NFPA® 4

Standard for Integrated Fire Protection and Life Safety System Testing

2015 Edition

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An International Codes and Standards Organization

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NFPA® 4

Standard for

Integrated Fire Protection and Life Safety System Testing

2015 Edition

This edition of NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*, was prepared by the Technical Committee on Commissioning and Integrated Testing. It was issued by the Standards Council on April 29, 2014, with an effective date of May 19, 2014.

This edition of NFPA 4 was approved as an American National Standard on May 19, 2014.

Origin and Development of NFPA 4

The basis for NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*, was Chapter 7 of the 2012 edition of NFPA 3, *Recommended Practice for Commissioning of Fire Protection and Life Safety Systems*. This chapter addressed integrated system testing as part of the overall fire protection and life safety system commissioning concept. Both the 2012 and 2015 editions of NFPA 3 were released as recommended practices as opposed to standards, which meant that the concept of integrated system testing was not required, but only described as a best practice.

The Technical Committee on Commissioning and Integrated Testing determined that while commissioning fire protection systems was not ready for standardization, there was an imminent need to create a standard for testing integrated fire protection and life safety systems. The technical committee requested to separate the concepts of commissioning and integrated system testing into two documents: the first, a recommended practice on commissioning; and the second, a new standard, NFPA 4, addressing the integrated system testing portion. This restructuring and request for a new project was approved by the Standards Council in October 2011 and resulted in Chapter 7 of the 2012 edition of NFPA 3 being removed for the 2015 edition and being used as the basis for NFPA 4.

NFPA 4 is intended to address the testing of the performance of the interconnection between multiple fire protection and life safety systems. Chapter 1 establishes the applicability of the standard and identifies that the standard is applied similar to a design or installation standard, from the perspective that the users should be directed to this standard by scoping provisions in a code, law regulation, or contract document.

NFPA 4 addresses the development of the integrated testing team and the coordination between the integrated testing agents (ITa) and test team. The standard spells out the roles and responsibilities of the owner, the ITa, and the test team in general, as well as qualifications for the ITa.

The standard also provides protocol for both the initial integrated system test that would occur during the construction phase of a project prior to issuance of the Certificate of Occupancy as well as the integrated system testing for existing buildings. Integrated system testing in existing buildings can be in the form of periodic integrated system testing or "trigger-based" testing. NFPA 4 provides the triggers for conducting these post-occupancy integrated system tests as well as the development for a frequency of periodic tests where they are deemed necessary.

Finally, the standard addresses the development of the test plan and the test scenarios as well as the documentation of the test.

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Committee Scope: This Committee shall have primary responsibility for documents that address commissioning and integrated system testing activities and tasks for fire protection and life safety systems. This includes the requirements for planning, organization, coordination, responsibility, implementation, and documentation of commissioning and integrated system testing of active and passive systems and features that serve a fire protection or life safety purpose.

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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1 Scope.

1.1.1* The standard shall provide the minimum requirements for testing of integrated fire protection and life safety systems where such testing is required by the design documents, comissioning plan, governing laws, codes, regulations, or standards.

1.1.2* This standard shall not provide requirements for testing of individual systems.

1.1.3 The requirements of this standard shall apply to new and existing systems.

1.1.4* This standard shall not be interpreted to require integrated fire protection and life safety systems testing unless otherwise required by the design documents or commissioning plan, or by governing laws, codes, regulations, or standards.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to provide a testing protocol that will verify that integrated fire protection and life safety systems perform as intended.

1.2.2 The integrated fire protection and life safety system test shall verify the proper operation and function of all interconnected fire protection and life safety systems.

1.3 Application.

1.3.1* This standard shall apply to integrated passive and active fire protection and life safety equipment and systems.

1.3.2* Integrated systems testing shall verify and document the following:

(1) Performance in accordance with applicable codes and standards
(2)*Sequence of operation
(3) Performance in accordance with manufacturers' published instructions
(4) Accuracy of record documents

1.4 Equivalency.

1.4.1 Nothing in this standard shall prevent the use of systems, methods, devices, or appliances of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.4.2 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.4.3 The systems, methods, devices, or appliances that are found equivalent shall be approved.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 3, *Recommended Practice for Commissioning of Fire Protection and Life Safety Systems,* 2015 edition.

NFPA 70®, National Electrical Code®, 2014 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2013 edition.

NFPA *101®, Life Safety Code®,* 2015 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems,* 2013 edition.

NFPA 731, *Standard for the Installation of Electronic Premises Security Systems,* 2015 edition.

NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

2.3 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 3, *Recommended Practice for Commissioning of Fire Protection and Life Safety Systems,* 2015 edition.

NFPA 70®, National Electrical Code®, 2014 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2013 edition.

NFPA *101®, Life Safety Code®,* 2015 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems,* 2013 edition.

NFPA 820, *Standard for Fire Protection in Wastewater Treatment and Collection Facilities,* 2012 edition.

NFPA 1031, *Standard for Professional Qualifications for Fire Inspector and Plan Examiner,* 2014 edition.

NFPA 5000®, Building Construction and Safety Code®, 2015 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, is the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents*.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.3 General Definitions.

3.3.1* Basis of Design (BOD). A document that shows the concepts and decisions used to meet the owner's project requirements and the requirements of governing laws, codes, regulations and standards. [**3,** 2015]

3.3.2* Building. Any structure used or intended for supporting or sheltering any use or occupancy. [***101,*** 2015]

3.3.3 Commissioning.

3.3.3.1 ***Commissioning (Cx).*** A systematic process that provides documented confirmation that building systems function according to the intended design criteria set forth in the project documents and satisfy the owner's operational needs, including compliance with applicable laws, regulations, codes, and standards. [**3,** 2015]

3.3.3.2* ***Commissioning Plan.*** The document prepared for each project that identifies the processes and procedures necessary for a successful commissioning process. [**3,** 2015]

3.3.4 Component. A part of an architectural, electrical, or mechanical system. [**5000,** 2015]

3.3.5 Construction Documents. Plans, specifications, and other documents that describe the construction project.

3.3.6 Construction Phase. The phase during which the systems and materials are fabricated and installed, tested, and accepted.

