

SECTION 283111 - DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This Section includes fire alarm systems with manual stations, detectors, signal equipment, controls, and devices and contains all relevant criteria contained in the North Carolina State Construction Office document “Fire Detection and Alarm Systems” dated 2020.

1.2 SCOPE

- A. This section of the specifications includes the furnishing, installation, and connection of the microprocessor controlled, analog addressable intelligent reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the Drawings and specified herein.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use on this project.
- B. Acceptable Manufacturers/Models: The University maintains its fire alarm system and as such all systems shall be fully serviceable and programmable by the University. New devices shall be completely compatible with the existing Honeywell E3 fire alarm system.
- C. Installer's Qualifications: Company specializing in performing the work of this section and making the final terminations of this section. Minimum of 5 years documented experience installing fire detection and alarm systems similar in size and scope to this project. Qualifications of installer shall be provided with equipment submittal. Installer shall be certified by the manufacturer to install, program and service the system and shall directly supervise the final connections between the equipment and the wiring system.
- D. Only the Installer may make program changes and must be present for the 100% test, Engineer's inspection and Owner inspections. Training certification shall not be more than 2 years old and must be for the equipment model installed on the project.

E. Codes and Standards:

1. NFPA Compliance: Comply with current applicable requirements of NFPA-72, National Fire Alarm Code.
2. NEC Compliance: Comply with current applicable requirements of NFPA-70, National Electrical Code (NEC) standards pertaining to fire alarm systems.
3. Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components, which are Listed and Labeled.
4. FM Compliance: Provide fire alarm systems and accessories, which are FM approved.

1.4 SUBMITTALS

- A. General: Submittals shall demonstrate compliance with technical requirements by reference to each subsection of this specification. Where a submitted item does not comply fully with each and every requirement of the specifications, the submittal shall clearly indicate such deviations. Identification requirements for non-complying features of items are very specific.

1. Prior to accepting the fire alarm shop drawing package, the Designer shall conduct a mandatory “fire alarm review meeting” with the NCSU construction management team and the Contractor. 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. Product Data: Submit Manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system equipment. Submit technical product data on the fire alarm service equipment. Submittals shall provide mA current draw data for each device submitted and UL Listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and Notification Appliance Circuits (NAC).
Shop Drawings: Submit shop drawings showing equipment, device locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams. Copies of Project Construction Documents or details therefore may not be a part of the shop drawing submittal. Provide distance and proposed route for each Notification Appliance Circuit (NAC). Drawings shall include design ambient sound level, audible alarm device sound power and alarm sound level for each space.
Installation Instructions: Submit Manufacturer's detailed installation instruction for all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
3. Battery Calculations: Systems are to be provided with a separate and independent source of secondary power. All shall have a minimum of 60 hours secondary power capacity, plus 15 minutes of full alarm load

Include a copy of system battery sizing calculations with the shop drawing submittal to the engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at

EOL, based on conductor resistance per manufacturer's data sheet or NEC 2014, Table 8; add any inherent voltage drop caused by the system's power supply.

The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result must be no less than the minimum listed operating voltage for the alarm notification appliances used.

All of these calculations must be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians. NAC voltage drop is to be verified during system tests.

4. Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual.
5. Certifications: Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification.
6. Qualifications: Submit data to indicate compliance with Quality Assurance requirements for Manufacturer and Installer.

PART 2 - PRODUCTS

2.1 ALARM APPLIANCES

- A. Programmable Electronic Sounders shall be located as shown on the Drawings; sounders located outdoors shall be listed for use in wet locations. Electric sounders shall have the following specifications:
 1. Voltage: Programmable electronic sounders shall operate on 24 VDC nominal.
 2. Programming: All signal appliances, shall be field selectable ANSI S3.41, three-pulse temporal pattern. Audible signal level shall be field adjustable, with 101 dbA high level and 96 dbA low level. Sound level based upon anechoic dBA at 10 feet.
 3. Mounting: Provide surface mounting devices suitable for mounting in a standard device box unless otherwise indicated on the Drawings.
- B. Strobe Lights shall be located as shown on the Drawings. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights flash in synchronization and shall have the following specifications:
 1. Voltage: Strobe lights shall operate on 24 VDC nominal.
 2. Maximum pulse duration: 2/10ths of one second.

