SECTION 281111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, and material as herein specified.

B. This section requires the Contractor to furnish all materials required to install the fire alarm system. The Contractor shall be responsible for installing, testing, and start-up of a complete functioning fire alarm system, and each element thereof, as specified or indicated on the Drawings or reasonably inferred, including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's function as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation and utilities. Installation of devices shall be performed or supervised by a National Institute for Certification of Engineering Technologies (NICET) Level 2 or higher Fire Alarm Technician. Submit copies of the certification for employees through shop drawing submittals.

C. All fire alarm system components shall include addressable field devices, and multiplexed, programmable, operator interface panels.

D. The scope of work in this section includes:

1. Fire alarm control panels.
2. Remote annunciator panels.
3. Manual fire alarm pull stations.
4. Automatic smoke and heat detectors.
5. Fire alarm notification appliances.
6. Auxiliary fire alarm equipment.
7. Activation and powering of combination fire and smoke dampers.
8. Sprinkler system waterflow and valve tamper alarms.
9. Air handling unit shutdown.
10. Door holder release.
11. Elevator recall.
12. Battery stand-by power.

E. Where coordination and interfacing with other systems or equipment is required, it shall be the responsibility of the fire alarm system installer (contractor) to either provide the relays, contacts, power supplies and other necessary hardware or see to it that such hardware is provided with the other systems or equipment.

1.2 RELATED WORK IN OTHER SECTIONS

A. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire alarm system shall include, but not be limited to:

1. Sprinkler waterflow and valve tamper switches shall be provided by the fire sprinkler installer, but wired and connected by the fire alarm installer.
2. Duct smoke detectors shall be furnished, wired and connected by the fire alarm system installer. The HVAC installer shall furnish necessary duct opening to install the duct smoke detector's housing.
3. Air handling fan control circuits and contacts to be furnished by the HVAC control equipment.
4. Conduit shall be by Division 26 "Common Work Results for Electrical".

1.3 APPLICABLE CODES AND STANDARDS

A. Provide an integrated fire alarm system, which meets the codes and standards cited below and applicable local building and fire codes. All fire alarm equipment shall be Underwriters Laboratory (UL) and Factory Mutual (FM) approved for the type and class of service performed.

1. NFPA 70 – National Electrical Code, 2002 Edition
2. NFPA 72 – National Fire Alarm Code, 2002 Edition
3. UL 864 – Control Units for Fire Protective Signaling Systems, 9th Edition
4. ULOJZ – Control Unit Systems
5. UL 268 – Smoke Detectors for Fire Protective Signaling Systems
6. UL 268A – Smoke Detectors for Duct Applications
7. UL 521 – Heat Detectors for Fire Protective Signaling Systems
8. UL 464 – Audible Signal Appliances
9. UL 38 – Manual Signaling Boxes for Fire Alarm Systems
10. UL 346 – Waterflow Indicators for Fire Protective Signaling Systems
11. UL 1971 – Signaling Devices for the Hearing Impaired
12. UL 1480 – Speakers for Fire Protection Signaling Systems
13. UL 1481 – Power Supplies for Fire Protective Signaling Systems
14. UL 1711 – Amplifiers for Fire Protective Signaling Systems
15. UL 1635 – Digital Alarm Communicator System Units
16. NFPA 90A – Installation of Air Conditioning and Ventilating Systems, 1999 Edition
17. IBC 2006 Edition with local amendments.
18. IFC 2006 Edition with local amendments.
19. ASME A17.1 – Safety Code for Elevators and Escalators, 2003 Edition

1.4 SYSTEM DESCRIPTION

A. The fire alarm system shall be a non-coded manual and automatic fire alarm system with connections to a remote supervising station. Control panel shall be micro-processor based, with fully addressable alarm devices.

