

16900 Fire Alarm System Design Guidelines

Part 1: General

- 1.01 The following guideline is established to aid the Engineer of Record during the design process including development of drawings and specifications. Contents and requirements stated herein are to be incorporated as required into the final contract documents prepare by Engineer of Record for a specific project.
- 1.02 Fire Alarm Systems shall be specified in Division 16 and the installation shall be by an approved contractor certified by the manufacturer.
- 1.03 The NC Department of Insurance is the Authority having Jurisdiction (AHJ) for code compliance. NC State Construction Office (SCO) is the Authority having Jurisdiction (AHJ) for construction administration, inspection, and acceptance.
- 1.04 The NC State Construction Office (SCO) requires the Engineer of Record to verify the fire alarm system complies with construction documents, NFPA 72 and has been 100% fully tested and certified in accordance with NFPA 72 Record Of Completion document.
- 1.05 North Carolina State University Facilities Planning and Design (NCSU-FP&D) manages the design process and coordinates design reviews and meetings between Engineer of Record, NCSU Construction Management and NCSU Facilities Operations Electronic Systems representative.
- 1.06 North Carolina State University Construction Management (NCSU-CM) manages the construction and commissioning of the fire alarm system. NCSU-CM coordinates review of submittals with NCSU-FP&D and NCSU Facilities Operations Electronic Systems representative.
- 1.07 North Carolina State University Construction Management requires the Fire Alarm Contractor of record to demonstrate to the satisfaction of NCSU Construction Management the system has been fully tested.

Part 2: Engineer of Record's Responsibilities

- 2.01 The Fire Alarm System design and installation shall comply with requirements of the latest edition of the following codes or standards:
 - NFPA 70 *National Electric Code*
 - NFPA 72 *National Fire Alarm Code*
 - North Carolina Department of Insurance design and testing guidelines titled *Fire Detection and Alarm Systems*
 - North Carolina State University's *Fire Alarm System Standards* located below as Part 3 of these design guidelines.
 - STATE OF NORTH CAROLINA, DEPARTMENT OF ADMINISTRATION, STATE CONSTRUCTION OFFICE, *ELECTRICAL GUIDELINES AND POLICIES*.
- 2.02 *NC State University Fire Alarm Standard*, Part 3 hereinafter, provides supplemental requirements for Fire Alarm Systems installed in NC State University facilities. The Engineer of Record shall incorporate project specific requirements of Part 3 into the written specification and drawings for the project.