3. Mounting: Provide surface mounting devices suitable for mounting in a standard single gang device box unless otherwise indicated on the Drawings. Unless otherwise indicated on the Drawings, strobe lights shall be mounted at 96" Above Finished Floor (AFF) to the top of the device.
 4. Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide synchronous strobe lights with specific intensity Candela (Cd) rating of 15/75 Cd in all locations unless indicated otherwise on the drawings.
- C. Audible/Visual Combination Devices shall be located as shown on the Drawings and shall comply with all applicable requirements for both Programmable Electronic Sounders and Strobe Lights. Unless otherwise indicated on the Drawings, combination A/V devices shall be mounted at shall be mounted at 96" Above Finished Floor (AFF) to the top of the device.

2.2 INITIATING DEVICES

- A. Addressable Devices - General: Unless otherwise indicated on the Drawings all initiating devices shall be individually addressable. All detectors shall be the plug in type with a separate base to facilitate testing and maintenance. Provide locking tabs for all models located within 12' of floor. All devices shall be provided with terminal strips for circuit connections, "Pigtails" are not acceptable. Provide skirts for bases to create a finished appearance.
1. Address Setting: Addressable devices shall provide an address setting means that use rotary decimal switches configured to provide decade (numbered 1 to 10) type addresses. Devices, which use a binary address setting method, such as a dipswitch, are not acceptable. Devices, which are addressed by the FACP, are acceptable.
 2. Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC). Signaling Line Circuits shall originate as indicated on the Riser Diagram shown in the Drawings.
 3. Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
 4. Devices shall be capable of reporting obscuration level to the panel for reporting purposes.
 5. Device Mounting Base: Unless otherwise specified all existing detectors are ceiling-mount and replacement shall be ceiling mounted and shall include a separate twist-lock base with tamper proof feature.
 6. Test Means: The detectors shall provide a test means 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 switch) or initiated remotely on command from the control panel when in the "test" condition.

7. Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device. Device identifications shall be either ION, PHOTO, or THERMAL.

- B. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light-scattering) 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. Unless otherwise indicated on the Drawings all smoke detectors shall be photoelectric type.

- C. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate either an intelligent photoelectric sensor as described elsewhere and shall be velocity rated. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When sufficient smoke is sensed, an alarm signal shall be initiated at the FACP.

1. Installation: Duct detectors and related items shall be furnished, connected and installed by the Contractor.

2.3 MISCELLANEOUS SYSTEM ITEMS

- A. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone (either Style D or Style B) of conventional Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.

1. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
2. Mounting Requirements: Monitor Modules shall be mounted in a standard 4-inch square, 2-1/8" deep electrical box at the same height as Audio Visual devices in a clearly visible location.

- B. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, either Class A or B (Style D or Style B operation) of conventional 2- wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.

1. Indication of Operation: Unless otherwise indicated on the Drawings an LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
2. Mounting Requirements: Monitor Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical box, and shall only be installed in conditioned spaces.

- C. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay. The control module shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. Control modules shall be rated for the load they control. (Inductive Loads require inductive rated modules.)
1. Mounting Requirements: Control Modules shall mount in a standard 4-inch square, 2-1/8" deep electrical box, and shall only be installed in conditioned spaces.
 2. Configuration: The control module NAC circuit may be wired for Style Y Class B with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
 3. Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply. A/V power sources and connections are not shown on the Drawings
 4. Test Switch: A magnetic test switch shall be provided to test the module without opening or shorting its NAC wiring.
- D. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop.
1. Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an Isolator Module after its normal operation.
 2. Mounting: The Isolator Module shall mount in standard 4-inch square, 2-1/8" deep electrical boxes at the same height as A/V devices in a clearly viewable area in corridors. It shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
 3. Locations: Provide isolator modules at FACP for both ends of each SLC loop. Provide a minimum of one (1) module in the field at the mid-point of the device loop. Provide additional modules necessary to limit the number of devices between isolators to 20.

