

**SECTION 16735**  
**SITE FIRE DETECTION AND ALARM SYSTEM**

**PART 1 - GENERAL**

**1.1 REFERENCES**

- A. The Publications listed below form a part of this specification to the extent referenced. Where Publication dates are not listed, the most current edition shall be used. The publications are referred to in the text by basic designation only.
1. DOE ORDERS:
    - a. DOE Environmental, Safety and Health Protection Standards.
    - b. DOE 420.1 Facility Safety.
    - c. DOE 420.2 Safety of Accelerator Facilities.
  2. NFPA:
    - a. NFPA 13 Installation of Sprinkler Systems (1996).
    - b. NFPA 70 National Electric Code (1996).
    - c. NFPA 72 National Fire Alarm Code (1996).
    - d. NFPA 75 Electronic Computer/Data Processing Equipment (1995).
    - e. NFPA 90A Installation of Air Conditioning Systems.
    - f. NFPA 92A Smoke Control Systems (1996).
    - g. NFPA 101 Life Safety Code (1997).
    - h. NFPA 110 Emergency Power Systems (1996).
  3. OAK RIDGE NATIONAL LABORATORY DESIGN DOCUMENTS:
    - a. ORNL Design Criteria – Fire Protection-Deviations – NFPA 13 and NFPA 101.
    - b. ORNL Technical Specification Section 15104A Fire Protection 4-24-96.
    - c. ORNL Technical Specification Section 16721 Fire Alarm Systems 7-1-00.
  4. DEPARTMENT OF LABOR:
    - a. OSHA Section 29 CFR 1910.36(b)(7).
    - b. OSHA Section 29 CFR 1910.164.
  5. OTHER:
    - a. ADA Accessibility Guidelines for Buildings and Facilities, January, 1998.
    - b. UL Fire Protection Equipment Directory.
    - c. Factory Mutual Approval Guide-Fire Protection Equipment.

**1.2 GENERAL REQUIREMENTS**

- A. Purpose: This Section describes the site fire alarm system, its operation, actuation, programming and configuration necessary, (along with the local building devices and equipment outlined in Section 16730), to provide a complete addressable intelligent fire alarm system network for the CNMS Project in Oak Ridge, Tennessee. The devices and systems used within the CNMS to initiate and indicate fire alarms, monitor fire suppression systems, control auxiliary life safety functions and the installation, testing and acceptance of these devices are specified in Section 16370. That Section also describes the performance of circuits used to connect devices to the local fire detection and alarm control panels (FACPs).
- B. This is a "design-build" turnkey project. The Contractor shall provide the Construction Manager with a completed, fully functional system that is designed, installed, and tested in accordance with the requirements presented in each Specification section.
- C. Design: The CNMS Fire Alarm System shall be provided in accordance with the requirements of this specification, as well as, NFPA 72 and other applicable codes and standards.

- D. Terminology: Terminology used in this specification is as defined in NFPA 72.
- E. System Description: The CNMS Fire Alarm System shall be a looped peer-to-peer token-ring Class A-Style configuration 7 (with the exception of segregation of fiber optic cables) and shall be connected to the SNS Site-Wide Fire Alarm System. The CNMS node will be connected to the SNS/CLO Node using the fiber optic cable system and patch panels as shown on provided drawings. The Contractor is responsible for providing and installing properly designed and configured EST 3 Fire Alarm Control Panel (FACP). The Contractor is responsible for providing and installing fiber optic cable between the CNMS FACP and the CNMS patch panels and between the CNMS patch panel and the CLO patch panel. The Contractor is responsible for providing needed wiring to supply power to the FACP from 120V AC power supplies located within the CNMS building. The field device wiring from the various building devices shall be in a Class B-Style 4 configuration. Notification Circuits shall be configured as Class B-Style Y. The attached CNMS Fire Alarm System Matrix indicates the minimum arrangement necessary to provide the CNMS Fire Alarm System. As a minimum, the system shall function as stipulated in the CNMS Fire Alarm System Matrix.
- F. Service Conditions
  - 1. Items provided under this section shall be specifically suitable for the following service conditions.
    - a. Altitude: 1,000 feet.
    - b. Ambient Temperature: -20 to 110 °F (exterior systems) and 32 to 120 °F & 85% humidity interior systems, except where conditioned.
    - c. Seismic Parameters: See Section 16730.
- G. Related Sections of SNS Specifications:
  - 1. Section 15300 – Fire Suppression Master Specification.
  - 2. Section 16730 – Fire Alarm Specification, Local Building Devices.
  - 3. Section 16129 – Fiber Optic Cable & Accessories.