- 2.03 The Engineer of Record shall be responsible for the design of a fire detection system that is fully serviceable by the university and can be U.L. certified as installed. The Engineer's design shall fully comply with *NC State University Fire Alarm Standard*; all deviations shall require written approval from the University
- 2.04 The Engineer of Record and NCSU Project Manager shall conduct a “**pre-design meeting**” with a representative of and NCSU Facilities Operations Electronic Systems team. The Facilities Operations Electronic Systems team maintains fire alarm systems for NCSU. The purpose of this meeting is to insure Engineer of Record **understands NCSU's** project specific requirements.
- 2.05 The Engineer of Record shall insure installation meets NFPA 72, chapter 6 Requirements for Notification Appliances for Fire Alarm System's. Engineer of Record may use a performance specification to insure compliance. However, the minimum quantity of notification appliances shall be as shown on plans and risers.
- 2.06 The Engineer of Record shall insure the FACP or annunciator, when applicable, is to be mounted at the main entrance to the facility (designated emergency entrance). Annunciation of all building alarms shall occur in one central location, such as central room, loading dock, or central entrance. This includes fire, ventilation failure, and gas monitor alarms.
- 2.07 Minimum acceptable audible signals shall have a sound level 15dbA above average ambient as defined by NFPA 72. Additionally, audible signal shall have a minimum sound level of 75 dbA 10 ft from appliance but sound level shall not exceed 135dbA at minimum hearing distance. Engineer of Record may use a performance specification to insure the required audible signal levels are achieved.
- 2.08 In lieu of using duct mounted smoke detectors and where allowed by the code, the Engineer of Record shall design a complete smoke detection system less duct detector. The Fire Alarm System shall comply with all applicable codes.
- 2.09 The Engineer of Record shall review specific vender requirements with NCSU and where requirements dictate specific vendor/equipment, the Engineer of Record shall assist NCSU in open meeting requirements to allow bid alternates. **The Engineer of Record shall prepare contract documents requiring alternate bids to be taken for the fire alarm systems listed in Section 3.**
- 2.10 The Engineer of Record shall insure continuous alarm protection when designing fire alarm systems where upgrading, modifying or phasing of work is required. Fire alarm protection shall be maintained in occupied areas of a building at all times. A construction phasing-plan shall be prepared by the Engineer of Record and shall be included in specifications whenever portions of the construction site shall be occupied prior to final inspection. The University's desire is to keep all life safety systems operating at all times. The Engineer of Record shall use all available means to avoid the need of disabling fire alarm systems.
- 2.11 The Engineer of Record, **prior to accepting the fire alarm shop drawing package**, shall conduct a mandatory “fire alarm review meeting” with the NCSU construction management team. The electrical contractor and fire alarm contractor shall review the fire alarm shop drawing package with NCSU. The purpose of this meeting is to insure contractor complies with NCSU's site specific fire alarm and detection installation requirements.
- 2.12 The Engineer of Record shall conduct a mandatory “pre-construction meeting” with the electrical contractor, the fire alarm contractor and the NCSU construction management team. The purpose of this meeting is to insure **NCSU understands the contractor's installation plan and the contractor understands NCSU's site specific requirements.**

- 2.13 NC State Construction Office (SCO) requires, **prior to final inspection**, the Engineer of Record to verify the fire alarm contractor has fully tested and certified the system in accordance with NFPA 72 and shall sign NFPA 72 Record of Completion. The Engineer of Record shall provide a copy of the verified NFPA 72 Record of Completion Form 1-6.2.1 to North Carolina State University’s construction manager.
- 2.14 At the same time as the verification described by 2.11, above, or prior to final inspection, the Engineer of Record, shall require Fire Alarm Contractor to demonstrate to a designated representative of NC State University, 100% compliance with plans, submittals, specifications and NFPA 72.
- 2.15 The Engineer of Record shall submit shop drawings of the fire alarm system to NCSU for review. Included shall be the contractor’s prepared plan drawing showing devices, system riser, system interconnection drawings, and manufacturer’s specification sheets. Drawings shall include design ambient sound level, audible alarm device sound power and alarm sound level for each space or contractor shall certify that design meets NFPA 72 for sound levels. *Any additional devices required while verifying the system shall be at contractor’s expense.*

Part 3: NC State University Fire Alarm Standard

- 3.01 The following guidelines apply to all new installations of Fire Alarm System’s in facilities owned by North Carolina State University. These guidelines cover both new facilities and/or renovations to existing facilities. *These guidelines shall be incorporated into design documents and shall be project specific.*
- 3.02 PURPOSE: Fire detection systems are an integral part of protecting life and property. These guidelines have been developed for use in the design and installation of these critical systems and to insure the University receives a reliable system that meets all applicable codes.

3.03 TABLE OF CONTENTS

- 1.0 General Requirements
- 2.0 Materials, Architecture and Qualifying Vendors
- 3.0 Contractor Submittal
- 4.0 Documentation
- 5.0 Warranty and Preventive Maintenance Requirements
- 6.0 Training Requirements
- 7.0 Labeling Requirements
- 8.0 Programming and Software Requirements
- 9.0 Zoning Requirements
- 10.0 DACT Communication Requirements
- 11.0 Security Requirements
- 12.0 Inclusion of Costs
- 13.0 Power and Environmental Requirements
- 14.0 Emergency Power Requirements

- 15.0 Elevator Capture Requirements
- 16.0 Audible/Visual Signal Appliances
- 17.0 System Outages
- 18.0 Air Handling Systems
- 19.0 Use of RAILS
- 20.0 Roll-up Fire Doors
- 21.0 Spare Parts

3.04 1.0 General Requirements -

A dual contact time-delay relay (Minimum 60 seconds capability) shall be installed at the main FACP to delay system trouble signals to the Public Safety Office per NC D.O.I.