2.4 SYSTEM REQUIREMENTS

- A. Fire and smoke detection and alarm systems shall comply with the following system requirements with regard to operation and installation.
1. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.
 2. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (*e.g.*, detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure.
- B. The system shall be new and furnished with a warranty (parts & labor) of a minimum of one year from the date of final acceptance by the Owner. Should the manufacturer provide a standard warranty of greater than one (1) year, that time period shall be the minimum warranty period. Equipment, initiating devices, and alarm appliances shall be arranged as described in the Drawings; annunciator zones shall be configured as described in the Drawings.
- C. The coverage of each fire alarm zone as described in the Drawings shall be indicated on the FACP and any remote annunciator. This may be accomplished by engraved labels, framed directories, and/or graphic displays. Label tape or handwritten labels are not acceptable.
- D. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor.
- E. All wiring shall be color coded in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

<u>Addressable Devices</u>	<u>Approved Manufacture Data Cable</u>
Initiating Circuits, General*	Red (+)/White (-)
Signal Line Circuit Cable	Red jacket with Red(+)/Black(-)
Alarm Indicating Appliance Circuits	Blue (+)/Black (-)
AHU Shutdown Circuits	Yellow (+)/Brown (-)
Door Control Circuits	Orange

- F. There shall be NO splices in the system other than at terminal blocks. "Wire nuts," crimp splices, or insulation piercing type connectors are not acceptable. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

- G. Permanent wire markers shall be used to identify all splices and terminations for each circuit. For splices, use markers or other means to indicate which conductors leads to the FACP. All junction boxes and covers shall be painted red, unless in finished areas.
- H. Device Numbering: Device number shall correspond to the way cable is installed (sequentially).
- I. All wiring and cable must be in EMT, 3/4" minimum diameter, unless indicated otherwise on the Drawings or elsewhere in the Specifications.
 - 1. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides. All painting of junction boxes and junction box covers shall be accomplished prior to installation of the boxes to avoid possible problems with overspray.
 - 2. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- J. Wire shall be new AWG #14 minimum stranded copper, type THHN/THWN for notification appliance circuits. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 minimum, low capacitance, twisted shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACU. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
 - 1. EXCEPTION #1: Unshielded cable, otherwise equal to the above, is permitted to be used where the manufacturer's installation instructions unequivocally require, or state a preference for, the use of unshielded cable of all systems, AWG #16 minimum.
 - 2. EXCEPTION #2: In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.
- K. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.
- L. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten megohms (10 MW), as verified with a megger. Provide advance notice to the A/E of these tests.
- M. All connections at the FACP must be made by the Manufacturer's authorized, factory trained representative (rather than by the electrical contractor).

- N. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.
- O. All addressable devices shall be installed in “conditioned” spaces.

2.5 SMOKE DETECTORS

- A. Detectors: Must be the plug-in type, each having a separate base, to facilitate replacement and maintenance. When installed in a room, detectors shall be oriented so their alarm light is visible from the nearest door to the corridor, unless Remote Alarm Indicator Light (RAIL) equipped.
- B. Spot type smoke detectors mounted within 12 feet of a walking surface shall have their built-in locking device activated.
- C. Unless suitably protected against dust, paint, etc., detectors shall not be installed until the final construction clean-up has been completed. Contaminated detectors must be REPLACED by the Contractor at no additional cost to the Owner.
- D. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with rear support. The preferred method for doing this is to have the tube go through the far side of the duct, with the point of penetration tightly sealed to prevent air leakage around the tube. This facilitates smoke testing and tube cleaning. Duct smoke detector mounting position and air sampling tube orientation, are critical for proper operation. The Manufacturer's detailed installation instructions must be followed. The contractor shall mark the direction of airflow on the duct at each duct detector location. Provide duct access doors.
- E. Identification of individual detectors is required. These device numbers, which must also be shown on the shop drawings, shall be permanently affixed to the detector base. Device labels may not be affixed to the device. Identification labels must be printed labels with black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Designer 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. No work may begin until this meeting occurs.

