SECTION 26 2933

CONTROLLERS FOR FIRE PUMP DRIVERS

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LANL MASTER SPECIFICATION SECTION

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| Rev. 0: New specification section adopting content aligned with commercial industry practice. |

Word file at <http://engstandards.lanl.gov>

This template 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.  The specification section must also be edited to delete requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.  This template is tailored to meet requirements contained in the LANL Engineering Standards Manual (ESM). To seek a variance from requirements in this section that are applicable, contact the Engineering Standards Manual Fire [POC](http://engstandards.lanl.gov/POCs.shtml#fire). Please contact POC with suggestions for improvement as well.

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

Note that DOE-STD-1066 Appendices A and B are not applicable to the Work specified herein. Consider the scope and purpose of DOE documents as pertains to commercial construction before editing such requirements into this specification section.

This template is 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 sections.  
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1. GENERAL
2. SECTION INCLUDES
3. Full-service, Full-Voltage Controllers (rated 600 V and less) for Electric Motor Drive Fire Pumps.
4. Controllers for Diesel Engine Drive Fire Pumps.
5. Controllers for Pressure Maintenance Pumps
6. RELATED SECTIONS
7. Section 01 2500, Substitution Procedures
8. Section 01 3300, Submittal Procedures
9. Section 01 4000, Quality Requirements – Non-Nuclear
10. Section 01 6000, Product Requirements
11. Section 01 9100, *Commissioning*
12. Section 21 3000, *Fire Pumps*
13. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
14. Section 26 0526, Grounding and Bonding for Electrical Systems
15. Section 26 0529, Hangers and Supports for Electrical Systems
16. Section 26 0533, Raceway and Boxes for Electrical Systems
17. Section 26 0548.16, Seismic Controls for Electrical Systems
18. Section 26 0553, Identification for Electrical Systems
19. Section 26 4300, Surge Protective Devices
20. Section 28 4600, Fire Detection and Alarm.
21. REFERENCES
22. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures
23. IEEE 344 – Seismic Qualification of Equipment for Nuclear Power Generating Stations
24. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
25. NEMA ICS 15 – Instructions for Handling, Installation, Operation and Maintenance of Electric Fire Pump Controllers Rated Not More Than 600V
26. NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection
27. NFPA 70 – National Electrical Code
28. NFPA 72 – National Fire Alarm and Signaling Code
29. UL 508 – Industrial Control Equipment
30. UL 1236 – Battery Chargers for Charging Engine-Starter Batteries.
31. DEFINITIONS AND ACRONYMS
32. For definitions and acronyms, refer to [COE Glossary of Terms](https://engstandards.lanl.gov/_assets/GLOS-COE-1.pdf). Definitions exist for the following terms: AHJ, Commissioning, Design Agency, STR, among others.
33. AHJ: Authority Having Jurisdiction.
34. ECM: Electronic control module.
35. ESM: Engineering Standards Manual.
36. MCCB: Molded-case circuit breaker.
37. POC: Point of Contact.
38. STR: Subcontract Technical Representative.
39. ACTION SUBMITTALS
40. Product Data: For each type of product include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
41. Shop Drawings: For each type of product indicated, and in accordance with NFPA 20.
42. Include plans, elevations, sections, and attachment details.
43. Include the following:
44. Details of equipment assemblies. Indicate dimensions, weights, center of gravity, required clearances, method of field assembly, components, and location and size of each field connection.
45. Each installed unit's type and details.
46. Enclosure types and details for types other than NEMA 250, Type 2.
47. Factory-installed devices.
48. Surge-protective devices.
49. Nameplate legends.
50. Short-circuit current (withstand) rating of integrated unit.
51. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
52. Include diagrams for power, signal, alarm, control wiring, and pressure-sensing tubing.
53. Special Certification from Manufacturer (only applicable if Fire Pump Driver Controller is a Designated Seismic System)
54. Commissioning Acceptance and Test Plan
55. Test Reports for Field Acceptance Testing
56. INFORMATIONAL SUBMITTALS
57. Source quality-control reports.
58. Field quality-control reports.
59. Manufacturer’s recommended spare parts.
60. Submit “Contactor’s Materials and Test Certificate for Fire Pump Systems” under Section 21 3000, *Fire Pumps*.
61. PRODUCTS

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Before selecting manufacturers and products, verify availability, suitability for intended applications, and compliance with minimum performance requirements. For definitions of terms and requirements for subcontractor's product selection, see Section 01 6000, *Product Requirements*.