### 1.3 QUALITY ASSURANCE:

- A. Contractor Qualifications:
  - 1. The Fire Detection and Alarm System Contractor shall be a factory authorized fire alarm system installer for all systems included herein. Personnel involved in detailed design, review, and testing shall be qualified, approved representatives of the equipment manufacturer.
  - 2. The Fire Detection and Alarm System Contractor shall hold all licenses and permits necessary to perform this work.
  - 3. The Fire Detection and Alarm System Contractor shall have several years of experience in the installation of systems of this type and be familiar with all applicable local, state and federal laws and regulations.
  - 4. The Fire Detection and Alarm System Contractor shall be regularly engaged in the design, servicing, installation and testing of fire detection and alarm systems.
  - 5. The Fire Detection and Alarm System Contractor shall submit a list of installations, preferably of similar scope and magnitude, which were completed within the last three (3) years, including a contact person for each reference. This list shall be submitted at the pre-bid meeting.
  - 6. The design of fire protection systems shall be done under the supervision of a Professional Engineer registered in the State of Tennessee as a Fire Protection Engineer. The design shall bear the stamp of the supervising Fire Protection Engineer.
  - 7. The Construction Manager may reject any proposed contractor who cannot show evidence of proper qualifications.
- B. Sub-Contractors:

1. The Construction Manager must approve all sub-contractors in writing.
2. All sub-contractors shall meet the quality assurance requirements listed for the Contractor in Section 1.3.A.

#### 1.4 SUBMITTALS

- A. Construction Manager approval is required for all submittals. After verifying all field measurements and after complying with the applicable procedures specified in the Contract Documents, the Contractor shall submit for review and approval, with such promptness as to cause no delay in the work, all Technical Submittals, as specified. The Submittals shall be in accordance with any appropriate General and Supplementary Conditions.
- B. Data:
1. Battery Load Calculations: Submit calculations for fire detection and alarm system back-up battery loads for standby and alarm conditions. Calculations shall indicate voltage drops in worst-case conditions for each circuit.
  2. Manufacturers Catalog Data: Submit data (including catalog cuts, brochures, specifications, product data and/or information regarding UL Listings or Factory Mutual approvals) in sufficient detail and scope to verify compliance with the requirements of the contract documents.
  3. Material, equipment and fixture lists: A complete itemized listing of equipment and materials proposed for incorporation into the work shall be submitted. Each entry shall include an item number, the quantity and the name of the manufacturer or supplier of each item. The listing shall include the following:
    - a. Fire alarm control panels.
    - b. Wire, cable, fiber optic cable, connectors, and terminal strips.
    - c. Any other materials, devices or equipment to be provided.
- C. Shop Drawings:
1. Shop drawings shall be provided in the format required by the project General and Supplementary Conditions. Current AE drawings shall be provided to the Contractor and used as backgrounds for the shop drawings. Drawings shall contain no extraneous information. Marked up copies of catalog data sheets or manufacturer's "typical" diagrams are not acceptable in lieu of the required drawings or diagrams. Drawing method shall be in accordance with the SNS CF CADD Plan and associated Appendix F. Contractor shall submit a test plan for acceptance testing for approval with shop drawings.
  2. Shop drawings shall include:
    - a. A drawing legend sheet identifying:
      - 1) All symbols used on the drawings, by type of device or equipment, manufacturer and manufacturer's part number. This information shall correspond to the manufacturer's catalog data sheets required as part of the equipment list.
      - 2) All conventions, abbreviations and specialized terminology used on the drawings, as necessary to understand and interpret the information contained thereon.
      - 3) All color codes and conduit, conductor/circuit and/or device numbering systems.
      - 4) A complete drawing list/index identifying all drawings in the shop drawing package by title, drawing number and Specification cross-reference.
    - b. Plan view drawings based upon the project architectural plans and drawn to 1/8-inch scale or larger, showing:
      - 1) Name of Project.
      - 2) Location, including street address.
      - 3) Point of compass.
      - 4) Graphical scale indicator.

