SECTION 28 4600

FIRE DETECTION AND ALARM

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LANL MASTER SPECIFICATION SECTION

Word file at <https://engstandards.lanl.gov/specs.shtml>

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| Rev. 4 Summary of Changes1. Revised in entirety to improve conciseness and clarity. Relocated requirements based on whether they were qualification, equipment, or execution requirements. Removed design requirements and added them to the ESM.
2. Added requirement for a points/address list as an action submittal.
3. Added requirements for area of refuge two-way emergency communication systems.
4. Added requirements for labeling inside terminal cabinets, and FACU/NAPPs.
5. Part 1.1.B: Added more fire alarm components.
6. Part 1.1C: Added codes and standards.
7. Part 1.2: Added more related sections.
8. Part 2: Added and updated products and removed design descriptions.
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This template applies to new and existing fire alarm systems and must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  Document must also be edited to delete requirements for processes, items, or designs that are not included in the project scope -- and specifier’s notes such as these.  To seek variance from requirements that are applicable, contact the Engineering Standards Manual [Fire](https://engstandards.lanl.gov/POCs.shtml#fire) POC. Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable sections from all Divisions, especially Division 1, General requirements.

Section developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality articles.

Seismic: To edit this section for job-specific seismic requirements, refer to author notes that indicate “Seismic,” and the document, *Seismic Spec-Editing for Electrical/Fire Alarm Components* (“Guide,” posted under References on the [LANL Master Specifications](https://engstandards.lanl.gov/specs.shtml) page) for guidance on properly editing this section.
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1. GENERAL
	1. SECTION INCLUDES
		1. Furnish, install, test, certify, and place into service a complete UL Listed and/or FM Approved, addressable fire alarm system. The system shall be complete with all hardware and software specifically tailored for this installation.
		2. Provide an addressable fire alarm system consisting of, but not limited to, the following components:

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Edit 1 through 16 to match project fire alarm system requirements. Supplement list for devices or equipment not listed. Specific details of the required system can be provided as necessary. Modify description for modifications of existing systems.

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* + - 1. Fire alarm control units (FACU)
			2. Notification appliance power panels (NAPP)
			3. Conduit and wiring
			4. Manual fire alarm pull stations and abort switches
			5. Fire detectors (e.g., smoke, thermal, flame)
			6. Monitoring of sprinkler system supervisory and alarm signals
			7. Notification appliances (horns, speakers, strobes, combination)
			8. Emergency control functions interfaces (Air handling system/fan/air conditioner shutdown relays, elevator recall/shunt/indicator relays, door release)
			9. Secondary power batteries
			10. Conduit and communication cable to building’s telecommunications room
			11. Knox Box supervisory and trouble switches
			12. Manual transfer switch for FACU or NAPP branch circuit.
			13. LED annunciator or switch card (disable buttons)
			14. Digital alarm communicator transmitter (DACT)
			15. Gas Detection
		1. Install the fire alarm system in accordance with the editions of NFPA 72 *National Fire Alarm and Signaling Code*, NFPA 70 *National Electrical Code*, ASME A17.1 *Safety Code for Elevators and Escalators,* NFPA 90A *Standard for the Installation of Air-Conditioning and Ventilating Systems,* NFPA 2001 *Standard on Clean Agent Fire Extinguishing Systems,* andNECA 305 2018 *Standard for Fire Alarm System Job Practices* cited within the edition of the IBC listed in the approved design documents.

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Seismic: See Guide discussed in first authors note for editing guidance.

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* 1. related sections
		1. Section 01 2500, *Substitution Procedures*
		2. Section 01 3300, *Submittal Procedures*
		3. Section 01 4216, *Definitions*
		4. Section 01 6000, *Product Requirements*
		5. Section 01 7700, *Closeout Procedures*
		6. Section 01 7823*, Operation and Maintenance data*
		7. Section 01 7839, *Project Record Documents*
		8. Section 01 8734, *Seismic Qualification of Nonstructural Components* (IBC)
		9. Section 02 4115, *Electrical Demolition*
		10. Section 07 8400, *Firestopping*
		11. Section 08 7100, *Door Hardware*
		12. Section 09 9100, *Painting*
		13. Section 21 1313, *Wet-Pipe Sprinkler Systems*
		14. Section 21 1316, *Dry-Pipe Sprinkler Systems*
		15. Section 21 1319, *Preaction Sprinkler Systems*
		16. Section 21 1326, *Deluge Fire-Suppression Sprinkler Systems*
		17. Section 21 2200, *Clean Agent Fire-Extinguishing Systems*
		18. Section 22 0535*, Electric Heat Tracing Systems*
		19. Section 23 3300, *Air Duct Accessories*
		20. Section 26 0526, *Grounding and Bonding for Electrical Systems*
		21. Section 26 0533, *Raceways and Boxes for Electrical Systems*
		22. Section 26 0548.16, *Seismic Controls for Electrical Systems*
		23. Section 26 0553*, Identification for Electrical Systems*
		24. Section 26 2726, *Wiring Devices*
		25. Section 27 1000, *Structured Cabling*
	2. SYSTEM DESIGN

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Edit system design description to match the project fire alarm system requirements. Include details to supplement the project (engineering) drawings, as required. The example list should not be considered comprehensive for any specific project. Projects with high explosives areas or NEC Article 500 hazardous locations will require additional specialized equipment and system characteristics not included in this specification.