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1. PERFORMANCE REQUIREMENTS
2. Comply with NFPA 20.

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Retain "IEEE Compliance" paragraph below for nuclear projects in seismic areas. Coordinate with Section 26 0548.16, *Seismic Controls for Electrical Systems*.

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1. [IEEE Compliance: Fabricate and test enclosed controllers in accordance with IEEE 344 to withstand seismic forces defined in Section 26 0548.16, *Seismic Controls for Electrical Systems*.]
2. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with OSHA, by a qualified electrical testing laboratory, and marked for intended location and application.

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Designated Seismic Systems (DSS): LANL Utility System is not seismically credited. Equipment that is designated DSS must be fed from a seismically credited generator or UPS.

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1. Seismic Performance Requirements:
2. Component importance factor of 1.0 is default unless noted otherwise on engineering drawings. If Controller for Fire Pump Driver is a Designated Seismic System, component importance factor is 1.5.
3. The following nonstructural components (controllers) are seismically exempt per ASCE 7, Section 13.1.4, but shall be positively attached to the structure provided that:
4. Component weighs 400 lbs or less with center of mass located 4 ft or less above the adjacent floor level, flexible connections are provided between the component and associated conduit (Note: trade size 2.5 or less is considered flexible), and component importance factor is equal to 1.0 or
5. Component weighs 20 lbs or less.
6. For Fire Pump Drivers Controllers outside the above exemptions, Engineer of Record shall provide support details for the controller that meet seismic requirements per ESM Chapter 5, Section II. If the Fire Pump Driver Controller is a DSS, manufacturer shall provide special certification per ASCE 7, Section 13.2.2.
7. FULL-SERVICE CONTROLLERS FOR ELECTRIC MOTOR DRIVE FIRE PUMPS

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Show voltage, size, type, accessories, and enclosure type for each controller on Drawings if not included in this section.

Standard features vary considerably among manufacturers of full-service, electric motor driver, fire-pump controllers; not all features in this article are available for every type and from every listed manufacturer. Features vary in accordance with motor characteristics and the driven-equipment operating criteria. Verify availability and unique characteristics with manufacturers; indicate here or show on Drawings those features that apply to each controller.

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1. Manufacturers:
2. Subject to compliance, provide products by one of the following, or approved equal:
3. Eaton.
4. Firetrol.
5. Grundfos.
6. Hubbell.
7. Master Control Systems.
8. Metron.
9. Pentair.
10. Substitutions: [Alternate Products may be accepted, follow Section 01 2500, *Substitution Procedures*; or Not Permitted – No substitutions].
11. General Requirements for Full-Service Controllers:
12. Comply with NFPA 20.
13. Listed for fire pump service.
14. Combined automatic and nonautomatic operation.
15. Factory assembled, wired, and tested; continuous-duty rated.
16. Method of Starting:
17. [Pressure; Nonpressure]-switch actuated.
18. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
19. System pressure recorder, electric AC driven, with spring backup.
20. Programmable minimum-run-time relay to prevent short cycling.
21. Programmable timer for weekly tests.
22. Magnetic Controller: Across-the-line type.
23. Method of Stopping: Nonautomatic.

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Show required controller short-circuit current rating (SCCR)), and Amps Interrupting Rating (AIC) on Drawings.

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1. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than fault current available at controller location.

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Functions in "Method of Isolation and Overcurrent Protection" and "Door-Mounted Operator Interface and Controls" paragraphs below are the minimum required by NFPA 20; however, standard features and optional modifications vary considerably among manufacturers of fire-pump controllers; they must be closely coordinated with "General Requirements for Full-Service Controllers," "Method of Starting," and "Method of Stopping" paragraphs in this article. Verify availability and unique characteristics with manufacturers; include in first two paragraphs below or show on Drawings those features that apply to the controllers.

