ sophisticated self-compensating solid state LED light source and photosensitive circuitry.

6. The sensor/control panel shall provide a calibrated test method whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic test switch, or may be activated remotely on command from the control panel.

7. The sensors shall provide address-setting means on the sensor base using binary DIP switches. The sensors shall also store an internal identification code which the control panel shall use to identify the type of sensor.

8. The sensors shall provide an alarm and power/status LED. Status LED shall flash under normal conditions, indicating that the sensor is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has

been detected and verified. The detector shall be capable of allowing an output connection shall be provided in the base for connecting an external remote alarm LED.

9. The sensor shall be flush ceiling-mounted and be provided with modular detector head with twist-lock base. Sensors shall also be suitable for surface-mounting below the raised floor or above the ceiling. Sensors shall be provided in smooth attractive white finish, and sealed against dirt, vermin, and back pressure. Sensors shall be provided with fine mesh insect/contaminate screen.

10. Sensors shall be UL listed with respective control panel.

B. Intelligent "Duct Mounted" Photoelectric Smoke Sensors: Duct-mounted intelligent photoelectric smoke sensor shall be provided where shown on the Drawings.

1. Sensors shall operate on the same principles and exhibit the same basic characteristics as area type "intelligent" smoke sensors. The unit shall be capable of interchanging/accepting either photoelectronic or ionization type sensors.

2. The sensor shall operate in air velocities of 300 FPM to 4,000 FPM without adverse effects in detector sensitivity.

3. Each sensor shall operate directly with the intelligent control panel loop, without an interface module.

4. The unit shall consist of a molded plastic enclosure with molded integral conduit knock-outs. The unit shall be provided with clear faceplate cover to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to provide proper sealing of housing to mechanical ductwork and to ensure proper air flow into the detector sampling chamber. Duct housing shall be designed to easily mount to rectangular or round ducts. Where duct detectors are mounted in a location not easily accessed, provide a remote alarm test switch and LED in an accessible location.

5. The duct sensor unit shall be UL listed to the most current UL 268A standard and be cross-listed for use with the fire alarm control panel.

6. Each duct sensor unit shall be equipped with sampling tubes protruding into the associated ductwork. Sampling tubes shall extend the width of the duct. Sampling tubes shall be provided with integral porosity filter system to aid in reducing detector contamination. Sensors shall be installed per NFPA 90A.

7. Each sampling tube will be supported on both ends.

C. Intelligent Ceiling Mounted Heat Sensors: Analog thermal sensors shall be provided where indicated on the Drawings.

1. The intelligent thermal sensors shall connect via two wires to one of the intelligent control panel loops.

2. The sensors shall use dual electronic thermostats to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.

3. The sensors/control panel shall provide a test method whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the sensor itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

4. The sensors shall provide address-setting means on the sensor base using binary DIP switches. The sensors shall also store an internal identification code which the control panel shall use to identify the type of detector.

5. The sensors shall provide am alarm and power/status LED. Status LEDs shall flash under normal conditions, indicating that the sensor is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. The detector shall be capable of allowing an output connection shall be provided in the base for connecting an external remote alarm LED.

6. The sensor shall be semi-flush ceiling-mounted and be provided with modular detector head with twist-lock base. Sensors shall be provided in smooth white finish.

D. Optical beam smoke detectors and an addressable input device shall be provided where indicated on the Drawings.

1. Detectors shall consist of a control unit, an infra-red transmitter unit and an infra-red receiver unit. Detector shall be powered at 24 VDC from the fire alarm system.

2. Detector shall have a self-check and automatic compensation circuit to compensate for dust accumulation, component aging and temperature change.

3. Detectors shall be installed to project a beam approximately 1 foot below the ceiling in the projected area and shall alarm when smoke in the beam path reduces the signal strength to between 40 and 93 percent for period of 5 seconds.

4. The detector shall remain in an alarm condition until reset.

2.17 MANUAL STATIONS:

A. Addressable Manual Stations: Flush mounted dual action manual stations with an addressable interface module or approved equal shall be provided where indicated on the Drawings.

1. Manual stations shall be an alternate color to the wall color they are installed on, for easy identification.

2. The manual station addressable module shall connect with two wires to one of the intelligent control panel loops.

3. The module at the manual station shall, on command from the control panel, send data to the panel representing the state of the manual station switch.