- 5) Locations of all walls, partitions extending to within 18" of the ceiling, major room fixtures that may obstruct optical detectors or visible alarm appliances, ceiling obstructions, exits and anticipated fire department response points.
  - 6) Use or occupancy of each room or area (i.e., office, mechanical, storage, laboratory, etc.).
  - 7) Locations of all fire alarm system devices, equipment, risers and electrical power connections, including sufficient dimensions for the contractor to properly position the device/equipment.
  - 8) Locations and identification of all non-fire alarm system equipment monitored and/or controlled by the fire alarm system.
  - 9) Point-to-point (actual) conduit, raceway and circuit routing, identifying number, size and type of conduits/raceways and conductors. This information shall be depicted in sufficient detail to readily locate specific conduits, raceways and circuits in the field and to identify the specific conductors/circuits contained therein. All penetrations of fire-rated barriers shall be individually noted.
  - 10) Conduit fill calculations, in chart form, indicating the cross-section area percent fill for each type of wire/cable in each size of conduit used in the system.
- c. Typical wiring diagrams for all alarm initiating and alarm indicating devices, identifying all required terminations, including types of terminations (terminals or pigtails) and pigtail/terminal identifications. All unsupervised connections and terminations shall be noted "unsupervised."
  - d. Any additional information necessary for installation of the system devices and wiring to the point of connection to the local fire alarm control panel, including copies of all cross-referenced drawings and documents.

D. Material Samples:

1. Material samples shall be provided concurrent with the Shop Drawing Submittal. Contractor shall provide samples in accordance with the requirements of the General and Supplementary Conditions. In addition, samples shall be submitted in original factory cartons (if applicable) with all factory documentation. Such documentation shall include evidence of UL listing or FM approval, as required. Samples of the following items shall be submitted:
  - a. Fault isolator modules.
  - b. Wire, fiber optic cable, and cable: Samples shall be 24 inches in length, minimum, and shall be labeled to identify the type of wire or cable, manufacturer, manufacturer's part number, and a description of the intended use for that particular wire or cable.

E. Record Drawings:

1. Record Drawings shall be maintained in accordance with the requirements of the General and Supplementary Conditions.

F. Operation and Maintenance (O & M) Manuals:

1. Preliminary O & M Manuals shall be provided, pursuant to this specification and the supplementary conditions, with the shop drawings. The manuals will be reviewed for required content and approved or disapproved on that basis. Upon completion of the project, the Contractor shall revise the approved, preliminary manual to be consistent with the system as installed and specifically to coordinate the testing and maintenance schedule with the approved Contractor testing protocols and with the device numbers indicated on the Contractor's Record Drawings.
2. Final O & M Manuals (Including Final Record Drawings) shall constitute the basis for the on-site training sessions required elsewhere in this Section and, as such, shall be both specific to this system, containing a minimum of superfluous information, and

suitable for that purpose. This manual shall be written, compiled and edited specifically for this project and the system installed. The Final O & M manual shall include copies of Final Record Drawings. Unedited manufacturer's catalog data sheets and/or equipment manuals are unacceptable as content for this submittal.

G. Reports:

1. Test Reports (procedures and checklists) for all required tests shall be submitted in accordance with appropriate requirements of the General and Supplementary Conditions.
  - a. The Test Reports shall include a detailed narrative description of each test/verification performed (consistent with the approved test protocols required elsewhere in these specifications), the date and time, results and the initials of the parties performing and witnessing each test/verification.
  - b. The Test Reports shall become a part of the permanent record and contain signatures of contractor's representatives involved in each phase of testing.