3.3.7 Drawings.

3.3.7.1* ***Record (Plan) Drawing.*** A design, working drawing, or as-built drawing that is submitted as the final record of documentation for the project. A drawing is also referred to as a plan. [**3,** 2015]

3.3.8 Individual System. See System.

3.3.9* Inspection. A visual examination of a system or portion thereof to verify that it appears to be in operating condition and is free of physical damage. [**820,** 2012]

3.3.10* Installation Contractor. A person or entity that provides labor and materials to install systems and equipment. [**3,** 2015]

3.3.11 Integrated System. See System.

3.3.12 Integrated System Tests.

3.3.12.1* ***Test.*** A procedure intended to establish the operational status or performance of a system or component. [**3,** 2015]

3.3.12.1.1 ***Control Group Test.*** An integrated system test that verifies the response of one or more individual systems by examining software programming and by testing only one or more initiating devices of another individual system.

3.3.12.1.2 ***End-to-End Integrated System Test.*** A test of the response of one or more individual systems to an input on another individual system.

3.3.12.1.3* ***Integrated Systems Test.*** A test performed on fire protection and life safety systems to confirm that operation, interaction, and coordination of multiple individual systems perform their intended function. [**3,** 2015]

3.3.12.1.4 ***Pre-Functional Testing.*** Tests performed prior to acceptance testing to confirm compliance with manufacturers' specifications, applicable codes and standards, and the project documents. [**3,** 2015]

3.3.13 Integrated Testing Agent (ITa). A person or entity identified by the owner, who plans, schedules, documents, coordinates, and implements the integrated testing of the fire protection and life safety systems and their associated subsystems. [**3,** 2015]

3.3.14 Interface. That place at which individual systems meet and act on or communicate with each other.

3.3.15* Interface Device. A component that connects an individual system to one or more other individual systems.

3.3.16 Issues Log. A formal and ongoing record of failures, deficiencies, or concerns, as well as associated priorities, implications, and resolutions. [**3,** 2015]

3.3.17* Manufacturer's Published Instructions. Published installation and operating documentation provided for each product or component. The documentation includes directions and necessary information for the intended installation, maintenance, and operation of the product or component. [**72,** 2013]

3.3.18* Narrative. A written summary description of the property and all applicable fire protection and life safety systems and related integrated operational features. [**3,** 2015]

3.3.19 Operation and Maintenance Manual. A system-focused composite document that includes the operation and maintenance requirements and additional information of use to the owner during the occupancy phase. [**3,** 2015]

3.3.20* Owner's Project Requirements (OPR). Documentation of the owner's goals and requirements for the project.

3.3.21* Qualified. A competent and capable person or entity that has met the requirements and training for a given field. [**3,** 2015]

3.3.22 Registered Design Professional (RDP). An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the jurisdiction in which the project is to be constructed, or other professional with qualifications or credentials acceptable to the jurisdiction in which the project is to be constructed. [**3,** 2015]

3.3.23* Sequence of Operation. A matrix, narrative, or table of system inputs and outputs or responses that illustrate the interactions of interconnected fire protection and life safety systems.

3.3.24 Stakeholder. Any individual, group, or organization that might affect or be affected by the project. [**3,** 2015]

3.3.25 System.

3.3.25.1 ***Emergency Power Systems.***

3.3.25.1.1 ***Critical Operations Power Systems (COPS).*** Power systems for facilities or parts of facilities that require continuous operation for the reasons of public safety, emergency management, national security, or business continuity. [**70:**708.2]

3.3.25.1.2 ***Emergency Power Supply (EPS).*** The source of electric power of the required capacity and quality for an emergency power supply system. [**110,** 2013]

3.3.25.1.3 ***Emergency Power Supply System (EPSS).*** A complete functioning EPS system coupled to a system of conductors, disconnecting means and overcurrent protective devices, transfer switches, and all control, supervisory, and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of electric power. [**110,** 2013]

3.3.25.1.4 ***Emergency Systems.*** Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction. These systems are intended to automatically supply illumination, power, or both, to designated areas and equipment in the event of failure of the normal supply or in the event of accident to elements of a system intended to supply, distribute, and control power and illumination essential for safety to human life. [**70:**700.2]

3.3.25.1.5 ***Legally Required Standby Systems.*** Those systems required and so classed as legally required standby by municipal, state, federal, or other codes or by any governmental agency having jurisdiction. These systems are intended to automatically supply power to selected loads (other than those classed as emergency systems) in the event of failure of the normal source. [**70:**701.2]

3.3.25.2 ***Fire Protection Systems.*** Systems, devices, and equipment used to detect a fire and its by-products, actuate an alarm, or suppress or control a fire and its by-products, or any combination thereof. [**1031,** 2014]

3.3.25.3* ***Individual System.*** A system with no interconnections or a system within an integrated system to the point of interconnection or to the interface device. [**3,** 2015]

3.3.25.4* ***Integrated System.*** A combination of systems that are required to operate together as a whole to achieve overall fire protection and life safety objectives. [**3,** 2015]

3.3.25.5* ***Interconnected System.*** An integrated system that has component systems or devices physically connected to achieve fire protection and life safety objectives.

3.3.25.6* ***Life Safety Systems.*** Those systems that enhance or facilitate evacuation, smoke control, compartmentalization, and/or isolation. [**1031,** 2014]

3.3.25.7* ***Passive Fire Protection System.*** Any portion of a building or structure that provides protection from fire or smoke without any type of system activation or movement. [**3,** 2015]

3.3.26 System Connection.

3.3.26.1* ***Switch Connection.*** A connection between multiple individual systems using a device for making or breaking the connection in an electric circuit. [**3,** 2015]

3.3.26.2* ***Data Sharing Connection.*** A connection between multiple individual systems in which data streams are transferred.