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1. System Design:
	* + 1. Pathways: Survivability Level [fill in as per project. Must be Level 1 minimum].
			2. System circuits configured as follows:
				1. SLC or Network Circuits between FACUs/transponders Class X;
				2. Other Signaling Line Circuits (SLC) Class B;
				3. Initiating Device Circuits (IDC) Class B;
				4. Notification Appliance Circuits (NAC) Class B;
				5. Emergency Two-Way Communication Class B;
				6. Emergency Control Function Circuits Class D.
			3. SLC zones configured as separate circuits or a hybrid Class A isolator loop with Class B branches.
			4. SLCs shall not exceed 80% total device capacity.
			5. Calculations: Use the UL max current draw for notification appliances.
			6. NACs: Provide end-of-line voltages 10% greater than the minimum device operating voltage, starting with the panel cut-off voltage at the terminals. Current draw not exceeding 80% of maximum capacity.
			7. Batteries: Sized for 24 hours of standby and 10 minutes (minimum) of alarm, fully loaded SLCs, and 10% of indicator lights and other auxiliary features active. De-rating factor: 50%.
			8. The FACU LED Annunciator/Switch Card pre-defined disable groups shall correspond to individual control relay for disabling emergency control functions independently and a separate group for all notification appliances (except for any sprinkler system waterflow audible alarms).
			9. Provide surge protection devices (SPD) on the primary power circuit, and all fire alarm and control circuits that leave or enter a building.
			10. Provide a remote indicator light for duct smoke detectors located outside, above a ceiling, or in a separate space than the associated control relay.
	1. QUALITY ASSURANCE
		1. Qualifications of Subcontractor producing shop drawings:
			1. Be licensed in the State of New Mexico to design fire alarm systems.
			2. Have successfully designed at least 20 fire alarm systems of equivalent nature and scope to the system described in this Section.
			3. Utilize a qualified fire alarm system technician who is NICET (National Institute for Certification in Engineering Technologies) III or IV certified.
			4. Be a manufacturer factory-certified representative for the specified fire alarm system.
		2. Qualifications of Subcontractor installing the fire alarm system:
			1. Have successfully installed and field-tested at least 20 fire alarm systems of equivalent nature and scope to the system described in this Section.
			2. Provide services of a NICET II (minimum) technician certified in Fire Alarm Systems installation and testing.
			3. Be factory trained in the theory, operation, installation, and troubleshooting of the specified fire alarm system.
	2. action submittals

Provide the following per the schedule in Appendix A of this Section.

* + 1. Certifications
			1. Within 30 days after Notice to Proceed, certifications of the qualifications of the fire alarm installing firm as described in the quality assurance paragraph above.
			2. Within 30 days after Notice to Proceed, certifications of the qualifications of the fire alarm system technician as described in the quality assurance paragraph above.
			3. Certification from the fire alarm control manufacturer that proposed alarm-initiating devices, alarm appliances, and auxiliary devices are compatible with the FACU and other auxiliary equipment.
		2. Deferred Detailed Design (Installation) Documents
			1. Catalog Data for all equipment and devices.
			2. A design package shall be submitted conforming to the requirements of NFPA 72 Section 7.4 “Shop Drawings” per the schedule in Appendix A.
			3. Submit for review at least 30 days prior to scheduled start of fire alarm system installation. Installation shall not proceed without 100% shop drawing approval by LANL (Fire Protection Office, and the FDAR or LBO, appropriately for the work type).
			4. Mark the first package as a 60% Shop Drawing Design. A design without comments may proceed to the 100% Design with the concurrence of the LANL Fire Protection Office. Address comments with additional design review percent.
			5. Draft revisions shall be marked with the appropriate number, starting with 0 for the initial, and letter, starting with A for 60%. Modifications of existing drawings shall be marked with the next sequential revision number.
			6. Provide calculations as a sheet in the design package drawings which includes:
				1. System battery load calculations
				2. Voltage-drop calculations
				3. Line resistance calculations
			7. In addition to NFPA 72 Section 7.4 “Shop Drawings” requirements:
				1. Provide two (2) sets of full-sized Arch D drawings for the 60% design, and when request by the LANL Fire Protection Office.
				2. The minimum scale shall be 1/8" = 1'-0" for plans and 1/4" = 1'-0" for details.
				3. Font size shall be a minimum of 3/16" and other lettering a minimum of 1/8".
				4. Show conduit layout, quantity, size, and type of wires in each conduit.
				5. Provide settings for each fire alarm device on the plans and risers including addresses, candela, loudness, wattage, and voltage.
				6. Provide location of and conductor pathway to electrical panels and other equipment supplying primary or secondary power.
				7. Provide location and type of all interfaced systems for monitoring or emergency control functions.
				8. Provide installation specific wiring and termination details for monitoring module and control relays/modules at the monitored or controlled equipment.
				9. Provide a system input/output matrix indicating output functions to occur for each input/initiating point or zone.
				10. Provide elevation drawings.
				11. Provide a sheet with the Materials and Parts List.

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Seismic: See Guide discussed in first authors note for editing guidance.

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* + - * 1. Required seismic design documentation:
			1. Include dimensioned representations or plans and elevations that identify the weight and the location of the center or gravity.
			2. Indicate field anchorage or mounting provisions to hold the component in place and resist forces derived from the criteria specified in [Section 01 8734] [Section 26 0548.16].
			3. Identify anchors and other mounting devices.
			4. Include information on the size, type, and spacing of factory-installed mounting brackets, holes, and other mounting provisions.
			5. Installation Instructions.
			6. Points/Address List with Descriptions.
			7. FACU Program and Central Station Report.
			8. Operations & Maintenance Manual
				1. Follow the requirements of Section 01 7823.
				2. Submit operating and instruction manuals that include the as-built calculations and drawings.
				3. Provide in an electronic format shall consist of all items combined into one PDF file.
				4. Submit project-specific operating and maintenance instruction manuals upon successful completion of testing.
				5. Provide complete, step-by-step recommended and required testing instructions with frequency, methods, and troubleshooting information for all devices and equipment.
				6. Maintenance instructions shall provide the following information:

Instructions for replacing any components of the system, including internal parts.

A list of recommended spare parts.

Instructions and schedule for periodic cleaning and adjustment of equipment meeting NFPA 72.

A list of all equipment with the address and telephone number of the manufacturer and local supplier.

* + 1. Test Reports

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An installer’s preliminary test report should be required when additional assurance that the system is ready for LANL pre-final and final testing with the fire alarm system reporting to the LANL supervising station at the Emergency Operations Console (EOC). This is not intended to require a report for LANL pre-testing of the fire alarm system and it’s reporting to the EOC, which precedes the final acceptance test. A statement of compliance can also be required. Neither are appropriate for system modifications, which often require final acceptance test immediately after tie-in to the existing system. Test plans and final test reports are required by the IBC/IFC and NFPA 72 for all work.