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1. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.
2. Door-Mounted Operator Interface and Controls:
3. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
4. Method of Control and Indication:
5. [Microprocessor-based logic; \_\_\_\_\_\_\_\_] controller, with multiline digital readout.
6. [Membrane; \_\_\_\_\_\_\_] keypad.
7. [LED; \_\_\_\_\_\_\_\_] alarm and status indicating lights.
8. Local and Remote Alarm and Status Indications:

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Manufacturers offer numerous alarm and status indications and interfaces. Consult manufacturers for availability and types.

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1. Controller power on.
2. Motor running condition.
3. Loss-of-line power.
4. Line-power phase reversal.
5. Line-power single-phase condition.
6. \_\_\_\_\_\_\_\_\_\_.
7. Audible alarm, with silence push button.
8. Nonautomatic START and STOP push buttons or switches.
9. \_\_\_\_\_\_\_\_\_\_\_\_.
10. Optional Features:

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Manufacturers offer numerous optional features for fire-pump controllers. Consult manufacturers for availability and limitations. Retain applicable features in "Extra Output Contacts" subparagraph below; insert others to suit project. Indicate requirements for and quantities of optional features on Drawings if not included here. These features are normally added-cost items.

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1. Extra Output Contacts:
2. [One; \_\_\_\_\_\_] NO contact(s) for motor running condition.
3. [One; \_\_\_\_\_\_] set(s) of contacts for loss-of-line power.
4. [One; \_\_\_\_\_\_] each, Form C contacts for high and low reservoir level.
5. \_\_\_\_\_\_\_\_\_.
6. Local alarm bell.
7. Door-mounted thermal or impact printer for alarm and status logs.
8. Operator Interface Communications Ports: USB, Ethernet, and TIA-485.
9. \_\_\_\_\_\_\_\_\_.

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Retain "ATS" Paragraph if an ATS is required. An ATS is only required if the primary supply to the fire pump is not considered a reliable source.

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1. Automatic Transfer Switch (ATS):
2. Complies with NFPA 20.
3. Listed for fire pump service.
4. Integral with controller as a listed combination fire-pump controller and power transfer switch.
5. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
6. Allows manual transfer from one source to the other.
7. Alternate-Source Isolating and Disconnecting Means:

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Retain one of first two subparagraphs below. Retain first subparagraph if the alternate source is a standby generator with a capacity of less than 225 percent of the motor's full-load current rating. Coordinate with upstream external overcurrent protection.

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1. Integral molded-case switch, with an externally mounted operating handle.

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NFPA 20 has separate, more stringent requirements for an integral ATS if the alternate source is a second utility service, an upstream ATS, or an emergency generator with a capacity exceeding 225 percent of the fire-pump motor's full-load current rating. Retain first subparagraph below if any of these situations apply.

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1. Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker must be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
2. Local and Remote Alarm and Status Indications:

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Manufacturers offer additional local and remote alarm and status indications and interfaces. Consult manufacturers for availability and types.

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1. Normal source available.
2. Alternate source available.
3. In normal position.
4. In alternate position.
5. Isolating means open.
6. \_\_\_\_\_\_\_\_\_\_.
7. Audible alarm, with silence push button.
8. Nonautomatic (manual, nonelectric) means of transfer.

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Retain first three subparagraphs below if alternate power is from a standby generator.

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1. Engine test push button.
2. Start generator output contacts.
3. Timer for weekly generator tests.
4. CONTROLLERS FOR DIESEL ENGINE DRIVE FIRE PUMPS

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Show voltage, size, type, accessories, and enclosure type for each controller on Drawings if not included in this section.

Standard features vary considerably among manufacturers of diesel engine driver, fire-pump controllers; not all features in this article are available for every type and from every listed manufacturer. Features depend on motor characteristics and driven-equipment operating criteria. Verify availability and unique characteristics with manufacturer; include here or show on Drawings those features that apply to each controller.