1.5 SUBMITTALS

A. **Reference specification section 260010, GENERAL ELECTRICAL REQUIREMENTS for general shop drawing submittal requirements. Also comply with the submittal requirements stated in this specification section. Submittals not complying fully with the submittal requirements of section 260010 and this section will be rejected.**

B. Submit a Description of Operation that explains in detail the specific methods the submitted fire alarm system functions. Pre-printed, generic material will not be accepted and will be rejected.

C. Shop Drawings:

1. The fire alarm system equipment vendor shall provide shop drawings showing fire alarm floor plans and a full building riser diagram. Fire alarm floor plans and riser diagram shall show fire alarm control panel, annunciator, all fire alarm initiating devices and notification appliances. Show typical wiring diagrams of control panel/s, annunciator and each device and wiring connections required. Show all interfaces to other systems, such as temperature control systems, and security systems.
2. Shop drawing scale shall match the Engineer's drawings where possible. Scale shall not be less than 3/16" = 1'-0".
3. The fire alarm floor plans and riser diagram shall show wiring to all fire alarm devices/appliances, indicating wire sizes and quantities as well as conduit/raceway sizes and locations of end-of-line (EOL) resistors. The fire alarm floor plans and riser diagram shall clearly show the routing of all fire alarm system wiring, including all horizontal routing and vertical routing (in chases). Routing of all fire alarm wiring shall comply with the "Survivability" requirements of NFPA 72.
4. The fire alarm floor plans shall also contain a Bill of Materials and a Sequence of Operations Matrix that explains how the submitted fire alarm system functions.

D. Product Data: Provide product cutsheets showing material specifications, electrical characteristics and connection requirements.

E. NICET certification information referred to in Section 1.1.B this section.

F. Test Reports: Indicate satisfactory completion of required tests and inspections.

G. Indicate within the submittal all applicable UL listings and all applicable approvals or certifications.

H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.6 PROJECT RECORD DOCUMENTS

A. The fire alarm equipment vendor shall submit As-Built fire alarm drawings per the General and Supplemental Conditions. The Contractor shall be responsible for providing as-built field changes recorded on a set of blue prints to the fire alarm equipment vendor for inclusion in the Record Drawings.

B. The record drawings shall show actual locations of initiating devices, notification appliances, and end-of-line devices. Show the approximate location, size and type of all wiring and routing of wiring. Drawings should also include one-line riser diagrams showing all devices.

C. The Contractor and fire alarm equipment vendor shall sign-off on the Record Drawings as being an accurate representation of the completed installation.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of the General and Supplemental Conditions.

B. Operation Data: Operating instructions.

C. Maintenance Data: Maintenance and repair procedures.

D. Include in the O&M manual a copy of the service representative's contact list with all applicable phone and pager numbers.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in installing the products specified in this section with minimum three years documented experience. Shall be bondable and licensed Contractor and employ full-time factory-trained and certified installers and technicians. Installers shall provide with the fire alarm submittal proof of factory training for each installer.

C. Final checkout and verification: Shall be conducted by a technician certified by the National Institute for Certification in Engineering Technologies (NICET) registered as level 2 or higher in the fire protection technology certification program. Provide certification information with fire alarm submittal.

D. The equipment manufacturer's service department shall be fully stocked in standard parts and components and engaged in the maintenance of fire alarm systems. On-the-premises service shall be available within 4 hours of notification, 7 days a week, 24 hours a day.

1.9 SERVICE AND GUARANTEE

A. Furnish service and maintenance of fire alarm system including wiring and raceways for one year from date of substantial completion.

B. All components, system software, parts and assemblies shall be guaranteed against defects in materials and workmanship for the one-year period stated above.

C. Labor (including travel expenses) to trouble-shoot, repair, reprogram, or replace components shall be furnished by this contractor at no charge during the warranty period.

D. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks.