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* + - 1. [Installer’s Preliminary Test Report: Submit report of the installing subcontractor’s preliminary tests in accordance with NFPA 72 and indicating system status and corrective actions required.]
			2. [Statement of Compliance per IFC Section 901.2.1 and NFPA 72 Section 7.5.2.]
			3. Test Plan: Submit test plan for the final acceptance tests, prior to scheduling the final acceptance test.
			4. Final Test Report: After final acceptance test, submit test reports.
		1. Project Record Documents
			1. Provide updated drawings reflecting as-built conditions of the work completed: one (1) full-sized drawing and two (2) 11” x 17” drawings.
			2. Provide the electronic drawing files in “.pdf” and AutoCAD “.dwg” formats.
			3. Provide Record of Completion and associated documentation for the completed system according to NFPA 72.
		2. Warranties: Warrant all equipment and wiring for mechanical and electrical defects for not less than one year (365 days) from the date of final acceptance
	1. PRODUCT HANDLING

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Add any special product handling requirements for the facility in which this system is to be installed.

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* + 1. Materials and Equipment: Protect from damage during shipping, storage, and installation.
1. PRODUCTS

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Seismic: If Project Spec includes 26 0548.16, and this Section (i.e., 28 4600) includes devices that differ from those in 26 0548.16, then these products (i.e., the devices that differ) must be included in PART 2. And, if/when what’s been described is applicable, use the same terminology for these devices in PART 3 herein to identify the type of devices required for each application.

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* 1. GENERAL
		1. Provide materials and equipment that are new and unused, free of defects, specifically designed for the use intended.
		2. Provide products suitable for operation at an elevation of 7,500 ft.
		3. Where two or more products serving the same function are provided, they shall be exact duplicates produced by one manufacturer. (*note,* *use of different models or options of products to achieve a system design requirement is not included in this requirement; e.g., weather-proof, conventional devices in exterior locations; or notification appliances with atypical output ratings that are better options for achieving design criteria).*

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Seismic: See Guide for editing guidance. If either paragraph 2.2.A or 2.2.B applies and there are too many systems/components to list here, then list them in an appendix to this section, and then add a reference to that appendix in 2.2.A/ 2.2.B.