1.5 CONFLICTS

- A. The referenced codes and standards represent minimum requirements for items not otherwise addressed in the Plans and Specifications. The Construction Manager reserves the right to specify requirements that exceed the requirements of either, the referenced codes and standards, typical industry practice, or both. Such differences between the bid documents and the referenced codes and standards/typical industry practice shall not be recognized as conflicts and shall not be grounds for adjustments to the contract.
- B. In the event of conflicts between these Specifications and/or the contract drawings and/or the referenced codes and standards, it is the Contractor's responsibility to notify the Construction Manager of such conflict in writing at least 7 days prior to bid. Any conflicts, which are not identified prior to bid, shall be subject to resolution, at the Construction Manager's discretion, by applying the more stringent criteria.
- C. No construction or installation will be authorized until the required submittals are received, reviewed and accepted by the Construction Manager. Any construction or installation performed without written authorization from the Construction Manager shall be entirely at the Contractor's own risk.
- D. As the specified submittals are essential to the Construction Manager's quality assurance effort and necessary to document the installation for future expansion, modification, service, testing and maintenance, overdue and/or unacceptable submittals may, at the sole discretion of the Construction Manager, result in the immediate suspension of all payments to the Contractor until such time as the problem is corrected.

1.6 SYSTEM REQUIREMENTS

A. System Architecture:

1. The System supplied under this specification shall utilize node-to-node, direct wired, multi priority peer-to-peer network operations. Each panel shall be an equal, active functional member of the network, which is capable of making all local decisions and generating network tasks to other panels in the event of panel failure or communications failure between panels.

B. System Performance and Supervision

1. The signaling line circuit interconnecting network panel/nodes shall be Class -Style 7,) with the exception of segregation of fiber optic cable. The media shall be fiber optic cable. The signaling line circuit connecting panels/nodes to addressable/analog

devices including, detectors, monitor modules, control modules, isolation modules, and notification circuit modules shall be Class B-Style 4 and Style Y. A single break or short on the network wiring shall cause the system to isolate the fault, and network communication shall continue uninterrupted, without any loss of function. Should multiple wiring faults occur, the network shall re-configure into many sub-networks and continues to respond to alarm events from every panel that can transmit and receive network messages.

2. All power supply circuits, including 24VDC power supply circuits shall be supervised using end-of-line power supervisory relays monitored by addressable monitor modules, one per power circuit, connected to the Fire Alarm Control Panel.
  3. Specified devices shall operate in accordance with the Input/Output matrices included in the Appendices.
  4. Standby power supply shall be by battery with capacity to operate the system under maximum supervisory load for 24 hours and then capable of operating the system for 5 minutes in the alarm mode at 100% load. The system shall include a charging circuit to automatically monitor and maintain the electrical charge of the battery.
- C. Component Supervision:
1. All control components shall be placement supervised such that removal of any control module shall cause a trouble signal.
  2. All remote power supplies shall be supervised for loss of normal AC operating power. Loss of AC power to any power supply/battery charger shall cause a supervisory signal.
  3. All power supplies shall continuously monitor the presence of the batteries, battery voltage, and charging status, causing a trouble signal in response to a low battery, missing battery or charger failure condition.

## PART 2 - MATERIALS

### 2.1 COMPONENTS

- A. Product Listing and Approvals:
1. As appropriate, all system components shall be listed by Underwriter's Laboratories, Inc. (UL) or approved by Factory Mutual (FM) if the component is from a category of devices that are listed/approved by UL or FM.
  2. Components requiring approval shall be delivered to the project site with factory applied UL and/or FM stickers. System components, which do not meet these requirements, are not acceptable unless specifically approved in writing by the Construction Manager.
- B. Fire Alarm Control Panel:
1. The EST 3 control panels shall be a multi-processor based networked system designed specifically for fire, smoke control, and extinguishing agent release. The control panel(s) shall be listed and approved for the application under the standard(s) as listed under the General section. The control panels shall include all required hardware, software, and site-specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified using software provided by a single supplier. The control panel operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.
  2. Each network control panel shall be capable of:
    - a. Supporting up to 2500 analog/addressable points.
    - b. Supporting up to 124 Keypad/Displays Supporting network connections to up to 63 other control panels and annunciators.
    - c. Supporting multiple digital dialers and modems.
    - d. Supporting multiple communication ports and protocols