1.10 EXTRA MATERIALS

A. Provide 10% of the total or a minimum of one (1) manual pull station.

B. Provide 10% of the total or a minimum of two (2) of each type of automatic smoke detector.

C. Provide 5% of the total or a minimum of one (1) of each type of automatic heat detector.

D. Provide 5% of the total or a minimum of two (2) of each strobe type and candela rating.

E. Provide 5% of the total or a minimum of two (2) of each speaker type. Combination speaker/strobe units matching the units installed are acceptable.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products manufactured by the following manufacturers as indicated on the Drawings:

1. Notifier
2. Siemens-Cerberus Division.
3. Edwards System Technology.
4. Silent Knight
5. Gamewell-FCI
6. Approved Equal
   a. Approved equals will not be considered unless formally submitted during the bidding process as an RFI.

2.2 FIRE ALARM SYSTEM CONTROL PANEL

A. The Fire Alarm System shall be a microprocessor-based system designed specifically for Fire applications. The System shall be shall be UL listed under Standards 864 (Control Units for Fire-Protective Signaling Systems). Modular construction with a surface mounted enclosure.

B. Remote Annunciator: Provide supervised remote annunciator(s) where shown on the plans, including audible and visible indication of fire alarm by address, and audible and visible indication of system trouble and supervisory. Install in flush mounted enclosure.

C. Power supply: Provide two separate and reliable power supplies. The control panel shall receive 120 VAC power via a dedicated fused disconnect circuit of the building's electrical system. Each shall have adequate capacity for the system. The fire alarm contractor shall submit battery calculations for review and approval. The calculations shall indicate each device and the load required in stand-by and alarm mode. The secondary power system shall be a battery-operated emergency power supply and charger with capacity for operating system in standby mode for 24hours followed by alarm mode for 15 minutes.

D. System Supervision: Automatically detects and reports open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification appliance circuits. Alarm, supervisory and trouble signals shall be monitored by the supervising station over a Digital Alarm Communicator Transmitter (DACT), or other approved method.

E. Initiating Device Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the style and class of the circuitry selected. Initiating device circuits shall be Class B, Style B.

F. Notification Appliance Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the style and class of the circuitry selected. Notification appliance circuits shall be Class B, Style Y.

G. Signaling Line Circuits: Provide circuitry, which meets the performance requirements during abnormal conditions, based upon the style and class of the circuitry selected. Signaling line circuitry shall be Class B, Style 4.

H. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified.

I. Digital Alarm Communicator Transmitter: Electrically supervised, capable of transmitting alarm, supervisory and trouble signals over telephone lines to remote station receiver.

J. Provide TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE switch.

K. Control Panel: The control panel and remote annunciator panel shall have dedicated alarm, supervisory and trouble LED's and dedicated alarm, supervisory and trouble acknowledge switches.

L. Lamp Test: Manual lamp test function causes each LED to function at fire alarm control panel.

M. Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.

N. Addressable systems shall have Silent Walk Test, History logging for a minimum of 400 events, 80 character LCD display.

O. Voice Communication: The system shall incorporate one-way voice communication via specified speakers. A central audible module shall provide for the necessary alarm message/tone generation, main and remote microphone connections and mixers/pre-amplifier circuits. Continuous supervision shall be provided along with specific information as to the type of failure (main microphone trouble, tone trouble, etc.) The following functions shall be provided at the fire alarm control panel.

1. Hand held push to talk, noise canceling microphone in recessed protective panel mounted enclosure; 5 feet coiled cable; and LED to indicate the microphone push to talk has been pressed.
2. Audible control switch module: Switches shall include "all circuits", "aux tone 1", "aux tone 2", "tone stop switch", "audible trouble reset"; and these switches shall be supervised.
3. Audible power amplifiers shall be self filtered; contain 24 volt power supply, transformer and amplifier monitor circuits; provide 70 volt RMS output with frequency response of 120 HZ to 12,000 HZ. Amplifier shall operate all system speakers plus twenty-five (25) percent spare capacity.
4. Audible supervision for open, short, or ground fault shall be provided with a distinct and individual trouble indication for each fault.
5. Digitized voice messages are required to notify building occupants during alarm conditions. Message player shall not rely on tape or mechanical means of transmitting the voice message. A standard evacuation message shall be provided; however, the system shall be capable of transmitting a custom message of up to five (5) minutes long.
6. Alarm sequence shall consist of a temporal (3) alarm tone for a maximum of 15 seconds followed by a automatic pre-selected message. At the end of the message the tone shall resume. This sequence shall continue until the fire alarm control panel has been silenced. Manual voice paging shall be available via panel switches to page individual floors or groups of floors. Each floor shall be an individual audible zone and have a corresponding audible switch.

