# D4050 INSPECTION, TESTING, AND COMMISSIONING

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## RECORD OF REVISIONS

| Rev. | Date | Description | POC | OIC |
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| 0 | 06/29/2023 | Extracted from Ch. 2 D40 Revision 6. Provided new requirements for basic commissioning and NFPA 3 commissioning. Added new requirements for basic end-to-end testing and NFPA 4 integrated system testing. | Keenan Dotson, *FP* | Michael Richardson, *ES-DO* |

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The LANL Engineering Standards are available at https://engstandards.lanl.gov.

# D4050 INSPECTION, TESTING, AND COMMISSIONING

## 1.0 GENERAL

A. Applicability: Inspection, testing, and commissioning requirements and expectations for new and modified fire protection and life safety systems, structures, and components (SSCs) installed with LANL buildings and facilities shall comply with this section (Requirement 2-0207).

B. Scope: This section augments the basic expectations in ESM Chapter 15, *Commissioning,* and supports Chapter 16, *Building Code Program,* on system acceptance. Refer to the Fire Chapter 2, Section D40GEN, for general requirements applicable to fire protection and life safety systems. Additional fire alarm testing requirements are in D5037, *Fire Alarm Systems.*

C. Inspection, testing, and commissioning shall include the following active and passive fire protection and life safety SSCs to assure conformance with the design intent:

1. Infrastructure supporting building fire protection and life safety SSCs.
2. Fixed fire suppression and control systems.
3. Fire detection and alarm systems, including occupant notification.
4. Remote alarm transmission to the LANL proprietary fire alarm system.
5. Smoke control and management systems.
6. Normal, emergency, and standby power systems.
7. Explosion prevention and control/relief systems.
8. Fire-resistant and smoke-resistant assemblies.
9. Opening protective and through-penetration firestop systems.
10. SSCs protecting commercial cooking operations.
11. Elevator systems.
12. Means of egress SSCs.
13. Spill collection/containment, water runoff control features.
14. Process control and safety SSCs.
15. Access control SSCs.

D. Systems not specifically addressed in this section shall follow the requirements of the applicable codes and standards.

E. Where systems are integrated, they are tested together to observe inputs on one system resulting in the appropriate output on other systems.

F. Subsections 3.0–9.0 provide a summary of requirements for individual system inspection and final testing.

Note: In the following, "contractor" shall be taken to mean the subcontractor or sub-tier subcontractor performing the work.

## 2.0 COMMISSIONING

*The overall LANL commissioning process is addressed in ESM Chapter 15, Commissioning.*

A. Fire protection and life safety systems shall be included in project commissioning activities, where commissioning is required by ESM Chapter 15, *Commissioning* (Requirement 2-0208).

B. Commissioning, including retro-commissioning of existing systems, shall also be performed where required by the LANL Fire Protection Office (Requirement 2-0209).

C. As a minimum, fire protection and life safety commissioning activities shall include (Requirement 2-0212):

1. Documenting performance objectives and criteria and acceptance criteria.
2. Coordinating design, installation, and testing of integrated and dependent systems.
3. Coordinating integrated system testing with the installers or owners of the integrated systems.
4. Developing and completing pre-functional and start-up testing checklists to verify components are functional prior to system acceptance testing.
5. Performing and documenting preliminary or final acceptance testing of individual systems prior to integrated system testing.

D. Commissioning of fire protection and life safety systems shall comply with National Fire Protection Association (NFPA) 3, *Standard for the Commissioning of Fire Protection and Life Safety Systems*, requirements for the following facility projects (Requirement 2-0210):

1. Line-item projects exceeding the construction threshold of $50 million TEC.
2. New or extensively modified fire protection and life safety systems in nuclear facilities (including below Hazard Category 3).
3. New or extensively modified ML-1, -2, or -3 fire protection and life safety systems.
4. New or modified smoke control systems and associated integrated systems.
5. Fire protection and life safety systems considered especially complex or critical in the judgement of the LANL Fire Protection (FP) Office.

*Guidance: For all other projects and facilities, NFPA 3 should be used as guidance for the commission process of fire protection and life safety systems; services of a dedicated fire commissioning agent (FCA) is not warranted. Basic commission testing is sufficient in commercial construction consisting of automatic sprinkler systems monitored by a fire alarm system interconnected to trigger air handler shutdown and elevator emergency recall. Compliance with NFPA 3 is not required.*

E. The required level of rigor of documentation and procedures for commission shall be confirmed with the LANL Fire Protection Office while developing the commissioning documents (Requirement 2-0211).