All conduit fittings shall be compression type fittings and shall have insulated throats.

All duct smoke detectors and/or linear beam smoke detectors shall have a Remote Alarm Indicating Light (RAIL) with a test switch. Test switch shall be mounted 8'-0" A.F.F.

All smoke detectors shall have magnet test capability if available for installed system.

All pull stations shall have keyed locks (allen key type locks are not approved) for resetting purposes if available for installed system. Two keys for each pull station shall be supplied to NC State University's AHJ.

Each addressable loop shall have a minimum of three (3) isolation modules; two (2) at the FACP and one (1) midway through the loop address scheme.

For addressable systems, all devices shall match the brand of FACP installed and these devices shall be addressable analog devices.

All fire alarm system devices that are located on any exterior surface of the building shall be weatherproof as defined by the National Electric Code, article 100.

All devices for Fire alarm systems for additions or renovations shall be U.L. listed, matching existing devices or approved compatible devices for use with the existing fire alarm control panel (FACP).

The Fire Alarm System contractor shall provide any special equipment, tools, and programming devices required in the operation, maintenance or repair of the installed fire alarm system.

Inclusion of Costs - Any costs for design, installation or programming required for any existing University FACP (if applicable) in order to add to the installation is to be included in contract.

3.05 2.0 Materials, Architecture and Qualifying Vendors –

Fire alarm systems shall be fully serviceable and programmable by the University.

Contractor shall (prior to construction) submit shop drawings of the fire alarm system. Included shall be the contractor's prepared plan drawing showing devices, system riser, system interconnection drawings, and manufacturer's specification sheets. Drawings shall include design ambient sound level, audible alarm device sound power and alarm sound level for each space or contractor shall certify that design meets NFPA 72 for sound levels. *Any additional devices required while verifying the system shall be at contractor's expense.*

Fire Alarm Contractor shall specialize in fire alarm system installation, be factory trained and certified, and a minimum of five years documented experience installing and maintaining fire alarm system for similar installations.

The Fire Alarm System that meet requirements and are approved are:

Note Alternate bids are required for the following:

Addressable Systems

EST Model III or EST Quick-Start

Notifier Intelligent Addressable Series

FCI Intelligent Addressable Series

3.06 3.0 Contractor Submittal -

Contractor shall submit shop drawings and construction drawings of the fire alarm system. Included shall be the contractor's prepared plan drawing showing devices, system riser, system interconnection drawings, and manufacturer's specification sheets. Drawings shall include design ambient sound level, audible alarm device sound power and alarm sound level for each space or contractor shall certify that design meets NFPA 72 for sound levels. *Any additional devices required while verifying the system shall be at contractor's expense.*

The submittal package described hereinabove shall be submitted and reviewed by NCSU Construction Management **prior to construction and installation.**

3.07 4.0 Documentation - FACP contractor to provide (3) three copies of maintenance, repair manuals and (2) copies of software manuals required in operation, maintenance, repair, and modification (for system additions or deletions) of fire alarm system.

Documentation provided shall be complete and include all necessary information to support the above stated functions. Manuals shall be bound, and published, consisting of the following:

- 1) Installation Manual
- 2) Operator/Users Manual
- 3) Technical Manual
- 4) Programming Manual

Documentation must be provided to the University at the time of acceptance.

3.08 5.0 Warranty and Preventive Maintenance Requirements - System shall have a 12 month warranty period for all installed or delivered hardware and software.

During the 12 month warranty period, one annual preventive maintenance (PM) inspection/test shall be performed on the entire fire alarm system by the contractor. This PM is to be performed 6 months or more after University acceptance of system. The system acceptance test, punch list items, and other acceptance issues do not meet the PM inspection/test requirement. All system deficiencies found shall be documented and corrected during this PM. All parts and repairs shall be covered under the system warranty. This PM shall include all items to be annually tested as defined by tables 7-2.2 and 7-3.2 in NFPA 72, latest edition, in addition to the following:

- A) Complete software backup (where applicable).