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1. Manufacturers:
2. Subject to compliance, provide products by one of the following, or approved equal:
3. Eaton.
4. Firetrol.
5. Grundfos.
6. Hubbell.
7. Master Control Systems.
8. Metron.
9. Pentair.
10. Substitutions: [Alternate Products may be accepted, follow Section 01 2500, *Substitution Procedures*; or Not Permitted – No substitutions].
11. General Requirements for Controllers:
12. Comply with NFPA 20.
13. Listed for fire pump service.
14. Combined automatic and nonautomatic operation.
15. Factory assembled, wired, and tested.
16. Method of Starting:
17. [Pressure; Nonpressure]-switch actuated.
18. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
19. System pressure recorder, electric AC driven, with spring backup.
20. Programmable minimum-run-time relay to prevent short cycling.
21. Programmable timer for weekly tests.

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Only a battery-powered starting method is allowed by NFPA 20 for diesel engine drive controllers.

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1. Dual, redundant DC-voltage battery units, with automatic changeover.
2. Emergency Control: Bypasses automatic control circuits during manual starting and running.
3. Automatic engine start on loss of AC power to the controller.
4. Method of Stopping: Nonautomatic.

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Functions in "Door-Mounted Operator Interface and Controls" paragraph below are the minimum required by NFPA 20; however, standard features and optional modifications vary considerably among manufacturers of fire-pump controllers; they must be closely coordinated with "General Requirements for Controllers," "Method of Starting," and "Method of Stopping" paragraphs in this article. Verify availability and unique characteristics with manufacturers; include in first paragraph or show on Drawings those features that apply to the controllers.

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1. Door-Mounted Operator Interface and Controls:
2. Monitor, display, and control devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
3. Method of Control and Indication:
4. [Microprocessor-based logic; \_\_\_\_\_\_\_\_] controller, with multiline [LCD; \_\_\_\_\_\_\_\_] readout.
5. [Membrane; \_\_\_\_\_\_\_\_] keypad.
6. [LED; \_\_\_\_\_\_\_\_\_\_] alarm and status indicating lights.
7. Local and Remote Alarm and Status Indications:

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Manufacturers offer numerous local and remote alarm and status indications and interfaces. Consult manufacturers for availability and types.

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1. Controller power on.
2. Engine-lubrication-system critically low oil pressure.
3. Engine-jacket coolant high temperature.
4. Engine fail-to-start.
5. Engine overspeed shutdown.
6. Low fuel level.
7. Missing or failed battery.
8. Battery charger failure.

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Retain first subparagraph below for engines equipped with pressure-limiting controls.

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1. System overpressure.

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Retain first two subparagraphs below for engines equipped with ECM controls.

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1. ECM selector switch in alternate ECM position.
2. Fuel injector malfunction.
3. \_\_\_\_\_\_\_\_\_\_\_.

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NFPA 20 does not allow a silence switch or push button for alarms listed in this article.

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1. Audible alarm.
2. Nonautomatic START and STOP push buttons or switches.
3. Optional Features:

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Manufacturers offer numerous optional features for fire-pump controllers. Consult manufacturers for availability and limitations. Retain applicable optional features in "Extra Output Contacts" subparagraph below; insert others to suit project. Indicate requirements for and quantities of optional features on Drawings if not included here.

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1. Extra Output Contacts:
2. [One; \_\_\_\_\_\_\_] Form C contacts for low pump-room temperature.
3. [One; \_\_\_\_\_\_\_] each, Form C contacts for high and low fuel levels.
4. [One; \_\_\_\_\_\_\_] each, Form C contacts for high and low reservoir levels.
5. \_\_\_\_\_\_\_\_\_\_\_.
6. Door-mounted thermal or impact printer for alarm and status logs.
7. Operator Interface Communications Ports: USB, Ethernet, and TIA-485.

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NFPA 20 allows use of diesel engine drive controllers "to supply essential and necessary AC or DC power to operate pump room dampers and engine oil heaters and other associated and required engine equipment only when provided with factory-equipped, dedicated, field terminals and overcurrent protection." Consult manufacturers for availability of optional feature in first subparagraph below; retain if required.