2.3 SEQUENCE OF OPERATIONS

A. Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:

1. Visible and audible trouble alarm indicated at fire alarm control panel.
2. Visible and audible trouble alarm indicated at remote annunciator panel, if provided.

3. Trouble signal transmitted to supervising station.
4. Manual acknowledge function at fire alarm control panel silences audible trouble alarm; visible alarm is displayed until initiating failure or circuit trouble is cleared.

B. Supervisory Sequence of Operation: The activation of any sprinkler valve tamper switch or duct-mounted smoke detector places system in supervisory mode, which causes the following system operations:

1. Visible and audible supervisory alarm indicated by address at fire alarm control panel.
2. Visible and audible supervisory alarm indicated by address at remote annunciator panel, if provided.
3. Supervisory signal transmitted to supervising station.
4. Duct-mounted smoke detectors shall shutdown their respective unit upon detection of smoke and remain down until manually reset.
5. Manual acknowledge function at fire alarm control panel and remote annunciator panel silences audible supervisory alarm; visible alarm is displayed until device is returned to its normal position/supervisory condition is cleared.

C. Alarm Sequence of Operation: Actuation of an alarm initiating device places circuit in alarm mode, which causes the following system operations.

1. Audible notification appliances shall sound until silenced by the alarm silence switch at the control panel.
2. All visible alarm notification appliances shall display a continuous synchronized pattern until reset by the Alarm Reset Switch.
3. Alarm signal transmitted to supervising station.
4. All air-handling systems that are monitored shall shutdown and remain down until the fire alarm control panel is reset.
5. The alarm LED shall flash on the control panel and remote annunciator panel until the alarm has been acknowledged at the control panel/remote annunciator panel. Once acknowledged, this same LED shall latch on and the custom label for the address in alarm shall be displayed on the alphanumeric LCD readout. A subsequent alarm received from another address after acknowledged shall flash the alarm LED on the control panel showing the new alarm information.
6. A pulsing alarm tone shall occur within the control panel until acknowledged.

D. Activation of an Elevator Lobby or Elevator Machine Room smoke detector shall place the system in alarm mode and shall initiate Phase I elevator recall per ASME A17.1. Provide output signals and logic as required by code and by the elevator system supplier and installer.

2.4 INITIATING DEVICES

A. Manual Pull Station: Provide semi-flush, non-coded type, double action manual pull station.

B. Spot Smoke Detector (Photoelectric type): Device shall have visible indication of detector actuation, self-restoring, plug-in with an integral addressable module indicating the detector status. Photoelectric detectors shall have sensitivity between 0.5 and 3.5 percent/foot smoke obscuration.

C. Heat Detector –Combination Type: The device shall be actuated by a fixed temperature alarm point rating of 135 degree F and/or a rate of rise of temperature that exceeds 15 degree F per minute. The base shall be plug-in with an integral addressable module indicating the detector status.

D. Duct Mounted Smoke Detector: Photoelectric detector along with a standard, relay or isolator detector mounting base. Provide for variations in duct air velocity between 100 and 4000 feet per minute. Protect the measuring chamber from damage and insects. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. Provide drilling templates and gaskets to facilitate locating and mounting the housing. Provide remote alarm LEDs and remote test stations as shown on the plans.