B) Performance test of battery backup.

All test shall be scheduled by the Contractor through Facilities Operations Electronic Systems and will required fifteen (15) days notice. The test shall be witnessed by a representative designated by NCSU Facilities Operations Electronic Systems.

A report consisting of the NFPA Inspection and Testing Form shall be furnished by the contractor, to the Engineer of Record and NCSU Construction Management within 2 days after completion of this test. The NFPA Inspection and Testing Form can be found on page 72-111, of NFPA 72, latest edition.

- 3.09 6.0 Training Requirements - Training shall address all operational functions available to the system at the FACP including but not limited to any system variable changes, programming changes, report creations and changes, system functional changes, etc.

Contractor shall also provide at no cost to the University, sixteen (16) hours of on site owners training. Training to include hardware repair and maintenance by University personnel of all building panels, devices, including but not limited to diagnostic procedures, system expansion and maintenance techniques.

- 3.10 7.0 Labeling Requirements - When field addressable modules are located in junction boxes, the junction box covers must be labeled as to their contents (E.G. 3-24 *Sprinkler Monitor*).

Contractor shall label all wires terminating in junction boxes and riser boxes. These labels shall be self-sticking wire numbers or similar type. Write-on labels are prohibited. Contractor shall provide a typed legend for all junction boxes and riser boxes corresponding to these labels. Legend shall be mounted in riser boxes (if applicable). If system does not have riser boxes, contractor shall provide legend to NCSU Electronic Systems at time of University acceptance of system installation.

On conventional systems (I.E. not addressable), all initiating devices shall be labeled with their respective zone and sequence number.

On intelligent P.I.D. systems, all initiating devices and modules shall be labeled with their respective addresses; including loop and point number.

All device labels shall be made using an electronic labeling system with black letters on white background. Write-on labels are prohibited.

- 3.11 8.0 Programming and Software Requirements

Contractor shall also include all software, hardware, interfaces, adapters, and cables, etc. required for all programming, and maintenance functions.

If the contractor would normally use a laptop to program the system, a similar computer shall be supplied even if programming from the FACP keypad is available.

Contractor shall provide to the University, all software required for full system maintenance and upgrades to fire alarm system including any device changes, additions, or deletions.

Contractor shall provide to the University, **without cost**, all software updates during the warranty period and **free upgrades to software** following the warranty period **that address system operating failures or known defects during the life of the system.**

Contractor shall provide to the University all levels of password access, and documentation to support the use of the above mentioned.

Contractor shall provide at no additional cost to the University, factory sponsored certified technical training for system installed. This training shall certify two (2) technicians to maintain, service, and program installed system and receive direct manufacturer's technical support for these systems, to include software updates if applicable. All expenses, to include tuition, transportation by University approved vendor and lodging for this training, shall be the responsibility of the contractor.

3.12 9.0 Zoning Requirements - All intelligent fire alarm systems shall be zoned.

System shall be zoned first by floor, then by wing (N, S, E, W), if applicable. System shall also be zoned at any fire partitions or identifiable building features.

System devices shall be zoned by type, i.e., smoke detectors, pull stations, heat detectors, duct detectors, sprinkler system monitor components, etc. shall all be on separate zones. Combining separate types of devices on the same zone is prohibited.

Any LED type annunciators shall have separate zone lights for alarm (RED) and trouble (AMBER).

3.13 10.0 DACT Communication Requirements - The fire alarm system (DACT) shall communicate separate signals for Fire Alarm (zone 3), Fire Alarm Trouble (zone 4), Sprinkler Alarm and Sprinkler water flow alarm (zone 5), and Sprinkler Supervisory Trouble (zone 6). **All other zones/signals required for specific installations shall be coordinated and approved by the NCSU before installation and programming.**

Digital communications shall be via FireLite MS-5210UD complete with battery back-up. Coordinate DACT programming and testing with NCSU Facilities Operations Electronics Systems Group.