- B. In addition to other requirements of these Specifications the fire alarm system must comply with the following:
1. The addressable fire alarm system shall be connected, programmed, and tested only by the Manufacturer or by an authorized distributor who stocks a full compliment of spare parts for the system. Technicians performing this service shall be trained and individually certified by the Manufacturer for the model of system being installed. Copies of installer certification must be included with the Contractor's submittal.
 2. The complete configuration data (site-specific programming) for the system must be permanently stored on a computer disk or diskette and archived by the manufacturer or authorized distributor. A diskette copy of this data must be submitted to the A/E for transmission to the Owner when the system is commissioned.
 3. The Manufacturer or authorized distributor must maintain software version (VER) records on the system installed. The system software shall be upgraded free of charge if a new VER is released for any reason during the warranty period. For any new VER to correct problems, free upgrade shall apply during the entire life of the system.
 4. All addressable loop controller circuits must be "Class A", with no "T" taps and shall have a minimum of 20% spare addresses for future use. To minimize the impact of a wiring fault on the system, isolation modules must be provided as follows:
 - a. After each 20 devices/control points on any addressable circuit.
 - b. For each circuit extending outside the building.
 - c. In the FACP, at each end of the loop.
 - d. On loops containing less than the 20 devices place an isolator at each end of the loop and one in the electrical center of the loop.
 5. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) must be supervised.
 6. The Fire Alarm System shall have multiple access levels, which permit the Owner's authorized personnel to make temporary changes in the system alarm response matrix without actually changing the system programming. This must include the ability to override selected alarm inputs or system responses to alarms without affecting the remaining portions of the system.
- C. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the control panel. A separate sheet shall be provided for each floor. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line resistors. Plans shall be bound bound and installed in a "tube" adjacent to the FACP. Provide legend for symbols.

3.2 SYSTEM TESTING & CERTIFICATION

- A. All connections to the FACP and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full compliment of spare parts for the system. The technicians who do this are required to be trained and individually certified by the manufacturer, for the FACP model/series being installed. This training and certification must have occurred within the most recent 24 months, except that a NICET Level III certification will extend this to 36 months. Copies of the certifications must be part of the Shop Drawing

submittal to the engineer, prior to installation. The submittal cannot be approved without this info.

The technician who makes final connections and programs the FACP is legally the "installer" even though most field connections to system devices and appliances are normally made by electrical contractor personnel. The responsibility for assuring a proper installation overall rests with this individual. In addition to doing the final hookups and activating the system, this individual is expected to check enough field connections to assure a proper job was done there. The absence of system "trouble" signals is not a sufficient measure of the field wiring, which could have "T" taps, the wrong type of wire, improper terminations, ground (drain wire) issues, etc.

- B. When programming the system, activate the automatic drift compensation feature for all spot-type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result.
- C. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep.
- D. Print a complete System Status and Programming Report, after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector.
- E. The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report".
- F. Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, etc.
- G. The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the system acceptance inspection:
 - 1. The NFPA 72-2013, Figure 1-6.2.1, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and also to certify that: (a.) It was done per Code, and (b.) The Code-required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form.
 - 2. The System Status and Programming Report. This must be generated on the day of the system acceptance inspection.
- H. After completion of a 100% system test of all new devices and at least 10% of the existing to remain devices; up to 50 devices, not related to this project area and submission of documentation, the installer is to request the engineer to set up an inspection. The system must

operate for at least two days prior to this inspection. This will normally include the use of appropriate means to simulate smoke for testing detectors, as well as functionally testing the system interface with building controls, fire extinguishing systems and any off-premises supervising station. This inspection is intended to assure that the contractor has properly installed the system and performed testing per NFPA 72 Section 14.4.2. The electrical contractor shall provide two-way radios, ladders, and any other materials needed for testing the system, including a suitable smoke source. The engineer must witness a “clean” test before the system is accepted.