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* 1. SEISMIC PERFORMANCE REQUIREMENTS
		1. The [\_\_\_\_\_ ] shall remain in place without separation of any parts when subjected to the design-basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 26 0548.16, *Seismic Controls for Electrical Systems*].
		2. The [\_\_\_\_\_] is a Designated Seismic System and, as such, shall remain in place and be fully operational following the design-basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 26 0548.16, *Seismic Controls for Electrical Systems*].
	2. FIRE ALARM CONTROL Unit
		1. The FACU shall incorporate all control electronics, relays, and necessary modules and components in a [flush] [semi-flush]mounted cabinet. The operating controls and zone/supervisory indicators shall be located behind locked door with viewing window. [Use NEMA 3 for FACU and power supplies.]
		2. The cabinet shall have a locked door with viewing window.
		3. Provide sealed lead-acid batteries from Edwards, NOTIFIER BAT Series, PowerSonic, or an approved equal. Provide battery calculations when submitting the battery size.
			1. Battery boxes, if required, shall be UL Listed for the purpose.
		4. The system program shall meet the requirements of this project, applicable codes and standards, and satisfy the LANL Fire Protection Group.
		5. The power supply shall be a high efficiency switch mode type with line monitoring. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc for notification appliance circuits. All outputs shall be power limited.
			1. Manufacturers: Edwards 4-PPS/M, NOTIFIER ACPS-610, or an approved equal
		6. The FACP shall have a high-contrast, alphanumeric display and LED indicators.
		7. Central Processor Unit Manufacturers: Edwards 4-CPU, NOTIFIER CPU, or an approved equal
		8. The FACP shall have a digital alarm communicator transmitter (DACT).
			1. The DACT shall support dual telephone lines, “contact ID” communications format, and configured for dual-tone, multi-frequency (DTMF).
			2. The DACT shall be listed for “Central Station Fire Service” and for “Proprietary Station Fire Service” and shall be of the same manufacturer as the control panel.
			3. Manufacturers: 3-MODCOM, NOTIFIER UDACT-2, or an approved equal.
		9. Manufacturers: Edwards EST3X, EST4, NOTIFIER NFS 2-640, or an approved equal.
		10. For applications requiring a conventional panel, use Fike SHP-Pro or an approved equal.
		11. For clean agent systems that are not using a conventional panel, follow the requirements of Section 21 2200 (*para 2.3.E*).
			1. Include Edwards EST SIGA-REL, NOTIFIER FCM-1-REL, or an approved equal.
			2. For mounting purposes: Edwards EST MFC-A, NOTIFIER SMB500, or approved equal.
			3. For conventional systems: Fike ARM-III with appropriate mounting or an approved equal.
	3. led annunciator/switch card
		1. Manufacturers: Edwards 4-24L12S, NOTIFIER ACM-24AT, or an approved equal.
	4. Remote annunciator PANEL
		1. Manufacturers: Edwards EST 4-[2]ANN with 4-2ANNMT cabinet or an approved equal.
	5. ADDRESSABLE THERMAL DETECTORS
		1. The detector shall be temperature-rated at 135°F (fixed temperature or rate-of-rise). For applications requiring other than 135° F, consult the LANL Fire Protection Group.
		2. Manufacturers:
			1. Fixed temperature: Edwards EST SIGA-HFD, NOTIFIER FST-951, or an approved equal.
			2. Rate-of-rise: Edwards EST SIGA-HRD, NOTIFIER FST-951R, or an approved equal.
			3. For conventional systems: Fike 60-1029, system Sensor Series 100, or an approved equal.
			4. For hazardous locations: Edwards EST 302 Series, or an approved equal.
	6. ADDRESSABLE PHOTOELECTRIC DETECTORS
		1. Photoelectric detectors shall be ceiling mounted and be suitable for wall mount applications.
		2. Manufacturers: Edwards EST SIGA-OSD or NOTIFIER FSP-951, or an approved equal.
			1. For conventional systems: Fike 63-1024 with the appropriate base, System S or an approved equal.
			2. For hazardous locations: Edwards EST 30-3013 or an approved equal.
	7. CARBON MONOXIDE DETECTORS
		1. Gas detectors: UL 2075 listed and responsive to the sensitivity limits of UL 2034.
		2. Manufacturers: Edwards EST SIGA-COD, NOTIFIER FSCO-951, or an approved equal.
	8. COMBINATION SMOKE/CARBON MONOXIDE DETECTORS
		1. Combination detectors, UL 1484 or UL2075 listed.
		2. Manufacturers: Edwards EST SIGA-OSCD, NOTIFIER FPC-951(A), or an approved equal.
	9. DETECTOR MOUNTING BASES
		1. Standard bases suitable for mounting on 3-1/2” or 4” octagon box and 4” square box. The base shall contain no electronics and support all detector types. Removal of the detector shall not affect communications with other detectors.
		2. Manufacturers: Edwards EST SIGA-SB4, NOTIFIER B300-6 Low profile base, or an approved equal.
	10. DUCT SMOKE DETECTOR AND HOUSING
		1. Provide duct housing assemblies for mounting an intelligent analog photoelectric detector along with a standard relay or isolator detector mounting base. Protect the measuring chamber from damage and insects. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream. Provide drilling templates and gaskets to facilitate locating and mounting the housing.
		2. Provide duct detectors that are suitable for the air velocity and differential pressures measured for each air handling unit.
		3. Where a duct detector is installed in a concealed location, more than 10 ft above the finished floor, or outside provide a remote alarm indicator.
		4. Manufacturers:
			1. Duct Detectors: Edwards EST SIGA-SD, NOTIFIER DNR Series, or an approved equal.
			2. Remote alarm LED: Edwards EST SIGA-LED, NOTIFIER RA100Z(A), or an approved equal.
			3. For conventional systems, use Fike 63-029, System Sensor InnovairFlex, or an approved equal.
	11. GAS DETECTors
		1. Refer to the design documents for exact products.
	12. BEAM DETECTORS
		1. Manufacturers: NOTIFIER FSB-200SA detector & RT151A test station with appropriate accessories, or an approved equal.
	13. AIR SAMPLING DETECTORS
		1. Refer to the design documents for the exact product.
	14. Video Flame/Smoke Detectors
		1. Manufacturers: Fike 28-001
	15. ADDRESSABLE MANUAL PULL STATIONS
		1. Provide addressable double-action, non-coded manual pull stations.
		2. The fire alarm station shall be of Lexan or metal construction with an internal toggle switch. Provide a key locked feature. Finish the station in red with white PULL IN CASE OF FIRE lettering. The manual station shall be suitable for mounting on 2-1/2” deep 1-gang boxes and 1-1/2” deep 4” square boxes with 1-gang covers.
		3. Provide the appropriate back boxes and mounting plates for flush-mounting or surface mounting (depending on the building construction).
		4. Manufacturers:
			1. Pull stations: Edwards EST SIGA 27, NOTIFIER NBG-12LX, or an approved equal.
			2. Backboxes: Edwards EST 276B-RSB, NOTIFIER SB-10, or an approved equal.
		5. Releasing manufacturers:
			1. Pull station & Abort Switch: Edwards EST 278A-REL & Edwards EST RELA-ABT, or NOTIFIER NBG-12LRAA, or an approved equal.
		6. Hazardous locations: Edwards EST MPSR series, Fike 10-2963, or an approved equal.
	16. ADDRESSABLE CONTROL RELAY MODULES
		1. Provide enhanced voltage and current ratings as appropriate for the application.
		2. Manufacturers: Edwards EST SIGA-CR, SIGA-CRH or NOTIFIER FRM-1, or an approved equal.
	17. addressable monitor modules
		1. Provide intelligent single-input or dual-input modules as required to the addressable analog loop. Each input shall provide a supervised Class B initiating device circuit.
		2. Manufacturers: Edwards EST SIGA-CT1 single-input or SIGA-CT2 dual-input; or NOTIFIER FlashScan Monitor Module FMM-1 or FDM-1 FlashScan dual monitor module; or an approved equal.
			1. For class A configurations, use Edwards EST SIGA-UM or an approved equal.
	18. NOTIFICATION APPLIANCES
		1. Provide NRTL-listed 24 VDC audible, visual, and audible-visual combination-type electronic three-pulse temporal pattern horn sounder, strobe, and combination notification appliances.
		2. Horns and hornstrobes shall be UL 464 listed. For voice alarm systems, speakers shall be UL 1480 listed. Horns and speakers shall be in a red housing.
		3. Strobes and hornstrobes shall be UL 1971 listed. Strobes shall have a xenon bulb or LED enclosed in a clear Lexan lens, and FIRE in white lettering on a red trim plate or device housing.
		4. Horns, strobes, and horn/strobes shall mount to a 4” x 2-1/8” deep electrical box with single device cover. Provide weatherproof wall boxes for outdoor mounting.
		5. Manufacturers: EST Genesis series, WHEELOCK Exceder series, System Sensor P[C]2RL Series, or an approved equal.
			1. Backboxes: EST Genesis series, WHEELOCK ESB[C] series, or an approved equal.
			2. Weatherproof: EST Genesis WG4 series, Wheelock Weatherproof appliances, or an approved equal.
			3. Explosionproof: EST 116DEGEX-FJ, 889D, or an approved equal
		6. Voice evacuation systems:
			1. Manufacturer: SYSTEM SENSOR SpectrAlert series, EST Genesis Series, or an approved equal.
			2. Backbox: EST Genesis G4B or approved equal.
		7. Releasing:
			1. Horns: WHEELOCK Exceder series, or an approved equal.
			2. Strobes: WHEELOCK Exceder series or approved equal strobe with [clear, amber, red, blue] lenses
			3. Backboxes: WHEELOCK ESB[C] Backbox or approved equal.
		8. Gas Detection:
			1. Wheelock Exceder series or approved equal strobe with [color] lens (weatherproof device if strobe is outside).
	19. NOTIFICATION Appliance Power PanelS (NAPP)
		1. Manufacturers: Edwards EST BPS-10A, NOTIFIER ACPS-610, or an approved equal.
	20. Area of Refuge Emergency Two-Way Communication Systems (ECS)
		1. Manufacturers:
			1. Central Control Point: RATH SmartRescue Base Stations (2500-205 / 2500-210), ALPHAREFUGE 2100 Series Refuge Command Center (RCC2505 / RCC2510), or an approved equal.
			2. Remote Call Stations: RATH 2100-986, ALPHAREFUGE RCB2100 Series Callbox, or an approved equal.
			3. Power Supply: RATH 2500-PWR24U or equivalent with contacts for power failure supervision. Use AlphaRefuge PWR2410A if the central control point is not remote powered.
	21. Door ReLEASE
		1. Refer to Section 08 7100 for door hardware requirements.
		2. Manufacturers: Edwards EST Electromagnetic Door Holders
	22. racewayS
		1. Provide EMT for interior work or outdoor work that is encased not less than 2 inches of concrete.
		2. Provide IMC or RMC for exposed outdoor raceways.
		3. Provide PVC, tape-wrapped IMC, or tape-wrapped RMC for underground work. Note: Must be installed per manufacturer recommendations.
		4. Minimum raceway size shall be ¾ inch, unless otherwise approved.
		5. All EMT raceway fittings shall be compression type.
		6. One-half (1/2) inch FMC up to 6 feet in length is allowed in between addressable modules and controlled and monitored devices.
		7. All interior fire alarm raceways for power-limited circuits shall be red, unless otherwise approved. *Note: Fittings, conduit bodies, junction boxes, and device boxes are not required to be red.*
		8. Raceways for 120V circuits shall be unpainted galvanized.
		9. If red exterior fire alarm raceway is not readily available, it is permitted to instead apply outdoor rated UV resistant “Fire Alarm” labels at 10’ intervals.
		10. Refer to Section 26 0533, *Raceway and Boxes for Electrical Systems*, for raceway systems.
	23. JUNCTION BOXES and Backboxes
		1. Refer to Section 26 0533, *Raceway and Boxes for Electrical Systems*, for junction boxes.
	24. WIRING
		1. New wiring shall be provided unless re-use of existing has been approved.
		2. Existing wiring shall be integrity tested (Megger) and phased per the color code.