3.3.26.3* ***Interconnection.*** The physical connections between interconnected systems.

3.3.27 Systems Manual. A compilation of all operational and maintenance manuals and description of the integrated fire protection and life safety systems. [**3,** 2015]

Chapter 4 General Requirements

4.1 Fundamental Principles.

4.1.1 This chapter shall apply to the testing of both new and existing integrated systems provided for fire protection and life safety.

4.1.2 Integrated testing of new or existing fire protection and life safety systems shall be performed where required by the design documents, commissioning plan, or governing laws, codes, regulations, or standards.

4.2 Integrated System Testing Team.

4.2.1* An integrated system test team shall be established in accordance with this section.

4.2.2 The owner shall be responsible for selecting the members of the integrated system test team.

4.2.3 At a minimum, the integrated test team shall consist of the integrated testing agent (ITa) and the installation, testing, or maintenance personnel for each integrated system.

4.2.3.1* Where permitted by the approved test plan, the owner shall assume the responsibilities of the ITa.

4.2.4* The integrated system test team shall be identified and documented in the test plan.

4.2.5 Personnel responsible for integrated system testing shall meet the qualifications listed in 4.3.

4.3* Qualifications.

4.3.1 Personnel involved in integrated system testing shall meet the requirements of this section.

4.3.2 Team members shall provide evidence of their qualifications when requested by the AHJ.

4.3.3 The integrated system test team shall have a working knowledge of the integration between systems for which testing is being performed.

4.3.3.1 The qualification of team members shall be as required by laws, regulations, codes, and standards relevant to the specific individual system.

4.3.3.2 Where no codes or standards are applicable to a system or portion of a system, the required knowledge of team members shall be in accordance with industry practices relevant to the particular system or portion of a system.

4.3.4* The integrated testing agent shall have skills that demonstrate an experience or knowledge of integrated operations of the design, installation, operation and maintenance of the type of fire protection and life safety systems installed.

4.3.4.1 Where an integrated testing agent is not required for the team, the team shall collectively have an understanding of the design, installation, operation, maintenance, and use of the integrated systems.

4.4 Responsibilities.

4.4.1 The owner shall be responsible for the testing of integrated fire and life safety systems.

4.4.2 The responsibility for integrated fire protection and life safety system testing shall be permitted to be delegated by the building or system owner to another person or organization.

4.4.3 Where the building or system owner has delegated any of the responsibilities for integrated fire protection and life safety system testing, a copy of the written delegation shall be included in the test plan and provided to the AHJ upon request.

4.4.4* The ITa shall be responsible for planning, scheduling, documenting, coordinating, and implementing the integrated system testing of the fire protection and life safety systems.

4.4.5 The test team shall be responsible for executing the test plan as directed by the ITa.

4.4.6 The ITa shall prepare a test plan.

4.5 Test Plan.

4.5.1* For new systems the minimum requirements for a test plan shall include the following:

(1) Written verification that the integrated system and its individual systems have been installed in accordance with the approved design documents.
(2)*List of the individual systems to be tested
(3) Documentation of the individual systems as required by the applicable codes or standards
(4)*Integrated test team and additional entities required to be in attendance
(5) Equipment required for testing
(6) A comprehensive functional matrix depicting all system inputs and associated output functions
(7)*List of necessary drawings, including riser diagrams and control diagrams
(8)*Narrative description of the test scenarios, including what is needed for record of completion to document approval by the AHJ
(9)*The extent of systems to be tested under the direction of the ITa
(10)*Test schedule, including individual systems
(11) Periodic integrated systems test frequency

4.5.2* For existing systems the integrated test plan shall include sufficient information to allow the test team to verify that the integrated system(s) functions as was required when the system was initially installed.

4.5.2.1 The test plan shall include as many of the items listed in 4.5.1 as can be provided.

4.5.3* An integrated systems test plan shall not be required for buildings with limited integrated systems, where approved by the AHJ.

4.5.3.1 If an integrated system test plan is not required, integrated system testing is still required.

4.5.4 Testing of integrated systems shall begin by initiating the test scenarios described in the integrated test plan.

4.5.5 The test shall demonstrate that required responses have occurred in accordance with the integrated systems test plan.

4.5.6 Unless otherwise permitted in Section 4.5, integrated system testing shall validate that all of the responses and interactions found on the integrated fire protection and life safety systems conform to the design objectives.

Chapter 5 Test Methods

5.1 General.

5.1.1 This chapter shall apply to the method(s) for testing of integrated fire protection and life safety systems.

5.1.2 The risks associated with integrated testing shall be assessed during development of the test plan.

5.1.2.1 Integrated tests shall not endanger:

(1) The building occupants
(2) The personnel conducting the tests
(3) The building, its contents, or operations

5.1.2.2 The integrated testing agent shall be responsible for ensuring that the assessment of risk is performed and documented by the test team.

5.1.2.3 Where the risk assessment identifies hazards to people, appropriate mitigation measures shall be included in the test plan.

5.1.2.4 Where the risk assessment identifies possible hazards to the building, contents, or operations the owner shall be notified in writing.

5.1.2.4.1 The owner shall determine if appropriate mitigation measures shall be required.

5.1.2.4.2 Where the owner chooses to accept the risk, the test plan shall record the decision.

5.1.2.4.3 Where the owner determines that the risk is not acceptable, appropriate mitigation measures shall be included in the test plan.