2.5 NOTIFICATION APPLIANCES

A. Alarm Horn: Flush type fire alarm horn. Sound rating: 87 dB at 10 feet.

B. Alarm Speakers: Speaker shall be UL 1480 listed; high quality tone and voice reproduction; capacitor connected for connection to supervised notification appliance circuit; semi-flush mounting; four inch cone; high impact, flame retardant PC/ABS thermoplastic; 70 VRMS; multi-tapped output power rated ¼ to 2 watts and produce 79 to 88 dB at 10 feet.

C. Visible Alarm Notification Appliances (Strobes): Strobes shall be xenon or equivalent, unfiltered or clear filtered white light, a minimum intensity of 15/75 candela and as indicated on drawings, flash rate range from 1 to 3 Hz, a maximum pulse duration of 0.2 sec with a maximum duty cycle of 40%. Strobe shall meet all requirements of the Americans with Disabilities Act (minimum 75 cd as tested per UL 1971).

D. Audible/Visible Alarm Notification Appliances (Speaker/Strobes): Combination units shall provide a common enclosure for the fire alarm audible and visible alarm appliances and be UL listed for its purpose. Minimum audible level and strobe intensity shall meet all requirements for separate appliances.

2.6 AUXILIARY DEVICES

A. Door Release: Magnetic door holders shall be suitable for wall or floor mounting. The electromagnet shall require no more than 3 watts to produce 25-lbf of holding force. The coil voltage shall be 120 VAC.

B. Waterflow Alarm Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer. Switch shall have an adjustable delay to minimize false alarms due to fluctuations in water pressure.

C. Gate Valve (Tamper) Switches: Shall be provided by the Fire Sprinkler Installer and shall be wired complete and ready for use by the Fire Alarm System Installer.

D. Control Relay Module: Provide intelligent control relay modules. The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

E. Fire Department Key Box: Shall be by Knox Company. Shall be provided with an internal switch to indicate a supervisory condition at the fire alarm control and annunciator panels when the lid is removed.

2.7 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Building wire as specified in Division 26.

B. Signaling Line, Initiating Device and Notification Appliance Circuits: Power limited fire-protective signaling cable, solid copper conductor, 300 volts insulation, suitable for temperature, conditions and location installed. Minimum wire size for initiating device circuits, control circuits and notification appliance circuits shall be determined by calculations and manufacturer's requirements or recommendations. Wire and cable shall be twisted and shielded if recommended by the system manufacturer. Initiating, notification, and control circuits shall be sized based on 20% additional power consuming devices. The conductors shall meet the requirements of NEC article 760.

C. The type of cable chosen should be based on fire alarm system requirements, specification requirements and applicable code requirements. Consideration should also be given to the length of cable runs and potential interference.

D. All wiring provided on this project shall be UL listed for the intended use. All wiring including wiring to existing modified devices and appliances shall be new.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall install, program and test all new equipment identified in this contract and revise existing equipment as noted.

B. The installation supervisor shall be on the job site during the entire installation. The installation supervisor shall maintain marked up copies of the drawings at the job site showing as-built conditions. These drawings shall be updated daily and available for Owner review.

C. The Contractor shall provide all required conduit and all associated hardware, and shall install (pull), connect, and test all cable for a complete fire alarm system. All wiring shall be installed in accordance with the guidelines of these specifications and documents as well as the NFPA codes and standards listed in these specifications.

3.2 INSTALLATION

A. All wiring shall be installed in conduit. Minimum allowable conduit size shall be ¾ inch. The conduit shall be sized so that conduit fill does not exceed 75% of NFPA 70 maximum fill requirements. Cables in vertical risers shall not exceed 50% of NFPA 70 maximum fill requirements. Conduit installation shall be as required by the Contractor's layout and as described in these specifications. All conduit field routing shall be acceptable to the Owner. Routing not acceptable shall be rerouted and replaced without expense to the Owner.

B. All wire, cable, conduit and raceways shall be concealed in walls, ceiling spaces, electrical shafts or closets in finished areas except as specifically noted otherwise. Conduit and raceways may be exposed in unfinished areas or where specifically approved by the Owner.