Color Code fire alarm wiring as follows:

|  |  |
| --- | --- |
| Black, Red, or Blue | 120 Vac (ungrounded conductor – match existing) |
| White | 120 Vac neutral wire (grounded conductor) |
| Green | Equipment grounding conductor |
| Brown (-) / Orange (+) | Negative / Positive connection for strobe-only circuit |
| Blue (-) / Yellow (+) | Negative / Positive connection for horn/horn-strobe circuit |
| Gray (-) / Violet (+) | Negative / Positive conventional alarm IDC |
| Black (-) / Red (+) | Negative / Positive auxiliary circuit connections |
| Black (-) / Red (+) T/S | Negative / Positive for SLC or speaker circuit |

Telephone wire color configuration (four-pair wire method) shall be as follows:

|  |  |
| --- | --- |
| *Pair 1* | *Pair 2* |
| *Tip 1* | *Ring 1* | *Tip 2* | *Ring 2* |
| To DACT Line #1 |
| White / Blue | Blue / White | White / Orange | Orange/ White |
| To DACT Line #2 |
| Orange / White | White / Blue | Blue / White | White / Orange |

* + 1. Conductors: Minimum requirements:
			1. Interior/Dry Locations: Red-jacketed FPL cable [shielded] with No. 16 AWG (minimum) twisted-pair conductors for SLC and listed per UL1424. Minimum No. 14 AWG unshielded for NAC, AUX, and IDC.
				1. Low voltage binary signal conductors shall be type THHN, or THWN, No. 16 AWG minimum, and solid copper conductor.
				2. Other low voltage conductors shall be type THHN, or THWN, No. 16 AWG (minimum), solid copper conductor.
			2. Exterior/Wet Locations: Red or Black-jacketed FPLP cable [shielded], No. 16 AWG (minimum), twisted-pair conductors for SLC, and listed for wet locations per UL1424. Minimum No. 14 AWG unshielded for NAC, AUX, and IDC.
				1. Manufacturers:

No. 16: West Penn Catalog #60990B or CSC Catalog #122008-04-1RL or an approved equal.

No 14: West Penn catalog #60993B, CSC Catalog #123010-04-1RL or an approved equal.

No 12: West Penn Catalog 60995B or an approved equal.

* + - * 1. Low voltage binary signal conductors: THWN-2, No. 16 AWG minimum, and solid copper conductor.
				2. Power conductors: Type THHN/THWN-2, No. 12 AWG, thermoplastic insulation, and single solid copper conductor.
	1. TEST EQUIPMENT
		1. Provide any special test equipment manufactured by the fire alarm equipment manufacturer for maintenance, testing, or troubleshooting.
		2. All test equipment shall be calibrated and provided with a calibration certificate.
	2. SURGE PROTECTION DEVICES (SPD)
		1. Provide a UL 1449 listed 120V surge protective device for the main FACP, each sub-FACP, and each booster power supply that has a 120V supply circuit.
			1. Device shall be capable of absorbing a maximum single pulse of at least 6,500A.
			2. Clamping voltage shall not exceed 330 volts line-to-neutral when tested in accordance with ANSI/IEEE C62.31 category C1/B3.
			3. Manufacturer: DITEK model DTK-120SRD.
		2. Provide UL 497B listed surge protective devices for each analog and 24V initiating device signaling circuits, 24V control circuits, and 24V notification appliances entering/leaving each building that is monitored by the FACP.
			1. Devices shall be capable of absorbing a peak 8x20 microsecond current of not less than 10,000A for 24V initiating devices & control circuits and 10,000A for analog initiating devices, at least 10 times.
			2. Devices for notification appliances shall be capable of absorbing a peak 8x20 microsecond current of 5000A and a 2000-ampere occurrence at least 50 times.
			3. Protective device for notification appliances shall have a series resistance not exceeding 0.2 ohms per pair and shall be capable of carrying a continuous current of 5A.
			4. Clamping voltage shall not exceed 30 volts for initiating devices control circuits, and 43 volts for notification appliances.
			5. Capacitance shall not exceed 50pf for analog initiating devices.
			6. Provide matching receptacle for plug-in surge protective devices.
			7. Manufacturer: DITEK model DTK-2MHLP series, or as recommended by the FACP manufacturer.
		3. Provide a UL 497B listed four-wire surge protective device for each FACP RS‑232 & RS-485 circuits entering/leaving each building monitored by the FACP.
			1. Device shall be capable of absorbing a peak 8x20 microsecond current of 10,000A at least 10 times.
			2. Clamping voltage shall not exceed 20 volts for RS-232 applications and 8 volts for RS-485 applications.
			3. Line-to-line and line-to-ground capacitance for RS‑485: 50pf maximum.
			4. Manufacturer: EDCO model PC642C-020 for RS-232 and PC642C-008LC for RS-485, with PCB1B socket.
		4. Provide a single-point ground bus for each enclosure containing one or more surge protective devices. Manufacturer: EDCO model TER-BUS or as recommended by the FACU manufacturer.
	3. MANUAL TRANSFER SWITCH
		1. Manufacturers: Reliance Model Easy/Tran CSR201, NO SUBSTITUTIONS.
	4. PANEL RECEPTACLES
		1. 125-VAC NEMA-5-15R duplex receptacle. Refer to Section 26 2726.
1. EXECUTION