5.1.3 Where all of the following conditions and tests are verified, it shall not be required to test all devices on one individual system used to initiate a common response on other individual systems:

(1) Two or more individual systems are interfaced using an interface device.
(2) The integration of the systems takes place through a single interface.
(3) The interface is programmed to deliver notification whenever any initiating device in a defined control group changes state.
(4) At least one test is conducted by activating one of the initiating devices listed in the control group and observing the response of the interconnected systems (end-to-end test).
(5) At least one test is conducted by activating an initiating device that is not listed in the control group and observing the response of the interconnected systems (end-to-end test).
(6) The control group initiating devices have been verified by testing of the individual system in accordance with the applicable system standard for inspection, testing and maintenance.
(7) For each test, it is verified that the response was in accordance with the functional matrix.

5.2 Test Method.

5.2.1* Integrated testing shall demonstrate that the final integrated system installation complies with the specific design objectives for the project and applicable codes and standards.

5.2.2 Test scenarios shall include events and combination of events, including but not limited to:

(1) Loss of normal power
(2) Water flow
(3) Presence of smoke

5.2.2.1* Test scenarios utilizing a combination of events shall be permitted to include simulated events to activate initiating devices.

5.2.3 Test scenario events shall demonstrate that all interface devices perform their intended function in accordance with the approved design or sequence of operation.

5.2.4* Test scenario events shall verify that all required building functions occur.

5.2.5 Integrated fire protection and life safety systems testing shall verify the interconnections function properly.

5.2.6* During integrated testing, equipment shall be tested in accordance with the applicable system standard to verify systems perform according to their design function.

5.2.7 Written documentation of the testing shall be provided in accordance with Chapter 7.

5.2.8* Testing shall be repeated if changes or corrections are made to systems during testing that could affect the overall functionality of the systems.

5.2.9 Switch connections to fire alarm systems shall be tested in accordance with *NFPA 72*, *National Fire Alarm and Signaling Code*.

5.2.10 Control circuits requiring electrical power shall be tested for presence of operating voltage.

5.2.11 Loss of power to monitored circuits shall be tested to confirm signal receipt at one of the following:

(1) A constantly attended location at the premises
(2) A monitoring station as described in NFPA 731, *Standard for the Installation of Electronic Premises Security Systems*, Chapter 9
(3) A supervising station as described in *NFPA 72*, *National Fire Alarm and Signaling Code*

5.2.12 Integrated testing of data sharing systems shall document the following:

(1) Completion of acceptance testing for each component system
(2) Verification of data transfer between component systems
(3) Test of visual and audible signal upon loss of communication
(4) Test of degrade mode for each component system
(5) Proper function of integrated data sharing systems

Chapter 6 Test Frequencies

6.1 General. Integrated system testing shall occur as follows:

(1) Upon installation (initial integrated systems test)
(2) Periodically
(3) Upon existing system modification

6.2 Initial Integrated Systems Test.

6.2.1* An initial integrated systems test shall be performed where required by a commissioning plan or integrated system test plan.

6.2.1.1 An initial integrated systems test shall verify the intended operation of all integrated systems and functions in accordance with either of the following:

(1) Commissioning plan, or
(2) Integrated system test plan

6.2.1.2 Where an integrated system test plan does not exist, a test plan shall be created in accordance with Section 4.5.

6.2.1.3 Where required, existing buildings that have not completed integrated system testing shall have integrated testing conducted in accordance with this standard.

6.3 Periodic Integrated Systems Testing.

6.3.1 Integrated fire protection and life safety systems shall have periodic integrated systems testing as specified in the test plan.

6.3.2* For existing systems, within five years of the adoption of this standard, an integrated system test plan shall be developed.

6.3.2.1 If an integrated system test plan is not developed within 5 years of the adoption of this standard, integrated systems testing shall be performed.

6.3.3* Integrated systems that were commissioned upon installation shall have periodic integrated systems testing at the interval specified in the commissioning plan.

6.3.4* Where integrated systems have not been commissioned in accordance with NFPA 3, an integrated system test plan shall be developed.

6.3.4.1 Where required by the governing laws, codes, regulations, or standards, the integrated system testing plan, including the integrated testing frequency and a schedule for conducting the tests shall be completed and submitted for approval as specified by the governing authority, codes, regulations, or standards.

6.3.5 In addition to periodic integrated systems testing, integrated system testing shall be performed when any of the following occurs:

(1) New fire protection or life safety systems are installed and integrated into existing fire protection and life safety systems.
(2) Existing fire protection or life safety systems are modified to become part of interconnected systems.
(3) Changes are made to site-specific software for an individual system that is part of an integrated system.

6.3.5.1 Where a failure of an individual system interface occurs during operation or testing of an integrated system, the affected integrated functions shall be required to be re-tested to verify correct operation after repairs have been made.

6.3.5.2* Where an individual system that is part of an integrated system is modified, the portions of the integrated system affected by the change shall be required to be tested to verify correct operation.

6.4 Existing System Modifications.

6.4.1* Integrated system testing shall be performed in accordance with 6.4.2 through 6.4.3 when any of the following occurs:

(1) New fire protection or life safety systems are installed and integrated into existing fire protection and life safety systems.
(2) Existing fire protection or life safety systems are modified to become part of an integrated system.
(3) Changes are made to site-specific software for an individual system that is a part of an integrated system.

6.4.1.1 Where a failure of an individual system interface occurs during operation or testing of an integrated system, the affected integrated functions shall be required to be re-tested to verify correct operation after repairs have been made.

6.4.1.2* Where an individual system that is part of an integrated system is modified, the portions of the integrated system affected by the change shall be required to be tested to verify correct operation.

6.4.2* All changes shall be tested as required by the applicable individual system standards.

6.4.3* In addition to known changes, 10 percent up to a maximum of 50 devices performing the unaffected input functions of each integrated system that has been changed shall be tested to verify correct operation or non-operation of the other integrated systems.

Chapter 7 Documentation

7.1 Application.

7.1.1 Documentation of integrated system testing shall comply with the minimum requirements of this chapter.

7.1.2 Documentation required by other approved installation standards referenced for the individual systems that make up the integrated system shall be used as required by those standards.