- e. Supporting up to 1740 chronological events
3. The network of control panels shall include the following features:
  - a. Ability to download all network applications and firmware from the configuration computer from a single location on the system.
  - b. Providing electronic addressing of analog/addressable devices.
  - c. Providing an operator interface control/display that shall annunciate, command and control system functions
  - d. Providing an internal audible signal with different programmable patterns to distinguish between alarms, supervisory, trouble and monitor conditions.
  - e. Providing discreet system control switches for reset, alarm silence, panel silence, drill, previous message, next message and details. It shall be possible to individually password protect the reset, alarm silence, panel silence and drill switches.
  - f. Providing system reports that list a detailed description of the status of system parameters for corrective action or for preventive maintenance. Reports shall be displayed on the operator interface or be capable of being sent to a printer.
  - g. Providing an authorized operator with the ability to operate or modify system functions such as system time, date, passwords, holiday dates, restart the system and clear the control panel event history file.
  - h. Providing an authorized operator the ability to perform test functions within the installed system.
3. Supervision shall be as follows:
  - a. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel.
  - b. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display
  - c. Software and processor operation shall be independently monitored for failure.
  - d. The system shall provide fail-safe operation, with multiple-levels of system operation.
4. FACP and system Capabilities for addressable detectors:
  - a. Each analog addressable detector's sensitivity shall be capable of being programmed individually from Most Sensitive, More Sensitive, Normal, Less Sensitive, and Least Sensitive.
  - b. In addition to the five sensitivity levels the detector shall provide a pre-alarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The system shall allow changing detector types for service replacement purposes without the need to reprogram the system.
  - c. The replacement detector type shall continue to operate with the same programmed sensitivity levels and functions as the detector it replaced.
  - d. System shall display an off-normal condition until the proper detector type has been installed or change in the application program profile has been made.
5. Control Panel and System Reporting:
  - a. The system shall provide the operator with reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs.
  - b. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining.
  - c. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
  - d. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.
  - e. The system shall provide a report that gives a chronological listing of system events. The system shall provide a listing of all of the firmware revision listings for all installed network components in the system.
6. System Message Processing and Display Operations:

- a. The system shall allow network functions to be configured to apply to any combination of nodes (panels) in the network.
  - b. Each control panel (network node) shall be capable of supporting a printer. All control panel printer ports shall be configurable to output any combination of alarm, supervisory, trouble, monitor, or group event messages.
  - c. Each control panel (network node) shall be capable of supporting an LCD display. The display shall be configurable to display the status of any and all combinations of alarm, supervisory, trouble, monitor, or group event messages.
7. System Programming Operation:
- a. Each LCD display on the system shall be capable of being programmed for control functions of any node or the entire network. The LCD display shall reside on the network as a node and continue to operate with any fault on the network.
  - b. The system program shall have a minimum of 100 system definable Service Groups to facilitate the testing of the installed system based on the physical layout of the system. Service groups that disable entire circuits serving multiple floors or fire zones shall not be considered as equal.
  - c. Advanced Windows based programming with Program Version Reporting to document any and all changes made during system start-up or system commissioning. Time and date Stamps of all modifications made to the program must be included to allow full retention of all previous program version data.
  - d. The operator display shall clearly identify unacknowledged and acknowledged alarm, supervisory trouble, and monitor status messages.
  - e. Control panel shall include one Edwards 3-12/SIRY Control Display Module.
8. Annunciation Features:
- a. The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the buildings. Standard LED annunciators may be combined in common enclosures provided that the groups of LED's comprising each of the required annunciators are separated from one another (Detection, Supervisory, Status, and Security) and clearly labeled.
  - b. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.
  - c. The annunciator shall contain the following system status indicators:
    - 1) 80 character Backlit Liquid Crystal Display.
    - 2) System Normal Indicator.
    - 3) System Common Alarm Indicator.
    - 4) System Common Trouble Indicator.
    - 5) System Common Supervisory Indicator.
    - 6) System Ground Fault Indicator.
    - 7) System Common Security Indicator.
    - 8) System Disabled Point(s) Indicator.
    - 9) System Reset Switch with indicator.
    - 10) System Alarm Silence Switch with Indicator.
    - 11) System Trouble Silence Switch with Indicator.
    - 12) System Drill Switch with indicator.
    - 13) System Message Queue Scrolling Switches.