## 3.0 INTEGRATED SYSTEM TESTING

*Historically, LANL has performed end-to-end, integrated systems testing of integrated fire protection and life safety systems as part of acceptance testing of fire alarm systems. This consists of functionally testing inputs and confirming operation of output functions of all interfaced building and fire alarm systems (e.g., opening an inspector's test connection to trigger a waterflow alarm and verifying elevator cars recall to the correct building levels after a smoke*

*detector is sprayed with canned smoke). Strictly speaking, NFPA standards only require testing individual systems within their scope and are silent on integrated systems, but the topic is now addressed by NFPA codes and the International Building Code (IBC).*

Where fire protection or life safety systems are integrated with another building, fire protection, or life safety system, either basic or full integrated system testing is required as follows:

A. Basic Integrated System Testing

1. At a minimum, basic integrated system testing shall be performed for all new and modified integrated systems (Requirement 2-0213).
2. Basic integrated system testing consists of end-to-end verification of the required output response for the specific input across systems).

   *Guidance: Basic integrated system testing is to verify correct response for a specific input is sufficient for commercial construction (e.g., automatic sprinkler systems monitored by fire alarm systems that are interconnected to trigger air handler shutdown and elevator emergency recall). This is already required by NFPA 1-2021 and NFPA 101-2021 for most occupancies. However, compliance with NFPA 4, Standard for Integrated Fire Protection and Life Safety System Testing, is not required.*
3. Integrated system input, output, and logic functions shall be documented in the fire alarm system input/output matrix, test plan and procedures, and inspection and testing forms. Where the integrated system does not include fire alarm, consult the FP Office (Requirement 2-0214).

B. Full Integrated System Testing

1. Perform full integrated system testing per NFPA 4 for new and modified integrated systems (Requirement 2-0215):
   a. In nuclear facilities (including below Hazard Category 3).
   b. When incorporating ML-1, -2, or -3 systems.
   c. Where considered especially complex or critical in the judgement of the LANL FP Office.

   *Guidance: The IBC and NFPA 101 already require integrated testing to NFPA 4 for integrated fire protection and life safety systems in high-rise buildings (IBC Section 901.6.2.1 and NFPA 101 Section 9.11.4.2) or when including a smoke control system (IBC Section 901.6.2.2 and NFPA 101 Section 9.3.5 and 9.11.4.2(11)) for most occupancy classifications.*

   *Compliance with NFPA 4 is also required by NFPA 3, Standard for the Commissioning of Fire Protection and Life Safety Systems.*
2. Repeat integrated testing of the system per NFPA 4 is not required for repair or replacement, but output functions for the replaced or repaired equipment shall be verified (Requirement 2-0216).

   *Integrated testing to NFPA 4 is required to be repeated every 10 years or as otherwise defined by the integrated testing plan. Documenting test criteria and procedures is critical for the success of future lifecycle testing, which is outside the scope of this document.*

## 4.0 FIRE PROTECTION SITE INFRASTRUCTURE

A. Fire protection water supply storage tanks shall be inspected and commissioned per NFPA 22, *Standard for Water Tanks for Private Fire Protection*, and applicable American Water Works Associations (AWWA) standards for potable water storage tanks (Requirement 2-0154).

1. Tank manufacturer/erector and/or representative shall document inspection and commissioning results within an inspection report (Requirement 2-0155).

B. Fire protection pumps and associated appurtenances (piping, valves, pressure maintenance pumps, controllers, fuel systems, battery systems, testing devices, enclosures, etc.) shall be inspected and commissioned to NFPA 20, *Standard for Installation of Stationary Pumps for Fire Protection* (Requirement 2-0156).

1. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Private Fire Service Mains (suction and discharge piping to/from the fire pumps), a Contractor's Material and Test Certificate for Fire Pump Systems (one for each pump), and a manufacturer's certified pump test characteristic curve to validate as-installed performance (Requirement 2-0157).

C. Fire protection water supply distribution systems and associated appurtenances (block valves, pressure reducing valves, control valves, and fire hydrants) shall be inspected and commissioned to NFPA 24, *Standard for the Installation of Private Fire Service Mains and their Appurtenances*, and applicable AWWA standards for potable (i.e., domestic) and combined potable/fire water systems where applicable (Requirement 2-0158).

1. Testing shall include verification of available fire flow in comparison with original design calculations (Requirement 2-0159).
2. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Private Fire Service Mains (Requirement 2-0160).

*Guidance: The LANL combined fire protection and potable (i.e., domestic) water supply distribution system is considered to operate as a public utility. NFPA 24 is not applicable to these portions of the water supply distribution system, including the fire hydrants supplied by the system. The standard is applicable to the lead-in to the automatic sprinkler or standpipe riser and distribution systems solely for the purpose of providing fire protection water to risers and/or fire hydrants. Dedicated fire protection water distribution systems are found at TA-35, LANSCE, and TA-55, among others.*

D. Fire department access roadways and associated fire lane marking and signage shall be inspected according to NFPA 1 – *Fire Code* and *International Fire Code (IFC)* criteria for fire department access roadways and FP Office requirements for fire lane marking (Requirement 2-0161).