7.1.3 This chapter outlines documentation requirements, but does not prohibit additional documentation from being provided.

7.1.4 Upon completion of testing, the integrated testing agent (ITa) shall submit a final report to the owner stating that the integrated system has been tested in accordance with the approved test plan and this standard.

7.2 Minimum Required Test Documentation.

7.2.1 The final test report shall summarize the results of the integrated testing.

7.2.2 The test report shall include a narrative or matrix describing each test and the response of the integrated system and individual systems.

7.2.2.1* The test report shall include a description of the status of each individual system for each test.

7.2.2.2 The report detail for each test shall identify the individual system where a condition was simulated or where a device state change was initiated.

7.2.2.3 The report detail for each test shall identify each individual system where a response occurred as the result of a simulated condition or a change in state for an initiating device.

7.2.3 The test report shall include a statement that all input and output functions of the integrated system have been tested and operate as intended.

7.2.3.1 Where any test result does not comply with the intended design, a description of the fault shall be made in an issues log.

7.2.3.2 Where any test result does not comply with the intended design, corrective action report shall be prepared.

7.2.4 The ITa shall maintain a record of faults, failures, and discrepancies discovered through the testing process in the issues log.

7.2.5 The issues log shall list each separate finding and its corresponding resolution, including dates of discovery and resolution.

7.2.6 Corrective action reports shall be prepared and shall provide a specific and detailed description of actions taken to remediate faults, failures, and discrepancies discovered during the testing process.

7.3 Completion Documents.

7.3.1 Upon completion of testing and after all issues and discrepancies have been resolved, the ITa shall submit completion documents to the owner and, where requested, to other stakeholders.

7.3.2 All documents required by section 7.2 of this standard shall be included in the completion documents.

7.3.3 A copy of the test plan required by 4.5 shall be included in the completion documents.

7.3.4 The completion documents shall include all documentation required by the integrated system design documents or by other governing laws, codes, or standards.

7.4 Record Retention, and Record Maintenance.

7.4.1 The property or building or system owner or the owner's designated representative shall be responsible for records retention.

7.4.2 Records shall be on a medium that will survive the retention period.

7.4.3 All records required by this chapter shall be available for examination by the authority having jurisdiction.

7.4.4 Archiving of records by any means shall be permitted if hard copies of the records can be provided promptly when requested.

7.4.5 All documents required by this chapter shall be retained as follows:

7.4.5.1 Documentation of the initial integrated system test shall be retained until a new initial integrated system test report has been provided to the owner.

7.4.5.2 The two most recent periodic integrated system test documents shall be retained.

7.4.6 All records required by this chapter shall be shall be kept in one location.

7.4.7 The location of the documentations shall be identified at the fire alarm control unit.

7.4.8* Security for documentation shall be determined by the stakeholders.

7.4.9 Where documents cannot be protected from public access, it shall be permitted to remove sensitive information from record documents provided that the owner retains complete documentation that will be made accessible to the authority having jurisdiction at an owner-designated location.

7.5 Forms.

7.5.1 Approved documents and forms shall be used to record integrated testing of fire and life safety systems.

7.5.2 Forms required by other governing laws, codes or standards, or by project specifications or drawings, shall be permitted to be used in place of forms required by this section provided that the minimum required content is included.

7.5.3 Custom forms shall be permitted to be used in place of forms required by this section provided that the minimum required content is included.

7.5.4 Where no form or checklist exists, specific forms or checklists shall be developed to document testing of the integrated system and individual systems.

7.5.5 Unless otherwise permitted or required in 7.5.1 through 7.5.4, Figure 7.5.5(a) shall be used as the issues log form and Figure 7.5.5(b) shall be used as the corrective action report form.

COMMISSIONING ISSUES LOG

Project: _____ Prepared by: _____ Page ____ of ____

Attach additional pages as necessary for issues requiring more explanation and tracking.

#	Issue	Date Found	Code/ Document Reference	Possible Cause	Recommendations	Actions Taken	O&M Doc. Issue?	Signature and Date

FIGURE 7.5.5(a) Issues Log.

CORRECTIVE ACTION REPORT

Project: _____ ID: _____

Equipment/System: _____ Equipment/System ID: _____

Identified from: ❑ Test ❑ Review ❑ Discussion _____ ❑ Site visit _____
Date

The above equipment has been observed and tested, or the performance report reviewed, and was found to not comply with the contract documents.

Deficiencies or issues and effects:

_____

_____

_____

_____

_____

Corrective action: ❑ Required ❑ Recommended

_____

_____

_____

For testing to proceed in a timely manner, it is imperative that the required corrective action be completed by:

_____
Date or Event

_____ _____ _____ _____
Commissioning Agent Date Owner's Representative Date

Forwarded to the following parties on _____ for corrective action:
Date

_____

_____

Attachments? ❑ Yes ❑ No

Fill in the following section and return entire form to commissioning agent when corrected.

Statement of Correction

The above deficiencies have been corrected with the following actions:

_____

_____

_____

_____ _____ _____
Signature Firm Date

FIGURE 7.5.5(b) Corrective Action Report.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.1 These requirements include protocol for testing procedures, responsibilities of various parties, methods and documentation for verifying the operational readiness and sequence of integrated systems. The standard is designed to ensure that interconnected active and passive fire protection and life safety systems operate as intended. It is not the intent of this standard to require implementation of emergency response procedures, evacuation drills, or other exercises that require facility staff or fire department response. However, when integrated systems tests are being conducted, it can be an appropriate opportunity to practice emergency procedures or drills.

This standard does not prohibit the owner of the property, building, or individual system or the owner's designated representative from requiring integrated system testing by design or contract documents.