4. The manual station addressable module shall provide address-setting means using binary DIP switches.

5. All pull stations will require a UL and ADA listed pull station cover with integral piezo alarm.

2.18 INPUT/OUTPUT DEVICES:

A. Monitor Module (Addressable input Device): Addressable monitor modules shall be provided where required to interface to contact alarm devices.

1. The monitor module shall be used to connect a supervised zone of conventional initiating devices (any N.O. dry contact device, including 4 wire smoke detectors) to an intelligent loop.

2. The monitor module will mount in a 4" square electrical box.

3. The monitor module shall provide address-setting means using a binary DIP switch.

B. Control Module (Addressable Output Device): Control/relay modules shall be provided where required to provide audible alarm interface and/or relay control interface.

1. The control module shall be used to connect a supervised zone of conventional indicating devices (any 24 volt polarized audiovisual indicating appliance) to an intelligent loop. The zone may be wired Class A or Class B field-selected. The control module may be optionally-wired as dry contact (Form C) relay.

2. The control module will mount in a standard 4" electrical box.

3. Power for the relay actuation shall be provided by the intelligent detector loop to reduce wiring connection requirements. Audio/visual power shall be provided by a separate loop from the main control panel or from supervised remote power supplies.

4. The control module shall provide address-setting means using a binary DIP switch.

C. Auxiliary Control Relays: Relays shall be provided for control interface. Relays shall be heavy duty type and rated up to 20 amps at 120 volts ac, 60 Hz. Relays shall be provided with NEMA 1 dust cover assembly and be provided with DPDT contacts.

D. Sprinkler Water Flow and Pressure Switches: Switches shall be furnished and installed under Division 15, with wiring and addressable input device interface by this Contractor.

E. Fire Protection OS&Y Valve Supervisory Switches: Switches shall be furnished and installed under Division 15, with wiring and addressable input device interface by this Contractor. Switches shall activate a supervisory signal within two turns of the valve or more than 1/3 of the valve travel toward the closed position.

F. Fire Suppression System Panel shall be a networked fire alarm control panel that will reside on the existing fire alarm network and share point information and control with the True Site Workstations and any panel on network.

G. Fire Pump Controllers: Dry alarm and trouble output contacts shall be provided in the Fire Pump Controllers furnished and installed under Division 15, with wiring and addressable input device interface by this Contractor.

H. Elevator Recall: Addressable fire alarm system dry output contacts installed by this Contractor shall provide a recall signal to the elevators furnished and installed under Division 14.

I. Security/Access Control Interface: Addressable fire alarm system dry output contacts installed by this Contractor shall provide an unlock signal to the Security/Access Control system furnished and installed under Division 11.

J. Magnetic Door Holders: Low profile 24 volt wall or floor mounted electromagnetic door hold opens as required to suit installation requirements. Magnetic door hold opens shall be powered from the fire alarm system.

K. Fire/Smoke Shutter Interface: Addressable fire alarm system N.C. dry output contacts installed by this contractor shall provide a hold open signal to fire/smoke shutters and release controls provided under another Division.

L. Fire Command Center Electric Strikes: Addressable fire alarm system N.C. dry output contacts installed by this contractor shall provide a hold locked signal to electric strikes provided under another Division.

M. Smoke Control/HVAC Interface: Addressable fire alarm system dry output contacts installed by this Contractor shall provide equipment positive start and stop signals for Firefighters' Override, stop signals for equipment shutdown and start signals for smoke control made initiation and equipment start up to the Building Control and Automation System furnished and installed under Division 15, as applicable. Addressable control relays and inputs shall be located within 2 feet of the controlled/monitored device.

2.19 ALARM SIGNAL DEVICES:

A. Ceiling Mounted Fire Alarm Speakers in Finished Areas: Flush mounted fire alarm speakers shall be provided.

1. Speakers shall be listed under UL Standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.

2. Speakers shall be 4" round with textured white decorative metal grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10'.

3. Speakers shall be ceiling mounted and located as required by Section 403 of the international Building Code and as located on the drawings. .

B. Ceiling Mounted Fire Alarm Speakers/Visual Signals in Finished Areas: Flush mounted fire alarm speakers with integral visual alarm signals or equal shall be provided.

1. Speakers shall be listed under UL Standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.

2. Speakers shall be 4" round with textured white decorative metal grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10'.

3. Speakers shall be ceiling mounted and located as required by Section 403 of the international Building Code, and as located on the drawings.

4. Visual alarm signals shall be integral with audible alarm device where shown on the drawings. Strobe lettering shall be oriented with lettering properly oriented with letters vertical, with strobe unit installed.