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1. Powered louver contacts.
2. Powered engine-oil heater contacts.
3. \_\_\_\_\_\_\_\_\_\_\_\_.
4. Battery Charger System:
5. Built-in, independent, dual battery chargers with automatic changeover; [12 V (DC); 24 V (DC)] for [lead-acid; nickel-cadmium] batteries.
6. Standard: [UL 1236; \_\_\_\_\_\_\_\_\_].
7. CONTROLLERS FOR PRESSURE MAINTENANCE PUMPS
8. Manufacturers:
9. Subject to compliance, provide products by one of the following, or approved equal:
10. Eaton.
11. Firetrol.
12. Grundfos.
13. Hubbell.
14. Master Control Systems.
15. Metron.
16. Pentair.
17. Substitutions: [Alternate Products may be accepted, follow Section 01 2500, *Substitution Procedures*; or Not Permitted – No substitutions].
18. General Requirements for Pressure-Maintenance-Pump Controllers:
19. Type: UL 508, factory-assembled, -wired, and -tested, across-the-line controller; for combined automatic and manual operation.
20. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
21. Factory assembled, wired, and tested.
22. Finish: Manufacturer's standard color paint.
23. Rate controller for scheduled horsepower and include the following:
24. Fusible disconnect switch.
25. Pressure switch.
26. Hand-off-auto selector switch.
27. Pilot light.
28. Running period timer.
29. ENCLOSURES
30. Fire-Pump Controllers and ATS: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.

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Coordinate subparagraphs below with Drawings by identifying the designated areas on plans or by including the required enclosure types. Enclosure materials and finishes may be added here. NFPA 20 requires NEMA 250, Type 2 as the minimum allowable enclosure type for indoor controllers and ATS; NEMA 250, Type 1 is allowed for alarm panels. Consult manufacturers for availability of, and limitations on, other than NEMA 250, Type 2 enclosures.

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1. Indoor Locations Subject to Dripping Noncorrosive Liquids: [Type 2 (IEC IP11); \_\_\_\_\_\_\_].
2. Outdoor Locations: [Type 3R (IEC IP14); Type 4 (IEC IP56); Type 4X (IEC IP56); \_\_\_\_\_\_\_\_].
3. Other Wet or Damp, Indoor Locations: [Type 4 (IEC IP56); Type 4X (IEC IP56); \_\_\_\_\_\_\_].
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).
5. Enclosure Color: [Manufacturer's standard; \_\_\_\_\_\_\_\_].
6. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.
7. Optional Features:

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Optional features in subparagraphs below pertain mainly to enclosures for fire-pump controllers; they are also limited in application by controller, enclosure type, and manufacturer. Retain applicable optional features and indicate requirements for and quantities of accessories on Drawings. Consult manufacturers for availability and limitations.

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1. Floor stands, 12 inch high, for floor-mounted controllers.
2. Space heater, [120 V (AC); 240 V (AC)], [with humidistat; with thermostat].
3. SOURCE QUALITY CONTROL

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NFPA 20 requires that "all controllers must be completely assembled, wired, and tested by the manufacturer before shipment from the factory." Retain "Testing" paragraph below for requesting copies of the test reports.

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1. Testing: Test and inspect fire-pump controllers in accordance with requirements in NFPA 20.
2. Verification of Performance: Rate controllers in accordance with operation of functions and features specified.

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See Section 01 4000, *Quality Requirements – Non-Nuclear* for retesting and reinspecting requirements.

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1. Fire-pump controllers will be considered defective if they do not pass tests and inspections.
2. Prepare test and inspection reports.
3. EXECUTION
4. INSTALLATION OF CONTROLLERS
5. Coordinate installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.

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Retain first paragraph below if required for base-supported controllers.

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1. Coordinate sizes and locations of concrete bases with actual equipment provided.

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NFPA 20 and NFPA 70 define specific installation requirements for fire-pump controllers.

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1. Install controllers within sight of their respective drivers.

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Retain first paragraph below for controllers actuated by water flow in fire-suppression piping.

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1. Connect controllers to their dedicated pressure-sensing lines.

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Retain "Wall-Mounting Controllers" paragraph below for equipment supported by walls or freestanding racks.

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1. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, and bottom of enclosure not less than 12 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 0529, *Hangers and Supports for Electrical Systems*.