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Seismic: If Project Spec includes 26 0548.16, and this Section (i.e., 28 4600) includes requirements associated w/ installation, testing, and inspection of mounting and/or anchorage devices that differ from those in 26 0548.16, then the differing requirements must be included in PART 3 herein. \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* 1. FIELD CONDITIONS
		1. Installation shall not proceed without 100% design approval by the LANL Fire Protection Office.
		2. Prior to installation carefully inspect the installed work of other trades, whether pre-existing or part of this project and verify that such work is complete to the point where the installation of the fire alarm system may properly commence.
		3. Notify the LANL Subcontract Technical Representative (STR) if conditions exist, not resulting from work of this project, that prohibit the installation from conforming to applicable codes, regulations, standards, and the original, approved design.
		4. Coordinate installation of fire alarm system with work of other trades.
		5. Coordinate fire alarm detectors and associated equipment with existing ceiling or roof materials, lighting, ductwork, conduit, piping, suspended equipment, structural and other building components.
		6. Verify dimensions in the field to lay out work in the most direct and expeditious manner and avoid interference.
		7. Locate notification appliances away from obstructions and notify the LANL STR of possible obstruction by other trades, equipment, or furnishings.
		8. Protect fire alarm equipment with suitable coverings until completion of project.
		9. Coordinate necessary shutdowns of existing systems by notifying the LANL STR a minimum of seven working days before rendering such systems inoperative. Do not render inoperative any system without the prior approval of the LANL STR.
	2. General INSTALLATION
		1. Install the fire alarm system in accordance with the NEC, NFPA 72, and this specification.
		2. Coordinate necessary shutdowns of existing systems by notifying the LANL STR a minimum of seven working days before rendering such systems inoperative.
		3. Do not render inoperative any system without the prior approval of the LANL STR. The LANL STR will submit the LANL Utility Outage Request.

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Seismic: If some of the components in the FAS are exempt, then Sects. 26 0529 and 26 0548.16—or 01 8734—are applicable. Regarding the applicability of Sect. 260548.16 or 01 8734, see Guide for editing guidance.