- I. A full copy of all final shop drawings, battery calculations, etc. shall be provided at the FINAL inspection for review by Designer, Owner and NCSCO.

3.3 LABELLING

- A. 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).
- B. 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.
- C. All initiating devices and modules shall be labeled with their respective addresses; including loop and point number.
- D. All device labels shall be made using an electronic labeling system with black letters on white background. Write-on labels are prohibited.

3.4 SYSTEM DOCUMENTATION, TRAINING, AND MAINTENANCE

- A. Warranty and Preventive Maintenance Requirements
 1. 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.

2. All tests 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.
3. 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.

END OF SECTION 283111

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Fire Alarm System Checklist

Building Name and Address: _____

Installation Company: _____ Observed by: _____

Date: __/__/____ Time started: __:__ Time ended: __:__

Prior to Inspection

Y N N/A

1. Building occupants, authority having jurisdiction, and University PD Communications have been notified of test.
2. FACP manufacturer and panel are approved for use by NCSU.
3. Installer/programmer has been certified within the last 2 years to install the FACP.
4. Battery calculations have been submitted to NCSU Electronics for review.
5. Received NFPA 72 certification for inspection and testing from the installer.
6. Received printout of 100% device test with addresses.
7. Received sensitivity test report for each smoke detector.
8. Received copy of installer's system response matrix.
9. Received copy of installer's layout system mapping (if applicable)
10. System program was downloaded externally and reinstalled from that point.
11. Installing programmer is NICET level 2 minimum.
12. Installing company is NICET level 4.

(If any of the above items have not been obtained, the observation cannot continue).

Fire Alarm System Installation and Configuration**Conduit and wiring:**

1. Insulated throat connectors and all conduit is 3/4" minimum.
2. No set screw raceway connectors.
3. No PVC conduit (interior or exterior).
4. All junction boxes are covered and all screws in place.
5. All junction boxes, extension rings, and metal covers are painted **RED**.
6. Each conduit length is securely fastened in place every 10'. In addition, each conduit shall be securely fastened within 3' of any box or cabinet.
7. Boxes containing a 120V or higher circuit must have a green ground wire and be bonded to an unpainted surface and/or grounding terminal.
8. Conductors for signal and notification circuits are continuous runs (no splices).
9. All field wiring in the system is labeled where attached to the FACP, in each terminal cabinet, and marked on a legend inside each terminal cabinet door on every floor.
10. All circuits are properly and securely terminated. Termination blocks are approved for the number and size of wires connected to each terminal. All wire connectors are approved. Terminal strips are securely attached to the inside of the junction box, no floating strips.
11. The feed and return loops are Class A circuits in separate conduit for each end of the line notification circuit. DO NOT combine loop notification conductors in the same conduit except where permitted by the specifications.
12. The supply and return conduits shall have a 3' separation between them.

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Pull station, smoke detector, heat detector, and A/V devices:

- [illegible]

Duct detectors:

- [illegible]

7. Confirm the system batteries are date labeled.
8. Confirm operational instructions are framed and mounted at the FACP and the annunciator panel.
9. Confirm zone map is legible, framed, and mounted at the FACP and the annunciator panel. Minimum font size of 6 point in bold.
10. Verify smoke detector and SNAC panel are located within 15' of the FACP and in the same room.
11. Building with 100 or more addressable devices or more than 3 or more occupies floors shall have a printer installed in an approved location and on an approved shelf or table. The printer must also be served by an electrical circuit.
12. Confirm location of LED annunciator as acceptable.
13. On new and existing projects: AHU confirm defeat switch must be installed at the FACP. An abnormal position of the switch must cause a trouble in the FACP.