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Retain "Floor-Mounting Controllers" paragraph below for controllers supported on slabs-on-grade.

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1. Floor-Mounting Controllers: Install controllers on concrete base(s), using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches above finished floor. Comply with requirements for concrete bases specified in Section 26 0529, *Hangers and Supports for Electrical Systems*.
2. For supported equipment, install anchor bolts that extend through concrete base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

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Retain "Seismic Supports" paragraph below if seismic controls are project requirement. Coordinate with Drawings.

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1. Seismic Supports: Comply with requirements specified in Article [2.1] Performance Requirements, paragraph on *Seismic Performance Requirements*.
2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
3. Comply with NEMA ICS 15.
4. INSTALLATION OF POWER WIRING

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Retain this article if retaining electric motor drive controllers. NFPA 20 and NFPA 70 have specific requirements and restrictions on wiring for electric motor drive controllers; review these standards before revising this article.

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1. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 26 0519, *Low Voltage Electrical Power Conductors and Cables*.
2. INSTALLATION OF CONTROL AND ALARM WIRING
3. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Section 28 4600, *Fire Detection and Alarm*.
4. Bundle, train, and support wiring in enclosures.
5. Connect remote manual and automatic activation devices where applicable.
6. IDENTIFICATION
7. Comply with requirements in NFPA 20 for marking fire-pump controllers.
8. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 26 0553, *Identification for Electrical Systems*.
9. FIELD QUALITY CONTROL

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Field acceptance tests are part of the formal process to verify compliance with NFPA 20; therefore, all pre-acceptance testing preparation should be complete before scheduling the tests for witnessing by authorities having jurisdiction.

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1. See Section 01 4000, *Quality Requirements – Non-Nuclear*, for additional requirements.
2. Acceptance Testing Preparation:
3. Inspect and Test Controller:
4. Inspect wiring, connections, and equipment installations. Test and adjust equipment as necessary.

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Retain only content pertinent to electric or diesel drive controller type.

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1. Verify and Test Each Electric Motor Drive Controller:
2. Perform and document Manufacturer’s recommended testing.
3. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for motor, notify LANL STR and LANL Electrical POC before starting the motor(s).
4. Test each motor for proper phase rotation.
5. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
6. Verify and Test Each Diesel Driver Controller:
7. Perform and document Manufacturer’s recommended testing.
8. At a minimum the following functions shall be tested.
9. Off Mode.
10. Manual Mode: Start, Stop.
11. Automatic Mode: Start, Stop
12. Automatic shutdown.
13. Weekly test timer.
14. Engine test button.
15. Run period timer.
16. Sequential start timer.
17. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

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NFPA 20 requires manufacturers of fire-pump controllers and ATS to be present during field acceptance testing regardless of who does the testing.

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1. Representatives from manufacturers of fire-pump controllers and ATS must be present during acceptance tests and inspections in accordance with NFPA 20.
2. Acceptance tests and inspections must be witnessed by [AHJ; LANL STR; \_\_\_\_\_\_\_\_\_\_].
3. Acceptance Tests and Inspections:
4. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to LANL STR, Design Agency, and AHJ.
5. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
6. Engage manufacturer's factory-authorized service representative to be present during the testing.
7. Perform field acceptance tests as outlined in NFPA 20.

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See Section 01 4000, *Quality Requirements – Non-Nuclear* for retesting and reinspecting requirements.

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1. Nonconforming Work:
2. Controllers will be considered defective if they do not pass tests and inspections.
3. Remove and replace defective units and retest.
4. Prepare test and inspection reports.
5. STARTUP SERVICE
6. [Engage a factory-authorized service representative to perform; Perform] startup service.
7. Complete installation and startup checks in accordance with manufacturer's written instructions.

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Add startup steps below, if any.

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1. \_\_\_\_\_\_\_\_\_\_\_\_\_.
2. ADJUSTING

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Retain applicable paragraphs in this article. Coordinate with selections made in PART 2.

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1. Adjust controllers [and battery charger systems] to function smoothly and as recommended by manufacturer.
2. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
3. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
4. Set field-adjustable pressure switches.

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 26 2933 Rev. 0, dated December 5, 2024.