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* + 1. Follow Section 26 0529, *Hangers and Supports for Electrical Systems[*, and] [Section 26 0548.16, *Seismic Controls for Electrical Systems]* for anchorage requirements. [The anchorage requirements for the components in Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, shall be in accordance with that Section.].
		2. Install fire alarm devices to be readily accessible, unless infeasible due to required installation location (e.g., above-ceiling smoke detectors).
		3. All fire alarm equipment requiring servicing or maintenance shall have a minimum clear working space of 36” by 36”, or as wide as the equipment, centered on the equipment. The clear height of the working space shall be 72”, or the height of the equipment if more than 72@. The clear working space shall be in a routinely accessible location as approved by the LANL Fire Protection Group.
	1. Power
		1. Install 120 VAC manual transfer switch (MTS) in FACU/NAPP branch circuit before the power SPD.
		2. Install MTS so that it is readily accessible above or adjacent to the FACU/NAPP. The transfer switch shall be located before the AC surge suppressor.
		3. Install a 125-volt NEMA-5-15R duplex receptacle below each FACU/NAPP. Provide dedicated circuit from a panel that does not power the FACU/NAPP. Refer to Section 26 2726 Wiring Devices.
	2. Device Mounting Heights
		1. Install manual pull stations with the operating portion (handle to pull, etc.) between 42 inches 48 inches inclusive above the finished floor (A.F.F.).
		2. Wall-mounted notification appliance shall be mounted such that the signal is not obstructed, and the device can be maintained. The installation height shall be [84” above the finished floor] [96” above the finished floor].
		3. Install monitor modules, control relays, and remote alarm indicators:
			1. Between 60” and 72” A.F.F.
			2. With 3 feet (nominal) of the monitored requirement or emergency control function, unless approved otherwise by the LANL FP Office.
	3. FACU and NAPP Installation
		1. Install FACU or NAPP following manufacturer’s written instructions, NFPA 72, and the NEC.
		2. Locate the FACU in the main building lobby or entry vestibule. Coordinate location of FACU with the LANL Fire Protection Office.
		3. Unless otherwise approved, install FACU or NAPP with top of cabinet trim 66 inches above finished floor. Refer to manufacturer’s recommended installation height.
		4. Mount FACU or NAPP cabinet plumb and rigid without distortion of the box.
		5. Mount flush cabinets uniformly flush with wall surfaces.
		6. Install filler plates in unused spaces in FACU or NAPP.
		7. Train conductors in cabinet gutters neatly in groups; bundle and wrap with cable ties after completion of testing.
		8. Tighten electrical connectors and terminals, including grounding connections, according to the manufacturer’s published torque‑tightening values (typically marked on the equipment). Where manufacturer values cannot be located, refer to NEC [2017] Annex I.
	4. Wiring Installation
		1. Install all fire alarm system and power wiring in conduit raceways.
		2. Do not install AC current-carrying conductors in the same raceway with the DC or digital fire alarm detection and signaling conductors.
		3. Underground conduit shall be swabbed prior to installing respective conductors.
		4. Do not pull wire or cable until the conduit system is complete between pull points.
		5. Bundle conductors in panels and boxes into groups by service and destination.
		6. Run electronic cable continuous between device termination points. No splicing is permitted without prior approval from the LANL Fire Protection Office.
		7. Where splicing is approved:
			1. NAC: Provide “Wago” splicing connectors or approved equivalent.
			2. All others: Terminal blocks or strips for are permitted for all circuits other than notification appliance circuits.
			3. Wire nuts shall not be used.
		8. Adhere to the manufacturer requirements/limitations for T-taps. Make no T-taps in notification appliance circuits. T-taps shall only be made on device terminals or on terminal strips that are acceptable to the LANL Fire Protection Office. Wire nuts are not approved and shall not be used.
		9. Make allowances in conductor length at panels and other enclosures to permit forming the conductors neatly within the enclosures. Where wiring troughs are not provided with the enclosures, neatly cable and adequately support the wiring.
		10. Plan for additional wires required during pulls, such as ground conductors for SPDs.
		11. Ring out and identify power and control conductors before terminal connections are made.
		12. Check polarity and phasing and make changes as required before making terminal connections.
		13. Test conductors for continuity and presence of shorts and unintentional grounds.
	5. Junction Box and Conduit Installation:
		1. Refer to Section 26 0533, *Raceway and Boxes for Electrical Systems*, requirements.
	6. Surge Protective Device Installation
		1. Install a 120V SPD for the FACU, NAPP, and any other AC power supplies.
		2. Install an SPD for each IDC, NAC, data, and SLC entering/leaving each building.
		3. SPDs shall be installed between 44” and 72” A.F.F.
		4. Install SPDs in the FACU cabinet, if permitted by the FACU manufacturer. If not permitted, install in one or more metal enclosures near the protected fire alarm equipment.
		5. Provide separate or divided enclosures for 120V power and low voltage devices.
		6. Install a single-point ground bar in the enclosure.
			1. Bond the ground bar to the enclosure and the power circuit equipment-grounding conductor.
			2. Connect each SPD to the ground bar with a separate 12 AWG solid, green-insulated ground wire.
		7. Install SPDs in accordance with manufacturer’s instructions, keeping leads and ground conductors as short and straight as possible.
		8. Provide matching receptacle for plug-in surge protective devices.
	7. Identification
		1. Follow Section 26 0553, *Identification for Electrical Systems*, for all system components.

Note: For field labelling purposes, FCP is the required acronym for FACUs.

* + 1. Provide pressure-sensitive, vinyl labels with red lettering of 3/4 inch (minimum) on a white background, unless otherwise noted below.
		2. Inside the FACU and NAPP, all devices shall be labeled, and all zone locations shall be clearly identified.
		3. Label each conductor at each terminal point:
			1. Use wire markers specified in Section 26 0553, *Identification for Electrical Systems*.
			2. On wire markers indicate the type of fire alarm circuit. SLC circuits shall be identified by the loop number indicated on the riser diagram (e.g. SLC-1).
			3. NAC circuits shall be identified by the source and circuit number indicated on the riser diagram (e.g., BPS1-1, FACU1-2).
			4. Auxiliary system circuits shall be identified by component ID of the interfaced system and the prefix FA (e.g., FA BAS-PNL-001, FA HVA‑001).
		4. Label fire alarm and branch circuit junction boxes and conduit bodies with FIRE ALARM on a 2-1/4” x 1/2” (minimum size) label.
		5. Label junction boxes containing terminal blocks with FIRE ALARM – TERMINAL BLOCK on a 2-1/4” x 1/2” (minimum size) label.
		6. Label all devices with address/zone information as shown on the drawings.
		7. Label device settings on adjustable devices (temperature, delay time, candela, wattage, loudness, alarm thresholds, etc.).
		8. Provide red markings on branch circuit breakers and other disconnecting means.
		9. Identify fire alarm equipment on electrical panel schedules and terminal cabinet schedules (“Fire Alarm”, “Emergency Communication System”).
		10. Label the MTS with the electrical panel and circuit number of the feeding branch circuit, and “For Fire Alarm Panel Use Only. For Use with Non-Bonded Portable Generator” on a 2-1/4” x 1/2” (minimum size) label.
		11. Remove abandoned cables and conduits. Tag conduits that are for future use.

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Painting is at the direction of the FOD (based on aesthetics, environmental conditions, etc.) If not required by FOD, delete the following article and any other references to painting in this document.

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* 1. PAINTING
		1. Exposed Surfaces: Paint/patch and clean exposed walls that were affected by the installation/demolition, with an approved matching paint.
		2. Refinishing: Thoroughly clean and touch up shop-primed or finish-painted surfaces damaged in installation with an approved matching paint.
	2. EQUIPMENT INSTALLATION
		1. Install devices or equipment not specifically covered by these specifications in accordance with manufacturer's instructions.
	3. CONNECTION TO LANL Proprietary Supervising Station
		1. Install a 6” x 6” x 4” electrical enclosure adjacent to the FACU with a conduit to the appropriate factory knockout.
		2. Install a 1” inch conduit, with a measuring pull tape, from the 6” x 6” x 4” electrical enclosure to the backboard located in the main telecom room.
		3. Install three (3) red GFE Category 6A cables in the conduit.
			1. Route two (2) Cat 6A cables to the building’s telephone terminal board.
			2. Route the third Cat 6A cable to the nearest open network switch in the building. Coordinate with the LANL Telecommunication Services Group (NIE-TS) to ensure proper location.
	4. CLEANING
		1. Blow out junction boxes and fire alarm equipment not hermetically sealed with clear, dry, oil-free (15 psig maximum) air to remove dust prior to energizing.
	5. FIELD QUALITY CONTROL

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Note: Testing and commissioning of fire alarm systems is a three-step process at LANL. First the installing Subcontractor performs quality control inspections and testing, and any required corrections. A Statement of Compliance and/or a Preliminary Test Report (if required) is to be provided to LANL, along with revised drawings and the current FACU program.