For some buildings, the integrated system testing requirements of NFPA 4 can be considered satisfied by performing the acceptance tests and the inspection, testing, and maintenance required by the NFPA standards for the systems in a building. For example, a less complex system in smaller buildings with automatic sprinkler and fire alarm systems can meet the integrated testing requirements of NFPA 4 by meeting the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, or NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, and *NFPA 72, National Fire Alarm and Signaling Code*.

A.1.1.2 Individual systems should be tested in accordance with the requirements of the appropriate installation standard.

A.1.1.4 The intent of this paragraph is to make it clear that the requirement to perform integrated fire protection and life safety systems testing is derived from the applicable building or fire code, not from NFPA 4.

A.1.3.1 These systems and equipment can include, but are not limited to, the following:

(1) Infrastructure supporting the building fire protection and life safety systems within the boundaries of the project. Project infrastructure should include those systems and utilities necessary for the support and operation of the fire protection and life safety systems of the proposed project. These infrastructure items can include the following:
   (a) Access roadways for general ingress and egress and those necessary for fire department access in accordance with local codes, standards, and policies
   (b) Utility systems for the provisions of electric power, fuel gas, water, and waste water; communication systems; and any other utility system deemed essential to the support of project operations
   (c) On-site combined heat and power generation systems, electric power generation plants or systems, fuel gas storage facilities, water supply and storage facilities, and environmental or waste management systems
(2) Fixed fire suppression and control systems
(3) Fire alarm systems
(4) Emergency communications systems (ECS)
(5) Smoke control systems
(6) The emergency power supply and emergency power supply systems serving emergency systems, legally required standby systems, and critical operations systems should be evaluated by the Fire Commissioning Agent (FCxA) for integrated testing as a stand-alone life safety system, whether or not a fire or smoke event is occurring in the building. Normal and emergency standby power systems including, but not limited to, those powering the following:
   (a) Smoke control systems
   (b) Stair pressurization systems
   (c) Smoke-proof enclosure ventilation systems
   (d) Electric driven fire pumps
   (e) Elevator systems
   (f) Fire suppression system controllers
(7) Explosion prevention and control systems
(8) Fire-resistant and smoke-resistant assemblies. Examples include, but are not limited to, floor-ceilings and roof decks, doors, windows, barriers, and walls protected by a firestop system or device for through-penetrations and membrane penetrations, and other fire and smoke control assemblies.
(9) Systems associated with commercial cooking operations
(10) Elevator systems
(11) Means of egress systems and components including, but not limited to, the following:
   (a) Emergency lighting and exit signs
   (b) Major egress components, such as corridors, stairs, ramps, and so forth
   (c) Exit path marking systems
(12) Other systems or installations integrated or connected to a fire or life safety system, such as, but not limited to, access control, critical processes, and hazardous operations

A.1.3.2 Where integrated systems testing is performed as part of a commissioning process, compliance with the Basis of Design and Owners Project Requirements should be verified.

A.1.3.2(2) See Figure A.3.3.23(a) for a sample sequence of operation

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection

department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.1 Basis of Design (BOD). The basis of design is normally used to assist in the plan review, inspection, and acceptance process.

A.3.3.2 Building. The term *building* is to be understood as if followed by the words "or portions thereof." The intent is to also apply this standard to structures such as roadway and transit tunnels, bridges, towers, fuel storage facilities, and other structures insofar as this document applies.

A.3.3.3.2 Commissioning Plan. The commissioning plan establishes the framework for how commissioning will be handled and managed on a given project.

A.3.3.7.1 Record (Plan) Drawing. A drawing is also referred to as a plan. A record drawing might also be referred to as an as-built drawing or working drawing.

A.3.3.9 Inspection. One purpose for inspections is to verify that systems and components appear to be in operating condition and is free of physical damage.

A.3.3.10 Installation Contractor. Installation contractors often provide shop drawings, working plans, and other related documents.

A.3.3.12.1 Test. Examples of tests include waterflow tests, fire pump tests, alarm tests, and trip tests of dry, preaction, and deluge valves.

A.3.3.12.1.3 Integrated Systems Test. Integrated testing can include other building systems integrated to fire and life safety systems such as elevator recall or HVAC control. Integrated tests might also be referred to as end-to-end tests. An integrated test might include activation of all individual system inputs and observation of all individual system responses or outputs, or it might only test specific inputs and outputs or responses.

An integrated system test might not be an end-to-end test. For example consider an integrated system consisting of a fire alarm system and an elevator system. An end-to-end test would require that the fire alarm smoke detector be activated and the elevator be observed to respond to the signal by returning to a specific location, parking properly and opening the elevator doors. However, another integrated test might only test the interface between the two systems by using a menu command on the fire alarm system to activate the interface device — a relay powered by the fire alarm system and interfaced to the elevator controller. The elevator might be observed to return, but the test did not originate at the fire alarm initiating device. Therefore, the test is not an end-to-end integrated system test.

A.3.3.15 Interface Device. Examples of interface devices include switches and data sharing as defined under system connection.

A.3.3.17 Manufacturer's Published Instructions. The manufacturer's published instructions include directions and information necessary for the intended installation, maintenance, and operation of the product or component.

A.3.3.18 Narrative. The narrative is written to assist and expedite the plan review and inspection process by the AHJ. The narrative is a written description of an individual or integrated system. The narrative for an integrated system includes details on how individual systems are integrated to meet the overall fire protection and life safety system objectives. It is maintained on file for use at the time of final inspection and for periodic reviews during future field inspections. It is referenced by the building owner and AHJ to ensure that all future modifications, alterations, additions, or deletions to the original systems are current and that the original system's protection and required system performance are not compromised or have not been altered without building or fire official prior review. The narrative should be recognized by all entities that it is one of the key documents associated with the commissioning process.

Building owners benefit by knowing how their building's fire protection and life safety systems work. The narrative provides a procedure including methods for testing and maintenance. A copy of the narrative report should be kept on the premises and should be available for review prior to testing and proposed modifications to any portion of the building's fire protection and life safety systems.