The DACT shall be mounted in an adjacent or nearest mechanical or electrical room to the FACP unless approved by the owner for installation adjacent to the FACP.

Installation in a telecommunications equipment room is prohibited.

The Contractor shall install conduit from a location next to the DACT for connection of the FireLite MS-5210UD to the main telecommunications room. A 6"x 6"x 3" deep hinged enclosure shall be installed within 1ft. of the DACT and connected by a 1" conduit. Cable termination will be performed by the NCSU Communications Technologies office.

3.14 11.0 Security Requirements - Where applicable for addressable systems, a minimum of two levels of security are required at the FACP. One level for limited interrogation of system status and a second higher level for system programming changes.

3.15 12.0 Inclusion of Costs - Any costs for design, installation or programming required for any existing University FACP (if applicable) in order to add to the installation is to be included in contract.

3.16 13.0 Power and Environmental Requirement - All system power to be isolated circuits with dedicated ground and D.O.I. required circuit protection. (120 VAC 60 HZ)

32-122 DEG.F (0C-50C)

0-95% RH (Relative Humidity), non-condensing.

3.17 14.0 Emergency Power Requirements - Power for the FACP, DACT and all remote power supplies shall be from the emergency power panel. Each shall be served by individual dedicated circuit.

3.18 15.0 Elevator Capture Requirements - All fire alarm devices, separate zones and other requirements shall be included in the fire alarm system design for future connection to elevator capture.

3.19 16.0 Audible/Visual Signal Appliances – All signal appliances, unless noted otherwise, shall be field selectable ANSI S3.41 three-pulse temporal pattern. Unless noted otherwise, audible signal level shall be field adjustable, 101 dbA high level and 96 dbA low level. Sound level based upon anechoic dBA at 10 feet.

3.20 17.0 System Outages - The University desires to keep all life safety systems operating 100% of time. The contractor is to use all available means to avoid the need of disabling active fire alarm systems providing protection to buildings and/or people.

The contractor shall notify the University prior to any work to contacts/interface with any alarm detection devices (smoke detectors, pull stations, horns, panels, etc.). If any disabling, disconnection, reconnection of fire alarm system equipment is necessary, the contractor shall notify the University at least five (5) working days prior to proposed work. Work cannot proceed until contractor receives written approval from the University.

Disabling or disconnection shall be limited to one working day per occasion, and to shorter periods when possible. The Contractor shall be liable for any costs, direct or indirect, due to false alarms resulting from Contractor's work

3.21 18.0 Air Handling Systems - All air handling units shall be shutdown directly by the FACP during alarm shutdowns. Fire alarm device relays and Building Automation Systems shall not be used for alarm shutdowns of air handling systems.

3.22 19.0 Use of RAILS on Conventional Hardwired Systems - Remote Alarm Indicator Light System (RAILS) for smoke detectors in non-occupied areas shall be used complying with applicable codes.

3.23 20.0 Roll-down fire doors shall be equipped with electric motor up/motor down controls interfaced with the FACP.

3.24 21.0 Spare Parts - The following spare parts shall be provide to NCSU prior to final inspection of system:

Fuses- (2) of each size used in the installed system

MPS- w/ monitor modules – - Minimum one or 2% of total installation

Audio-visual devices- - Minimum one or 4% of total installation

Indoor strobe only devices-- Minimum one or 4 % of total installation

Exterior indicating devices-- Minimum one or 2% of total installation

Spot Smoke Detectors- - Minimum one or 6% of total installation

Spot heat/thermal detectors- - Minimum one or 6% of total installation

Spot detector bases-- Minimum one or 2% of total installation

Spot detector sounder bases- - Minimum one or 6% of total installation

Relay modules- Minimum one or 4% of each total installation

Monitor modules-- Minimum one or 4% of total installation

Isolation modules- - Minimum one or 4% of total installation

END OF SECTION 16900