Fire Alarm testing and operation:

1. The fire alarm panel must be clear of troubles and in a 'green' condition before beginning testing.
2. Perform an LED lamp test of the panel. Do all the lights work?
3. Disconnect each phone line 1 at a time to verify line failure is transmitted to the monitoring station within a 1 minute time period. Reconnect each line to verify the trouble clears.
4. Have contractor unscrew each end of line device from the wall and in each NAC circuit for verifying battery voltage during testing, per procedures listed below.
5. Disconnect the batteries to the FACP, verify a trouble is indicated in the panel. within 1 minute. Reconnect the batteries to verify the trouble clears.
6. Perform a battery/current test. This requires 2 digital meters to test current and voltage.
7. All troubles should activate the DAC within 1 minute.

NAC test procedure for A/V devices:

Turn off A/C power & while on battery power initiate an alarm condition, test battery voltages at FACP to confirm there is @ 13 volts with no more than a 0.4 volt difference between batteries.
Install 1 digital meter to read inline current and 1 digital meter to read voltage.

Starting Voltage and Current Test:

FACP

Battery 1 ____ VDC
 Battery 2 ____ VDC
 Batteries 1&2 Series ____ VDC
 Card output NAC 1 ____ VDC ____ Amps
 Card output NAC 2 ____ VDC ____ Amps
 Card output NAC 3 ____ VDC ____ Amps

End of Line Device

____ VDC
 ____ VDC
 ____ VDC

SNAC#_____

Card output NAC 4 ____VDC ____Amps ____VDC

SNAC#_____

Card output NAC 4 ____VDC ____Amps ____VDC

SNAC# _____

Card output NAC 4	VDC	Amps	VDC
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SNAC# _____

Card output NAC 4	VDC	Amps	VDC
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30 Minute Voltage and Current Test

End of Line Device

Card output	VDC	Amps	VDC
Card output NAC 4			

SNAC# _____

Battery 1	_____ VDC	
Battery 2	_____ VDC	
Batteries 1&2 Series	_____ VDC	
Card output NAC 1	_____ VDC _____ Amps	_____ VDC
Card output NAC 2	_____ VDC _____ Amps	_____ VDC
Card output NAC 3	_____ VDC _____ Amps	_____ VDC
Card output NAC 4	_____ VDC _____ Amps	_____ VDC

SNAC# _____

Battery 1	_____ VDC	
Battery 2	_____ VDC	
Batteries 1&2 Series	_____ VDC	
Card output NAC 1	_____ VDC _____ Amps	_____ VDC
Card output NAC 2	_____ VDC _____ Amps	_____ VDC
Card output NAC 3	_____ VDC _____ Amps	_____ VDC
Card output NAC 4	_____ VDC _____ Amps	_____ VDC

SNAC# _____

Battery 1	_____ VDC	
Battery 2	_____ VDC	
Batteries 1&2 Series	_____ VDC	
Card output NAC 1	_____ VDC _____ Amps	_____ VDC
Card output NAC 2	_____ VDC _____ Amps	_____ VDC
Card output NAC 3	_____ VDC _____ Amps	_____ VDC
Card output NAC 4	_____ VDC _____ Amps	_____ VDC

SNAC# _____

Battery 1	_____ VDC	
Battery 2	_____ VDC	
Batteries 1&2 Series	_____ VDC	
Card output NAC 1	_____ VDC _____ Amps	_____ VDC
Card output NAC 2	_____ VDC _____ Amps	_____ VDC
Card output NAC 3	_____ VDC _____ Amps	_____ VDC
Card output NAC 4	_____ VDC _____ Amps	_____ VDC

Batteries shall not exceed a voltage drop of three (3) volts from the NAC card output terminal to the End of Line device for each loop. If the voltage drop is more than 3 volts the test must stop and the system fails inspection until the error can be corrected.