Development Format. The narrative is prepared by a qualified, identified individual who has "taken charge" in the development of an entire coordinated narrative that includes all information regarding the design basis, sequence of operation, and testing criteria associated with all required or non-required fire protection systems set forth by applicable laws, codes, regulations, and local ordinances of the jurisdiction and applicable national and/or international standards.

The narrative should be submitted with plans and specifications for review and approval by the AHJ prior to the issuance of a building permit. The narrative should be written in a clear conversational format. The construction specifications should not be considered a narrative; however, some applicable portions of the construction specifications could be included to support or clarify the intent of the narrative. The narrative is a stand-alone document, it should be 8½ in. × 11 in. for filing and ease of use by the AHJ and building owners, and it should include an administrative cover page identifying the project name, building address, and name, address, and phone number of the individual who has "taken charge" in the preparation of the narrative.

Commentary. Codes and standards are written in a way to require uniformity in design and construction for all buildings and structures. The codes and standards can be subjective and are subject to interpretation by building owners, designers, and the AHJ; uniformity is not always necessarily achieved. The narrative should attempt to clarify to the AHJ the designer's intent and interpretation of the code and standards. The AHJ can agree or disagree with the designer's interpretation. Historically, the requirements for fire protection and life safety systems have become site-specific, and building code requirements are not uniformly enforced. The size of the community, fire department staffing, fire department equipment availability, and suppression tactics established by the local fire department have affected the uniformity of enforcement. Site-specific requirements more or less than that of the building code can have reasonable intent; however, this type

of enforcement in some cases has proven to be controversial in the applicability of code uniformity. The narrative can be and should be a valuable instrument when accurately prepared, and it will establish a line of communication between the designer and the AHJ, resulting in what the building codes and standards mandate, which is uniformity and consensus in the interpretation of the codes and standards. The narrative should be written in a three-sectional format with subsections as necessary (methodology, sequence of operation, and testing criteria sections) for clarity and should be limited to a summary. A sample narrative outline can be found in Annex B.

A.3.3.20 Owner's Project Requirements (OPR). The owner's project requirements (OPR) document the owner's goals for the project, their expectations for how individual systems will be integrated and how the individual systems and the integrated systems will be used and operated. The OPR also establishes benchmarks and criteria for performance.

A.3.3.21 Qualified. The definition of qualified is intended to be generic. Chapter 4 has specific requirements for the qualifications of persons or organizations that perform different functions.

A.3.3.23 Sequence of Operation. See Figure A.3.3.23(a) and Figure A.3.3.23(b). The matrix and the sequence of operations form are examples only, and they might need to be modified based on the actual installation requirements. The system outputs on the sequence of operations matrix correspond to the system outputs on the sequence of operation form.

A.3.3.25.3 Individual System. Individual systems might be made up of various hardware and software components and assemblies. Other systems might include building architectural features such as ceiling and walls that might affect voice messaging, alarm audibility or smoke migration. Some individual systems that are a critical part of a successful integrated system might be composed of procedures rather than just hardware and software. The following are examples of individual systems:

(1) Fire alarm systems
(2) Emergency communication systems
(3) Building automation management systems
(4) Means of egress systems and components
(5) Heating, ventilating, and air conditioning (HVAC) systems
(6) Gas detection systems
(7) Normal, emergency, and standby power systems, including fuel supply
(8) Automatic sprinkler systems
(9) Fixed fire suppression and control systems
(10) Automatic operating doors and closures
(11) Smoke control and management systems
(12) Explosion prevention and control systems
(13) Elevator and pedestrian movement systems
(14) Security systems
(15) Commercial cooking operations

A.3.3.25.4 Integrated System. Integrated systems are made up of individual systems that might be physically connected or might require manual operation by a person to achieve integrated operation. An example of an integrated system is a fire alarm system, sprinkler system, and elevator system that are interconnected to respond in specific ways to specific conditions. Several standards, codes, designers, authorities, and installers are involved in the individual systems that make up the integrated system.

An integrated system can contain a combination of individual fire protection and life safety systems and other individual systems (i.e., building systems such as elevators, HVAC systems, and automatic door closures) that might or might not be physically connected, but that are required to operate together as a whole to achieve overall fire protection and life safety objectives.

For example, a smoke control system is often activated by water flow in a sprinkler system but the sprinkler system is not physically connected to the HVAC system. The physical connection might be from the sprinkler system to the fire alarm system and then to the building automation system. Further examples of integrated systems include the need for wall integrity when using total flooding suppression agents or automatic door closers that close upon activation of smoke control systems or stair pressurization systems. See Figure A.3.3.25.4 for examples of integrated systems.

A.3.3.25.5 Interconnected System. An example of two interconnected, individual systems that interface using an interface device is a fire alarm system that uses a relay as an interface device to connect to an elevator controller. Another example would be an energy management systems that is interconnected to a fire alarm system using a network data connection and a communications software protocol.

Some integrated systems may rely on individual systems that are not interconnected. In a prison, a fire alarm and emergency communications system might present information to an operator who in turn must make decisions and manually control a separate door locking system. The door locking system is an individual system that is not interconnected to the fire alarm system. The door system, the fire alarm system and the operations personnel are all part of an integrated fire and life safety system.

A.3.3.25.6 Life Safety Systems. Life safety systems can include both active and passive fire protection systems, devices, or assemblies. These systems are comprised of several items of equipment, processes, actions, or behaviors, grouped or interconnected so as to reduce injuries or death from fire or other life-threatening event.

A.3.3.25.7 Passive Fire Protection System. Examples of passive systems include, but are not limited to, floor-ceilings and roof, door, window, and wall assemblies, spray-applied fire-resistant materials, and other fire and smoke control assemblies. Passive fire protection systems can include active components and can be impacted by active systems, such as fire dampers.