C. Fiber Optic Patch Panel:

1. A suitable enclosure shall be provided. Panel shall provide for strain relief of incoming cabling as well as providing connector panels and connector couplings adequate to accommodate the number of fibers to be terminated. Panel shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturer's recommended

minimums or 1.2", whichever is larger. All terminated fibers shall be mated to SC couplings mounted on patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the housing assembly.

### PART 3 - EXECUTION

#### 3.1 DESIGN AND INSTALLATION

- A. Design and installation of the Fire Alarm System shall be in accordance with NFPA 72 and this Section.
- B. All fire alarm wiring shall be run in dedicated raceways or conduit; no other wiring shall be allowed in the fire alarm raceways, conduit, enclosures, or junction boxes (except interfaces to devices and circuits controlled by the fire alarm system). Short sections of liquid-tight flexible metal conduit shall be allowed at points requiring flexibility or vibration isolation, such as connections to sprinkler flow switches.
- C. Conductors supplying AC power to the fire alarm system shall not be installed in the same raceways, enclosures, or junction boxes as fire alarm signal circuits.
- D. Field wiring shall not terminate directly to fire alarm panel components.

#### 3.2 INSULATION TESTING

- A. All fire alarm system conductors shall be tested for integrity of insulation, prior to connection of any equipment, using a megger operating at 500 VDC. This testing shall be coordinated with the installation schedule to prevent over-voltage damage to system components.
- B. All test values shall be recorded in ohms. All circuits measuring less than 10 mega ohms to ground, or between conductors installed in the same conduit, shall be replaced.
- C. Upon completion of insulation testing, the Contractor shall provide written certification documenting successful completion of all required insulation testing in accordance with these Specifications.

#### 3.3 CONTRACTOR'S 100% TEST AND CERTIFICATION

- A. All alarm initiating devices, notification appliances, auxiliary function relays, solenoids, connections to local fire alarm control panels and associated circuits shall be functionally tested to verify proper operation (including synchronization) and supervision.
- B. Correct annunciation of all alarm, supervisory and trouble conditions, including any user programmable text messages, shall be verified.
- C. Correct operation of all releasing, remote annunciation, and interfacing functions shall be verified.
- D. The Contractor's 100% test shall be conducted with the final system program installed in non-volatile memory. In the event that errors are identified in the system program, the program shall be corrected and all required testing repeated with the new software iteration. The intent of this paragraph is that all required system tests, except insulation testing, be conducted with the final system program installed.

- E. Upon completion of Testing, the Contractor shall provide written certification to the Construction Manager's Representative documenting successful completion of all required tests in accordance with these Specifications.