Post Voltage Test Continuation

1. Request a mapping chart layout to test isolation modules. Modules shall be installed after a max. of 25 devices in each addressable loop.
2. Confirm addressable loop controller circuits are Class 'A' with the contractor.
3. Confirm isolation modules are installed at the FACP on both the outgoing and returning conductors for each loop (minimum of 3 per loop).
4. Confirm each ISO module is labeled as 'Isolation Module' with the Loop #.
5. If speakers are installed, all must be shielded and tested free of grounds with

good continuity from connection to speaker.

6. Request Contractor to reconnect the 120V power source to the FACP and reset the panel to Normal (green).
7. Request Contractor to place an 'Open' in the '+' and '-' SLC/NAC to test the power supervision. The FACP should indicate a trouble on each. This shall be performed between each isolation module in each loop, a minimum of 2 locations in each loop, a maximum number of fault tests will be determined by the number of ISO modules.
8. Request contractor to place a 'short' in the '+' and '-' SLC/NAC to test the power supervision. The FACP should indicate a trouble on each. This shall be performed between each isolation module in each loop, a minimum of 2 locations in each loop, a maximum number of fault tests will be determined by the number of ISO modules.
9. Request contractor to place a 'ground fault' in the '+' and '-' SLC/NAC to test the power supervision. The FACP should indicate a trouble on each. This shall be performed between each isolation module in each loop, a minimum of 2 locations in each loop, a maximum number of fault tests will be determined by the number of ISO modules.
10. Request the contractor return the panel to a Normal (green) condition.

SLC Test Procedures: Smoke, Heat and Duct Detectors, Pull Stations, Etc.

1. Initiate all alarm devices by manually operating pull stations, using test smoke for detectors (no magnets for initial testing), smoke testing duct detectors, and flowing water to trip flow switches and tampers.
2. Confirm each device address, device descriptor, and location is correct on the Contractor provided Fire Alarm Zone Map and on the FACP display/printer for each device being tested.
3. Confirm during testing the operation of A/V alarm notification appliances. The audible level must be 15dBA above the normal ambient sound levels in all occupied areas of the building.
4. Indoor Strobe appliances must flash between 60 and 120 times per minute.
5. Sounder base detectors: request the Contractor to place an 'open' in the '+' and '-' to test the power supervision. The FACP should indicate a trouble on each.
6. Sounder base detectors: request the Contractor to place a 'Short' in the '+' and '-' to test the power supervision. The FACP should indicate a trouble on each.
7. Sounder base detectors: request the Contractor to place a 'Ground fault' in the '+' and '-' to test the power supervision. The FACP should indicate a trouble on each.
8. Confirm during the test: operation of HVAC shutdown and closure of all Fire doors.
The HVAC shutdown must occur within 20 seconds (gas pack equipped units may delay up to 50 seconds to protect the heat exchanger).
9. Confirm any outside A/V appliances for operation and that they silence on the FACP silence command. These devices shall also sync with the building A/V devices.
10. Place an 'Open' in the '+' and '-' of any auxiliary 24-volt circuits that power

[illegible]

external equipment such as beam detectors, 4 wire duct detectors, or others to verify proper supervision. The FACP should indicate troubles on each.