C. Except as otherwise specified or indicated on the drawings, all conduit shall be installed parallel or perpendicular to dominant surfaces with right angle turns made of symmetrical bends or fittings. Except where prevented by the location of other work, a single conduit or a conduit group shall be centered on structural members.

D. Conduit shall be located at least six inches from hot water or steam pipes, and from other hot surfaces. Conduit shall not block access to any existing equipment or fixtures.

E. All conduits and junction boxes shall be labeled as specified in Division 26 (red).

F. All wiring shall be terminated at devices or panels using terminal connectors for screw type terminals. All terminal connectors for conductors shall be pre-insulated ring type or pre-insulated spade type. Pre-insulated terminal connectors shall include a vinyl sleeve, color coded to indicate conductor size. Pre-insulated terminal connectors shall include a metallic support sleeve bonded to the vinyl-insulating sleeve and designed to grip the conductor insulation.

G. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit for conventional hardwired class B initiating and notification appliance circuits.

H. Conduit shall be securely fastened to all boxes and cabinets. Threads on metallic conduit shall project through the wall of the box to allow the bushing to butt against the end of the conduit. The locknuts both inside and outside shall then be tightened sufficiently to bond the conduit securely to the box. Conduit shall enter cabinets from the bottom and sides only.

I. Install manual station with operating handle 48 inches above floor unless noted otherwise on drawings.

J. Install ceiling mounted initiating devices in areas with exposed structure tight to underside of floor/roof deck.

K. Install ceiling mounted visible and audible/visible notification appliances in areas with exposed structure to bottom of floor/roof structure or at 30 ft AFF, whichever is lower.

L. Install ceiling mounted visible and audible/visible notification appliances in areas with finished ceilings flush with bottom of ceiling or at 30 ft AFF, whichever is lower.

M. Install wall mounted visible and audible/visible notification appliances with visible element (strobe) between 80 inches and 96 inches above finished floor unless noted otherwise on drawings.

N. Install wall mounted audible devices with the top of the device at least 90 inches above finished floor or 6 inches below the ceiling, whichever is lower, unless noted otherwise on Drawings. If combination devices are installed, they shall be installed per the visible signal device requirements.

O. Install remote test station/indicating light for duct detectors in finished ceiling where ceilings are 10 feet or less in height. Install at 48" AFF on nearest wall for areas with exposed structure or where the ceiling height exceeds 10 feet.

P. Mount outlet box for electric door holder to withstand 80 pounds (36.4 kg) pulling force.

Q. Make conduit and wiring connections to equipment provided by others.

R. Provide strobe synchronization as required per NFPA 72.

3.3 FIELD QUALITY CONTROL

A. Systems shall be checked and tested in accordance with the instructions provided by the manufacturer to insure that the system functions as required and is free of grounds, opens, and shorts. Each device shall be tested. Smoke detectors shall be tested with products of combustion.

B. Upon completion of the system installation and before the Date of Final Acceptance, a factory-trained technician shall perform all necessary tests and adjustments and shall then file a Letter of Certification and a Certificate of Completion (NFPA 72) with the Owner indicating that the system functions and conforms to the Fire Alarm System Specifications.

C. Test in accordance with NFPA 72 and local fire department requirements.

3.4 MANUFACTURER'S FIELD SERVICES

A. Include services of factory trained and certified technician to supervise installation, adjustments, final connections, and system testing as performed by the fire alarm contractor's factory-trained technicians.

3.5 DEMONSTRATION

A. The equipment supplier's factory trained technician shall train the Owner's personnel in the proper use and maintenance of the system. Training sessions shall be conducted as needed, not to exceed a total of 2 sessions, with each session lasting a maximum of 4 hours each.

B. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.6 ACCEPTANCE TESTING

A. Upon completion of the system installation, a factory-trained technician shall perform all necessary tests and adjustments in the presence of the Owner's designated personnel.

END OF SECTION 281111