5. Visual units shall be of the electronic flashing xenon strobe type and operate on 24 volts dc. Lights shall operate in unison with audible alarm signals and continue flashing upon silencing of alarm signals.

6. Visual shall be synchronized.

C. Wall Mounted Fire Alarm Speakers/Visual Signals in Unfinished Areas: Recess/surface mounted fire alarm speakers with integral visual signals or equal shall be provided.

1. Speakers shall be listed under UL Standard 1480, meet all specifications of the Life Safety Code and be capable of reproducing both tone alerts and voice communication instructions. Speakers shall have built in matching transformer, field selectable multiple power taps and circuitry for speaker/line supervision. Speakers shall be provided with screw terminal connection points.
2. Speakers shall be 4" round with textured white decorative metal grill. Speakers shall be tapped to produce a minimum sound-pressure level of 87 dBA at 10'.
3. Speakers shall be ceiling mounted and located as required by Section 1807 of the Uniform Building Code and as located on the Drawings.
4. Visual alarm signals shall be integral with audible alarm device where shown on the Drawings. Strobe lettering shall be oriented with lettering properly oriented with letters vertical, with strobe unit installed.
5. Visual units shall be of the electronic flashing xenon strobe type and operate on 24 volts dc. Lights shall operate in unison with audible alarm signals and continue flashing upon silencing of alarm signals.
6. Visual shall be synchronized.

2.20 FIRE ALARM POWER BOOSTERS:

A. Provide power boosters as required. Power to be provided from emergency panel located on each floor in mechanical or electrical rooms.

2.21 SYSTEM WIRING:

A. The equipment supplier shall furnish to the installing contractor a complete detailed point-to-point wiring diagram showing the system equipment and required number, type and sizes of conductors and conduit sizes. Where common devices which break the alarm circuit are installed on a common zone with shorting type device, the circuit breaking devices shall be wired electrically downstream of the shorting type devices.

B. All fire alarm system wiring shall be multi-conductor, UL listed FPL for limited energy (300 volt) and fire alarm applications, and NEC approved fire alarm cable. Wiring shall be installed in accordance with NEC, local codes, Article 760 of NFPA Standard 70, and manufacturer's recommendations. All wiring shall be copper and installed in conduit sized in accordance with the National Electrical Codes.

C. Fire alarm system wiring shall be color coded.

D. All fire alarm system junction boxes including covers, shall be secured, painted red and marked in white lettering as specified in Section 16100.

E. Wire size shall be determined by calculated voltage drop and circuit loading. Minimum wire size shall be as follows:

1. #18 AWG twisted and shielded for data and communications circuits.
2. #18 AWG for non-data and communications initiating and low voltage auxiliary control circuits.
3. #16 AWG twisted for alarm circuits.
4. #14 AWG for all power circuits.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Installer shall examine the areas and conditions under which the fire alarm system is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 SYSTEM DESIGN:

A. General: The basic equipment and device locations have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor's responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.

3.3 PROGRAMMING:

A. General: The manufacturer shall provide and install a menu driven software package, and shall provide all required programming of the system, including digitized voice alarms, graphics and action messages. Map and report formatting will be part of the software package. The software programming shall provide clear decision-making displays and text during critical alarm conditions that will allow the operator to make simple decisions during a crisis.

B. Review: Before the manufacturer loads the program the Owner shall be given the opportunity to review and approve all textural displays, messages and system sequences.

3.4 INSTALLATION:

A. General: Install system and materials in accordance with manufacturer's instructions, roughing-in drawings, and details on the Drawings. Install electrical work and use electrical products complying with the requirements of the applicable Division 16 sections of these Specifications. Mount manual stations and alarm devices at heights specified in Section 16100, "Basic Materials and Methods".

B. Wiring: All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and Article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

1. Install fire alarm system line voltage and low-voltage wiring in a suitable raceway. Conceal fire alarm system conduit except in mechanical rooms and areas where other conduit and piping are exposed. Fasten flexible conductors, which bridge cabinets and doors, neatly along hinge side and protect against abrasion. Tie and support the conductors neatly.

2. All wiring shall be run in a supervised fashion (i.e. no branch wiring or dog-legged wiring) per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and UL requirements. Intelligent SLC loops may be T-tapped/branch wired due to inherent dynamic supervision.

3. Wiring splices shall be kept to a minimum with required splices to be made in designated terminal boxes or at field device junction boxes. Transposing or color code changes of wiring will not be permitted. End-of-line supervisory devices shall be installed with the last device on the respective circuit. Said device shall be appropriately marked designating it as the terminating device on the respective circuit.