Next a LANL-supported, pre-final test is performed to verify correct DACT signals reporting to the LANL supervising station at the EOC. Changes made after the pre-final test will require sufficient time to make changes to LANL supervising station account.

Finally, the LANL-supported final acceptance test is performed.

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* + 1. The Subcontractor’s qualified fire alarm technician shall assure the completeness and correctness of the installation by performing the following:
			1. Field-verify and red-line installation/design drawings of fire alarm layout, conduit and wiring plans, and point-to-point field-wiring diagrams.
			2. Verify correct labeling of fire alarm system conductors.
			3. Verify correct conductor sizes.
			4. Update calculations to reflect field changes.
			5. Verify audible alarm in all spaces meets design sound pressure levels.
			6. Test all devices for proper supervision and alarm operation.
			7. Test all emergency interfaces with for proper operation in all modes.
			8. Perform preliminary inspection and testing of the fire alarm system.
			9. Prepare test plan and report (*see Paragraph 1.5.C.2*).
			10. Prepare as-built (record) drawings.
	1. PRE-FINAL and FINAL ACCEPTANCE TESTS
		1. Coordinate date of pre-final and final acceptance tests with installer, LANL Project Leader, LANL Fire Protection Office representative, and sub-tier Subcontractors for HVAC, sprinklers, elevator controls, and all other interfaced systems.
		2. Requests for pre-final or final acceptance tests shall not be made before approval of the 100% design documentation.
		3. Notify lANL STR at a minimum of 10 working days in advance of LANL-supported pre-final and final acceptance tests. For large projects based on a timeline approved by the LANL Fire Protection Office.
		4. The following shall be provided with the request for LANL-supported pre-final and final acceptance test:
			1. Revised versions of the FACU program, Centration Station Reports, or Input/Output Matrix.
			2. Marked-up (red-lined) shop drawings and point-to-point wiring diagrams.
			3. Approved final test plan.
			4. [Statement of Compliance].
			5. [The Installer’s Preliminary Test Report, indicating the status of the fire alarm system and any corrective actions required.]
		5. Perform pre-final and final acceptance tests on the completed fire alarm system:
			1. Perform final tests in the presence of authorized representatives of LANL’s STR, Fire Protection Office, and Facility Operations Director (FOD).
			2. Follow the approved test plan and comply with NFPA 72 requirements.
			3. Perform end-to-end, integrated testing for the entire system.
			4. LANL will perform 24-hour discharge test on the FACU/NAPP batteries.
			5. LANL will measure air velocity and pressure differentials in ducts.
			6. LANL will perform tests on connections made by other LANL groups.
			7. LANL Telecommunication Services Group (NIE-TS) will perform the acceptance test of the telephone lines from the modular plug connectors.
		6. Re-verify the complete fire alarm raceway and wiring system in the presence of a LANL Fire Protection Office representative, upon request.
		7. Correct deficiencies discovered in the final acceptance test and re-test fire alarm system until satisfactory test results are obtained.
	2. SYSTEM IDENTIFICATION PLACARD
		1. Furnish and install a permanently mounted placard in or adjacent to the fire alarm control cabinet that can withstand the environmental conditions at the panel.
		2. Provide the following information typewritten or engraved on the placard:
			1. Name, address, and telephone number of installing Subcontractor.
			2. Reference to the standards, including date of issue to which the system conforms (e.g., NFPA 72 20XX edition and NFPA 70, 20XX edition).
			3. Supplying branch circuit number and panel board number and location.
			4. Location of fire alarm system Operating and Maintenance Instructions.
			5. Location of fire alarm system as-built documents.
		3. Provide operating instructions prominently displayed on a separate sheet located next to the FACP per UL Standard 864.

END OF SECTION

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Do not delete the following reference information.

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 28 4600 Rev. 4, dated November 10, 2022.

Each deliverable shall be provided in a pdf format except where noted.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Deliverable | Spec Ref. | Design Maturity/Review(of deferred design submittals normally) | 4Ten Working DaysBefore Pre-Final Test | Before Final Test | After Completing Final Acceptance Test |
| 160% | 290% | 3100% |
| Certifications | 1.5.A | X |  |  |  |  |  |
| Design drawings including:CalculationsFloor plansWiring diagramsSystem input/output matrix | 1.5.B | X | X | X | X |  |  |
| Catalog data | 1.5.B.1 | X |  |  |  |  |  |
| Installation instructions | 1.5.B.8 |  |  | X |  |  |  |
| Materials and parts list | 1.5.B.7.k | X | X | X |  |  |  |
| Points/address list w/ description | 1.5.B.9 |  | X | X | X |  | X |
| 5FACU program and central station reports | 1.5.B.10 |  |  | X | X |  | X |
| Operations & Maintenance Manual | 1.5.B.11 |  |  |  |  |  | X |
| Test reports:Installer’s preliminary test report *(when requested)*Test PlanFinal Acceptance Test Report Record of Completion | 1.5.C |  |  |  | XX |  | XX |
| Revised:6FACU programCentral station reportsInput/output matrixDrawings (red-lined) | 3.15.D |  |  |  |  | X |  |
| Project Record Documents7 (as-built of all items) | 1.5.D |  |  |  |  |  | X |
| Warranties | 1.5.E |  |  |  |  |  | X |

1. Shall be (2) full-size drawings unless determined 11” x 17” is acceptable during design scoping.

2. Typically 11” x 17” drawings will suffice unless full size required by LANL Fire Protection Office reviewers.

3. 11” x 17” drawings will suffice.

4. Larger projects may require additional review time.
5. Shall be provided in the format required per panel type.

6. Red-line drawings [at][# day(s) prior] the final test. Provide revised FACU programs [10] days prior.

7. Shall include (1) full-sized and (3) 11” x 17” drawing sets shall be delivered to the STR.