Sprinkler System

1. Confirm operation of Water flow switches by manually flowing water from all inspectors’ test valve locations. The alarm should latch on within 20-45 seconds and the outside mechanical water gong should sound within 15 seconds.
2. The inspector’s test discharge is limited to a ½” stream by the use of a sprinkler head minus the deflector.
3. Request the contractor to close all supervised control valves one at a time to verify the supervisory signal to the FACP within 2 turns of the control handle. Close the valve all the way to ensure the signal does not clear. Verify the return to a normal /restore condition on the FACP for each valve.
4. Request the contractor to close the PIV to verify the supervisory signal at the FACP within 2 turns of the wrench/handle or 1/5 the mechanical travel distance. Shut all the way to ensure the signal does not clear. Reopen fully to verify the restore signal.
5. If there is a dry pipe system or pre-action system request the contractor to demonstrate that the water-flow alarm functions by manually flowing water through the test valve to activate the water gong.
6. If applicable, request the Contractor to place the air compressor into a low air and high air condition to verify the supervisory signals are sent to the FACP.
7. Verify the Design Data plates are riser mounted and stamped or engraved, labels or written data is acceptable. Also verify control valve tags are attached to each valve with the area they control on the back of the tag.
8. Verify the installation of a 3” minimum PVC tube with end caps mounted **Horizontally** in a location not prone to get wet and labeled “Approved Sprinkler Drawings”. The tube must contain Engineer sealed sprinkler drawings and the approval letter from SCO for the system.
9. The Fire Alarm devices are installed with liquid tight conduit and mounted up and out of the way of any water spray. Especially the area around the back-flow prevention devices.
10. Verify the PIV has a University lock installed with the Public Safety ‘M’ core.
11. Visually inspect the PIV surge protection to verify it meets the SCO installation guideline. Surge protection must also be grounded per the manufacturer’s instructions.
12. Verify the exterior hot box has a heater installed with a low temperature alarm.
13. The heater circuit and low temperature circuit are in two separate conduits.
14. The low temperature alarm signals directly to the DAC without N.O. contacts.

Pre-Action Systems

1. The PAS panel is installed in the same manner as the FACP.
2. Any pump associated with the PAS is on an emergency power circuit with a circuit breaker lock and tag in place.

Commercial Kitchen Hood Extinguishing System

1. Each hood system is connected to the FACP to automatically activate the Fire Alarm. Request the Contractor to demonstrate this function by manually operating the monitoring switch without releasing the extinguishing agent.

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Note: If the system is a wet agent based system the activation must shut off the gas supply (if equipped) and also activate a shunt trip circuit breaker to disconnect ALL electrical power to the appliances under the hood. The exhaust fans should continue to run but the make-up air must shut down. These functions are to be controlled by the Hood System Extinguishing system not from signals sent by the FACP.

Single Range type Residential Kitchen Hood Systems

1. The fire extinguishing system on a residential kitchen hood is connected to the FACP to automatically activate the Fire Alarm if equipped with a local suppression system. Request the Contractor to demonstrate this functions properly by manually operating the monitoring switch without releasing the extinguishing agent.

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Note: If the system is a wet agent based system the activation must shut off the gas supply (if equipped) and also activate a shunt trip circuit breaker to disconnect ALL electrical power to the appliances under the hood. The exhaust fans should continue to run but the make-up air must shut down. These functions are to be controlled by the Hood System Extinguishing system not from signals sent by the FACP.

Note: If the Stove/Range is equipped with Low Heat Elements it will be exempt from requiring a local suppression system.

Air Sampling Systems

1. System shall be networked through and controlled at the FACP.
2. A functional test report shall be presented by the installing Contractor and verified by the design Engineer prior to testing by the University.
3. All panels and associated piping shall be labeled according to University and Manufacturer's guidelines.
4. System is installed to specifying Engineer's design and verified by the installing contractor and University representative.
5. System shall be tested to the Manufacturer's specifications and documented by the Contractor and University Representative.
6. Any equipment necessary to field program the system for maintenance or use shall be provided to the University as part of the acceptance package.
7. The air sampling system shall be identified on the Fire Alarm zone map including the tubing/piping layout.
8. All commissioning procedures established by the Manufacturer shall be followed and documentation to support these procedures shall be presented to the University, as part of the acceptance process.
9. Verify the system filter has been replaced prior to the beginning of the warranty period.
10. Verify any buttons on the control module are disabled and that the system functions off the controls on the Fire Alarm Control Panel.

[illegible]