4. No AC wiring or any other wiring shall be run in the same conduit as fire alarm wiring.

5. Number code and color code conductors appropriately and permanently for future identification and servicing of the system.

C. Conduit/Raceway: All wire shall not be required to be installed in an approved conduit/raceway system (except where excluded by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

1. Conduit and raceway system shall be installed, where required, as specified other Sections of the Specifications.

2. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

3. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/ conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required. All vertical risers shall be installed in 2 hour rated chases.

D. Labeling: All system controls, indicators and other devices shall be labeled with names, designations and operating instructions as applicable. Labels shall be either engraved nameplates or covered printed labels and shall be approved by the Engineer. All water flow switches which are hidden shall have identification points. These identification points shall be red tags with white lettering indicating location of the water flow switch. Tag location will be visible from corridors.

E. Checkout: Check wiring to ensure that wiring is in accordance with the system manufacturer's wiring diagrams and that the system is free of open circuits, short circuits, and grounds.

F. Identification: Refer to Section 16100 for additional requirements concerning painting, nameplates, and labeling.

3.5 COORDINATION:

A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with all trades. Adequate coordination shall be provided to ensure proper installation and interface to all peripheral items required to interact with the fire alarm to provide a complete and functional life safety system.

B. The installing contractor shall be fully responsible for coordinating all system and device messages and system operation with the Owner's Representatives and Operating Personnel.

3.6 SYSTEM CHECKOUT AND TEST:

A. All final control panel connections shall be made by a state licensed, factory-trained technical representative of the manufacturer and who shall supervise a System Checkout and Test to demonstrate and confirm to the Engineer, Owner's Representative and the fire department, that the fire alarm system is 100% operational upon completion of the installation, and that it complies with all local code requirements and these specifications. It is intended that the System Checkout and Test be followed by a continuing program of inspection testing and maintenance. The Contractor shall provide a proposal to the Owner for a Maintenance, Inspection and Quarterly Testing Contract in compliance with NFPA 72H, upon completion and system checkout.

B. The System Checkout and Test shall be performed within 30 days after the fire alarm installation and all peripheral systems are completed. The System Checkout and Test shall be performed by a minimum of two licensed fire alarm system technicians, one of which is licensed by the State of Texas, and acceptable to the Engineer and

the authority having jurisdiction. The test shall be performed in two parts and two-way radios for use by the test observers shall be provided. The first part shall be a full dry-run test with all subcontractors present, but without the Owner's Representative or fire department present. After the dry-run test is successfully completed, then the final test with the Owner's Representative and fire department present shall be performed.

C. This Contractor shall coordinate the test schedule with all necessary parties and subcontractors required to be present for a complete and functional test.

D. The System Checkout and Test which is a comprehensive 100% inspection and test of all fire alarm system equipment and shall include, but not be limited to the following:

1. Fire Alarm Control Equipment:
    a. A visual and functional test of all fire alarm control and auxiliary control equipment.
    b. A visual inspection shall be conducted to establish that all electrical connections and equipment as required are properly installed and operating.
    c. A remote functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that all wiring is properly supervised as required.
    d. All indicators shall be tested to ensure proper function and operation.
    e. All device messages shall be verified to be correct, as installed.
    f. All system auxiliary functions including, but not limited to, CPU reporting, elevator recall, fire/ smoke door and shutter control, security interface, HVAC equipment control and shutdown, smoke control initiation, and other specified control functions shall be functionally tested to verify proper operation and proper system messages.
    g. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A 3 minute general alarm stress test both under ac power and standby power shall be conducted to further ensure complete operation of the system.
    h. The Voice Communication System shall be visually and functionally tested to verify proper operation. Voice paging zoning shall be verified and automatic and manual operation of the voice paging system shall be fully verified. Self-monitoring functions of the voice paging system shall be verified.
    i. An intelligibility test shall be conducted with the ADS (acoustically distinguishable space) designated by the AHJ.
    j. The firefighters' HVAC system override panel shall be 100% functionally tested to verify that all control switches and indicators function as specified.
2. Fire Alarm Peripheral Devices: All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
3. Initiating Devices (Manual and Automatic):
    a. All manual and automatic initiating devices shall be inspected to ensure proper placement and mounting as recommended by the manufacturer and as indicated in these specifications.

b. All manual fire alarm stations and all automatic initiating devices (smoke detectors, heat detectors, water flow switches, etc.) shall be functionally tested for alarm operation.

c. A minimum of 10% of initiating devices shall be functionally tested for proper wiring supervision. Failure of any tested device on any zone shall require that all devices in that zone shall be tested for supervision.

d. All device messages shall be verified to be correct as installed.