### 3.4 FIRE ALARM SYSTEM ACCEPTANCE TEST

- A. All testing shall be conducted in accordance with NFPA 13, 14 and other appropriate standards, as well as NFPA 72.
- B. Upon completion of the Fire Alarm Installation, an Acceptance Test of the fire alarm system shall be performed in the presence of the Construction Manager and/or his designated Representative(s).
  - 1. In preparation for the Acceptance Test, the Contractor shall submit Record Drawings, as required elsewhere in these Specifications.
  - 2. The Contractor's Record Drawings will be reviewed for conformance to the applicable Specification requirements. Upon approval of the Record Drawings, one copy will be provided to reflect the Acceptance Test plan.
  - 3. The Contractor shall develop the Acceptance Test Plan in accordance with the appropriate Codes and Standards. The Test Plan shall be submitted to the Construction Manager for approval.
- C. Acceptance Testing will be conducted by the contractor and witnessed by the Construction Manager's Representative, in accordance with the Acceptance Test Plan. The Acceptance Test Plan shall include at a minimum:
  - 1. Functional testing of 100% of the initiating devices.
  - 2. Functional testing of 100% of the evacuation signaling devices. This testing shall include audibility testing with a dBA meter.
  - 3. Supervisory testing of 100% of the initiating device circuits.
  - 4. Supervisory testing of 100% of the evacuation signaling circuits.
  - 5. Supervisory testing of all power supplies/standby batteries.
  - 6. Functional testing of all manual functions.
  - 7. Two, consecutive full load tests (all fire alarm initiating devices in alarm and all evacuation signals, annunciators and auxiliary functions activated simultaneously), one under standby battery power and one under normal power, 15 minutes duration each, minimum.
  - 8. Verification of proper annunciation of all signals.
  - 9. Verification of proper system operation under a variety of fault conditions, including power failures, opens, ground faults, and short circuits.
  - 10. Any additional tests deemed necessary by the Construction Manager or his designated representative.
  - 11. Turnover of hardcopies and electronic copies of system program and Final Record Drawings (as described elsewhere in this specification.)
- D. 100% successful performance during Acceptance Testing is expected, based on the Contractor's Insulation Testing Documentation and 100% Test Certification required elsewhere in these Specifications. In the event of system performance inconsistent with the Contractor's testing certifications, the Construction Manager will make a determination as to whether or not the test results constitute failure of the Acceptance Test. Failure of the Acceptance Test shall invalidate the Contractor's System Certification, in which case re-certification (including 100% Contractor retesting) and a repeat of the Acceptance Test shall be required at no additional cost.
  - 1. Failure of the Acceptance Test may result in the immediate suspension of all payments to the Contractor, until such time as the required Contractor's retesting/re-certification is complete and the failed Acceptance Test is successfully repeated.

### 3.5 TRAINING

- A. Training, by factory trained and certified personnel, shall be provided under this contract, pursuant to this specification and the supplementary conditions, for personnel who will program, maintain, and use the fire alarm system, as follows:
1. Training for four persons (electricians) who will maintain the fire alarm system provided at the CNMS. Training to be given after acceptance testing of FACP-4 hours combined classroom and hands-on training.
  2. Training for SNS operations personnel who need to understand the system and its operation, will be provided at the SNS site. Training to be conducted at completion of acceptance testing of FACP- 2 hours of classroom and hands on training. The Contractor shall videotape each training class provided at the SNS site. These will be turned over to the Construction Manager for refresher training.
  3. The contractor shall provide proposed training outline and handouts at least one week prior to scheduling the acceptance testing of the FACP. Handouts must be updated prior to each new training class. Training to be provided by personnel certified and approved by the equipment manufacturer.

### 3.6 WARRANTY

- A. The Contractor warrants all equipment installed under this contract for a period of three (3) years. Other warranty provisions are contained in the General and Supplementary Conditions.

SNS SITE FIRE ALARM SYSTEM MATRIX

	<b>Coverage</b>	<b>Bldg. #</b>	<b>FACP Location**</b>	<b>Sub Panel</b>	<b>F/A Zone/Loop #</b>	<b>Primary Circuit Routing*</b>
Center for Nanophase Materials Science	Laboratory Level B1	8610	CNMS		1	Conduit
Center for Nanophase Materials Science	Level 1	8610	CNMS		1	Conduit
Center for Nanophase Materials Science	Level 2	8610	CNMS		1	Conduit
Center for Nanophase Materials Science	Level 3	860	CNMS		1	Conduit
Center for Nanophase Materials Science	Level B1 NRL Wing	8610	CNMS	VESDA 1	2	Conduit

\* All conduits by F/A contractor.

\*\* FACP in ORNL FD and CLO-CCR annunciate zones from CNMS FACP.

**END OF SECTION 16735**