1. Inspection shall include verification of intended fencing, gates, Knox Box, fire hydrant, fire department connection (FDC) and apparatus accessibility (Requirement 2-0162).

## 5.0 WATER-BASED FIRE SUPPRESSION SYSTEMS

A. Automatic sprinkler systems (wet-pipe, dry-pipe, preaction, deluge) shall be inspected and commissioned according to NFPA 13, *Standard for the Installation of Sprinkler Systems* (Requirement 2-0163).

1. Documentation of commissioning results shall include a contractor's Material and Test Certificate for Underground Piping (lead-in piping), a contractor's Material and Test Certificate for Above Ground Piping, and a listing of the sprinklers

installed within the facility (posted at the spare head cabinet) (Requirement 2-0164).

2. The type and quantity of factory premixed antifreeze solution shall also be posted at the control valve of any antifreeze subsystem (Requirement 2-0165).

B. Water spray fixed systems shall be inspected and commissioned according to NFPA 15, *Standard for the Installation of Water Spray Fixed Systems* (Requirement 2-0166).

1. Documentation of commissioning results shall include a contractor's Material and Test Certificate for Underground Piping (lead-in piping) and a contractor's Material and Test Certificate for Water Spray Systems (Requirement 2-0167).

2. Also provide a listing of the spray nozzles installed within the facility (posted at the spare head cabinet) (Requirement 2-0168).

C. Automatic foam-water sprinkler systems shall be inspected and commissioned according to NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems* (Requirement 2-0169).

1. Documentation of commissioning results shall include a contractor's Material and Test Certificate for Underground Piping (lead-in piping) per NFPA 24, a contractor's Material and Test Certificate for Above Ground Piping, and a listing of the sprinklers installed within the facility (posted at the spare head cabinet) (Requirement 2-0170).

2. Also provide documented confirmation of the compatibility of the foam concentrate, foam concentrate storage tank, foam proportioning devices, piping, valves, and sprinkler heads/spray nozzles (Requirement 2-0171).

D. Standpipe systems shall be inspected and commissioned according to NFPA 14, *Standard for the Installation of Standpipe and Hose Systems* (Requirement 2-0172).

1. Documentation of commissioning results shall include a contractor's Material and Test Certificate for Underground Piping (lead-in piping) and a contractor's Material and Test Certificate for Above Ground Piping (Requirement 2-0173).

## 6.0 CLEAN AGENT EXTINGUISHING SYSTEMS

A. Carbon dioxide ($CO_2$) extinguishing systems shall be inspected and commissioned according to NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems* (Requirement 2-0174).

1. Installing vendor and/or manufacturer's representative shall document inspection and commissioning results within an inspection report, including enclosure integrity testing results (Requirement 2-0175).

B. Clean agent (e.g., FM 200, Inergen, Argonite, Novec 1230, etc.) extinguishing systems shall be inspected and commissioned according to NFPA 2001, *Standard on Clean Agent Extinguishing Systems* (Requirement 2-0176).

1. Installing vendor and/or manufacturer's representative shall document inspection and commissioning results within an inspection report, including enclosure integrity testing results (Requirement 2-0177).

## 7.0 CHEMICAL EXTINGUISHING SYSTEMS

A. Dry chemical extinguishing systems shall be inspected and commissioned according to NFPA 17, *Standard for Dry Chemical Extinguishing Systems* (Requirement 2-0178).

1. Documentation of commissioning results shall include a Dry Chemical System Acceptance Test Report prepared by the installing vendor and/or manufacturer's representative, including confirmation of any auxiliary functions/controls test results (Requirement 2-0179).

B. Wet chemical extinguishing systems shall be inspected and commissioned according to NFPA 17A, *Standard for Wet Chemical Extinguishing Systems* (Requirement 2-0180).

1. Documentation of commissioning results shall include a Wet Chemical System Acceptance Test Report prepared by the installing vendor and/or manufacturer's representative, including confirmation of any auxiliary functions/controls test results (Requirement 2-0181).

## 8.0 FIRE DETECTION AND ALARM SYSTEMS

A. Fire detection and alarm systems shall be inspected and commissioned according to NFPA 72, *National Fire Alarm and Signaling Code* (Requirement 2-0182).

1. Documentation of commissioning results shall include a test plan, record of completion, and inspection and testing forms (Requirement 2-0183).
2. Commissioning shall include proper integration and functionality of the control unit and remote power supply panels, battery load demands, all initiating devices, notification appliances and features (e.g., emergency responder microphones), auxiliary functions (e.g., elevator controls, HVAC controls, fire door release, smoke dampers, process interlocks, smoke management systems, etc.), NFPA 72-compliant electrical supervision of fire suppression systems and equipment, remote annunciators, and alarm transmission to the LANL proprietary fire alarm system (Requirement 2-0184).