4. Alarm Signaling Devices:

a. All visual alarm indicators and exit sign flashing shall be functionally tested to ensure proper operation and that they are clearly visible.

b. Alarm signaling devices shall be field-checked and tested for proper operation and output.

c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility, if required by the authority having jurisdiction. Additional devices may be required to provide adequate sound penetration (or as required by the local authority having jurisdiction). Contractor shall provide a unit price for such devices should they be required.

d. An intelligibility test shall be conducted to ensure the alarm message can be clearly heard in all areas of the facility. The ADS (acoustically distinguishable space) shall be designated by the authority having jurisdiction.

e. A minimum of 10% of the alarm signaling device shall be functionally tested for proper wiring supervision.

5. Reporting:

a. Upon completion of the 100% System Checkout and Test, four copies of the final report shall be documented, certified, and sent to the Engineer for distribution to the Owner or authorized Owner's Representative indicating that all fire alarm equipment has been tested and is 100% operational.

b. The final report shall be generated by the equipment manufacturers headquarters or authorized representative to ensure integrity and uniformity of all testing procedures and reporting. The report shall contain the testing information, stating the precise location and operational status of each and every peripheral device and shall include a Fire Alarm System Certification and Description Document per NFPA 72.

c. The 100% System Checkout and Test shall be performed by factory-trained representatives, and one of the individuals shall possess a state license for fire alarm installation supervision.

3.7 TRAINING:

A. Upon completion of the installation, the equipment manufacturer shall furnish his services for a period of 8 hours of demonstration and training in the use of the system and its connected equipment. The 8 hour training period shall consist of operations and trouble shooting and technical trouble shooting of the fire alarm panel and system. All training shall be provided at the site.

3.8 AS-BUILT/RECORD DRAWINGS:

A. Two sets of manuals and as-built drawings shall be provided by the Contractor. The as-built drawings shall include a reproducible drawing and two copies of each as-built drawing. The drawings and manuals shall be used in the training sessions. At this

time, manuals describing the system equipment, as-built wiring diagrams, system keys, and certification of a 100% system audit will be delivered to the Owner. Record drawings shall include, but not be limited to:

1. As-built wiring and conduit layout diagrams incorporating wire color code and/or label numbers and showing all interconnections in the system.
2. Actual locations of each input and output circuit termination, the identification marking of each circuit and the address of each device. Provide an input/output assignment chart. A unique identification number shall be assigned to each alarm initiating device. Identification should be by zone number permanently mounted adjacent to the device or its mounting base. Markings with felt tip pens will not be acceptable.
3. As-built schematic wiring diagrams of all control panels, modules, annunciators and communications panels.
4. As-built heat and smoke detector location drawings showing location dimension of each detector and alarm box.
5. Copies of the manufacturers technical literature on all major parts of the system including detectors, manual stations, signaling appliances, alarm panels. communication panels and equipment and power supplies.
6. Completed Fire Alarm System Certification and Description Document.

B. Refer to Section 26 01 00 for additional As-Built/Record Drawings requirements.

3.9 OPERATING AND MAINTENANCE DATA:

A. The manufacturer's authorized representative shall instruct the Owner's designated employees in the proper operation of the system and all required periodic maintenance. This instruction will include three copies of a written summary in booklet or binder form so employees can retain for future reference. Basic operating instructions for the system shall be framed and mounted at the main control unit. Refer to section 26 01 00 for additional requirements.

3.10 WARRANTY:

A. The fire alarm and security systems shall be warranted against defects in workmanship and materials, under normal use and service, for a period of 2 years from the date of acceptance by the Owner. Any equipment shown to be defective shall be repaired, replaced or adjusted free of charge.

B. The warranty period shall begin after successful completion of the Owner's inspections and tests. In the event of any system malfunctions or nuisance alarms, the Contractor will take appropriate corrective action. This action may necessitate a repeat of the response test if the Owner so desires. Continued improper performance during warranty shall be cause to require the Contractor to remove the system.

C. The warranty start date will not begin until after a period of 30 consecutive days of system operation without any nuisance alarms caused by malfunctioning of hardware of software.

END OF SECTION 28 31 00