## 9.0 PASSIVE FIRE PROTECTION AND LIFE SAFETY FEATURES

A. Fire resistance-rated walls, floor/ceiling systems, barriers, and partitions shall be inspected to confirm that they comply with the IBC, NFPA 101, Life Safety Code, NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, and the design drawings and specifications (Requirement 2-0185).

B. Spray-applied and mastic and intumescent fire-resistant materials and coatings, respectively, used as components of a fire-resistant barrier are subject to special inspection and testing as described in IBC Chapter 17 and ESM Chapter 16, Building Code Program (Requirement 2-0186).

C. Firestop assemblies and fire-resistant joints in high-rise buildings or in buildings assigned to Risk Category III or IV are subject to special inspection and testing as described in IBC Chapter 17 (Requirement 2-0187).

D. Smoke barriers and partitions, and associated air leakage, limiting firestop assemblies and fire-resistant joint systems shall be inspected to confirm they meet the IBC, NFPA 101, *Life Safety Code,* and the design drawings and specifications (Requirement 2-0188).

E. Fire doors, windows, and glazing systems within fire- and smoke-resistant barriers shall be inspected according to the IBC, NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, NFPA 101, *Life Safety Code*, and the design drawings and specifications (Requirement 2-0189).

1. Door hardware, access control, and other security features are verified to be consistent with fire door assemblies and life safety means of egress requirements (Requirement 2-0190).

F. Fire dampers, smoke dampers, and combination fire/smoke dampers within fire- and smoke-resistant barriers shall be inspected according to the IBC; NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilation Systems*; NFPA 80, *Standard for Fire Doors and Other Opening Protectives*; and NFPA 101, *Life Safety Code*, for conformance with the design drawings and specifications (Requirement 2-0191).

1. Where dampers cannot be provided within ductwork for operational reasons (e.g., exhaust systems), external duct wrap systems shall be inspected according to NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids*, for conformance with the design drawings and specifications (Requirement 2-0192).

G. Electrical, mechanical, and other penetrations into and through fire- and smoke-resistant barriers shall be inspected to verify that specified listed/approved through-penetration firestop systems have been properly installed and labeled per the IBC; NFPA 101, *Life Safety Code*; and NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls* (Requirement 2-0193).

H. Spill collection (e.g., oil-filled transformer basins) and fire suppression water runoff containment/collection features shall be inspected for conformance with the design drawings and specifications (e.g., NFPA 15, *Standard for the Installation of Water Spray Fixed Systems*, NFPA 30, *Flammable and Combustible Liquids Code*, NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, etc.) (Requirement 2-0194).

## 10.0 LIFE SAFETY FEATURES

A. Portable fire extinguishers shall be inspected (location/spacing, accessibility, rating, compatibility with hazards, and signage) according to NFPA 10, *Standard for Portable Fire Extinguishers*, for conformance with the design drawings and specifications (Requirement 2-0195).

B. Means of egress features (exit access paths, exit enclosures, horizontal exits, stairs, and doors) shall be inspected to the IBC and NFPA 101, *Life Safety Code*, or conformance with the design drawings and specifications (Requirement 2-0196).

C. Access control and other security features shall be verified to be consistent with life safety means of egress requirements (Requirement 2-0197).

D. Emergency lighting and exit signage shall be inspected according to the IBC and NFPA 101, *Life Safety Code*, or conformance with the design drawings and specifications. Units dependent on integral batteries or centralized emergency power supplies shall be tested to confirm illumination levels and duration satisfy per NFPA 101, Sections 7.9 and 7.10, performance requirements (Requirement 2-0198).

E. Emergency power systems supporting life safety-related systems and features shall be inspected and commissioned according to the IBC, NFPA 101, *Life Safety Code*, NFPA 110, *Standard for Emergency and Standby Power Systems*, and the design drawings and specifications (Requirement 2-0199).

1. Installing vendor and/or manufacturer's representative shall document inspection and commissioning results within an inspection report (Requirement 2-0200).

F. Smoke control and management systems shall be inspected and commissioned according to the IBC, NFPA 101, *Life Safety Code*, NFPA 92, *Standard for Smoke Control Systems, and/or NFPA 204, Standard for Smoke and Heat Venting*, for conformance with the design drawings and specifications (Requirement 2-0201).

1. Commissioning shall be performed under the direction and supervision of the engineer of record (Requirement 2-0202).
2. Commissioning shall be documented within an inspection report (Requirement 2-0203).
3. Smoke control and management systems are subject to special inspection and testing per IBC Chapter 17 and ESM Chapter 16, Building Code Program (Requirement 2-0204).
4. Training shall be offered and delivered at the discretion of the Los Alamos Fire Department on the manual operation controls for any new or modified smoke control system. Contact the LANL FP Office to schedule (Requirement 2-0205).