A.3.3.26.1 Switch Connection. For purposes of this definition, a relay is an electrically controlled switch. An example of a monitored switch is a waterflow switch that is either open or closed (normal/not-normal output), which when connected to the input of a fire alarm system can cause multiple outputs in the fire alarm system including sounding the waterflow bell and notification appliances, starting smoke control systems, and so forth. An example of a relay as a switch connection is for elevator control when a fire alarm relay controls when the fire fighters' recall occurs through the elevator control monitoring the status of the fire alarm relay.

A.3.3.26.2 Data Sharing Connection. Data sharing systems are connected such that data from one component system is shared with other component systems, which then make independent decisions to achieve a desired result. The communication can be one-way or two-way, serial or parallel. A data

System Inputs		No.	Input	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
			System Outputs →	Fire Alarm Control Center									Notification		Other Required Fire Safety				
				Actuate common alarm signal indicator	Actuate audible alarm signal	Actuate common supervisory signal indicator	Actuate audible supervisory signal	Actuate common trouble signal indicator	Actuate audible trouble signal	Display and print change of status and time of initiating event	Transmit alarm to fire department and to central station — masterbox	Illuminate associated detector LED indicator	Actuate associated exterior fire alarm beacon(s)	Actuate all evacuation signals for the building	Release all magnetically held doors	Recall associated elevator in accordance with recall sequence (see Note 2)	Shut down associated mechanical equipment (see Note 3)	Release preaction valve (charge sprinklers)	Elevator hoistway vent open
Fire Alarm System	Fire Alarm Inputs	1	Typical manual pull station (by device) — levels 1–5	X	X					X	X		X	X	X				
		2	Typical elevator recall smoke detector (by device) — by floor (lobby)	X	X					X	X		X	X	X	X			X
		3	Elevator machine room smoke detector	X	X					X	X	X	X	X	X				X
		4	Typical smoke detector (by device) — computer room (third floor) — preaction system	X	X					X	X		X	X	X	X			
		5	Typical wet sprinkler system flow control valve assembly flow switch — by floor	X	X				X	X	X		X	X	X				
		6	Typical wet sprinkler system flow control valve assembly tamper switch — by floor			X	X			X									
		7	Typical preaction sprinkler system flow control valve assembly flow switch — by floor	X	X				X	X	X			X	X				
		8	Typical preaction sprinkler system flow control valve assembly tamper switch — by floor			X	X			X									
		9	Kitchen cafeteria ansul system — first floor	X	X					X	X				X				X
		10	Typical duct-in smoke detector (by device) — by floor							X							X		
Fire Alarm System Inputs	Building	11	Fire pump running			X	X			X									
		12	Fire pump power failure			X	X			X									
		13	Fire pump phase reversal			X	X			X									
		14	Fire pump connected to emergency power			X	X			X									
		15	Fire pump circuit breaker at generator output			X	X			X									
	FACP	16	Fire alarm system open circuit					X	X	X									
		17	Fire alarm system ground fault					X	X	X									
		18	Fire alarm system battery disconnect					X	X	X									
		19	Fire alarm system low battery					X	X	X									
		20	Fire alarm system ac power failure					X	X	X									
		21	Fire alarm system amplifier failure					X	X	X									
	Misc.	22	Generator status indicator					X	X										

Notes:
1. Five-story office building, use Group B. Cafeteria (use Group A) on first floor equipped with an ansul system. Computer room on third floor equipped with a preaction system.
2. Upon activation of elevator recall the elevator should stop at primary recall floor. If fire is on primary recall floor the elevator should stop at an alternate recall floor. Primary and alternate recall floor should be coordinated with the fire department.
3. Shutdown of mechanical equipment should be interfaced with building automation system.

FIGURE A.3.3.23(a) Sequence of Operation.

SEQUENCE OF OPERATION TEST FORM

Building Information

Building name: _____

Building address: _____

Owner's name: _____

Owners address: _____

Owner's phone/fax/e-mail: _____

Installing Contractor

Company name: _____

Address: _____

Contact person: _____

Phone/fax/e-mail: _____

System Input	System Output	Test Results	Date	Initials
1. Typical manual pull station (by device) floors 1–5	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	J. Actuate associated exterior fire alarm beacons			
	K. Actuate all evacuation signals for the building			
	L. Release all magnetically held doors			
2. Typical elevator recall smoke detector (by device) by floor (lobby)	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	J. Actuate associated exterior fire alarm beacons			
	K. Actuate all evacuation signals for the building			
	L. Release all magnetically held doors			
	M. Recall associated elevator in accordance with recall sequence			
	P. Elevator hoistway open			
3. Elevator machine room smoke detector	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	I. Illuminate associated detector LED indicator			

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FIGURE A.3.3.23(b) Sequence of Operation Form.

SEQUENCE OF OPERATION TEST FORM *(continued)*

System Input	System Output	Test Results	Date	Initials
3. Elevator machine room smoke detector *(continued)*	J. Actuate associated exterior fire alarm beacons			
	K. Actuate all evacuation signals for the building			
	L. Release all magnetically held doors			
	P. Elevator hoistway open			
4. Typical smoke detector (by device) computer room (3rd floor) preaction system	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	J. Actuate associated exterior fire alarm beacons			
	K. Actuate all evacuation signals for the building			
	L. Release all magnetically held doors			
	M. Recall associated elevator in accordance with recall sequence			
5. Typical wet sprinkler system flow control valve assembly flow switch — by floor	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	J. Actuate associated exterior fire alarm beacons			
	K. Actuate all evacuation signals for the building			
	L. Release all magnetically held doors			
6. Typical wet sprinkler system flow control valve assembly tamper switch — by floor	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			
7. Typical preaction sprinkler system flow control valve assembly flow switch — by floor	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	K. Actuate all evacuation signals for the building			
	L. Release all magnetically held doors			
8. Typical preaction sprinkler system flow control valve assembly tamper switch — by floor	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			

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FIGURE A.3.3.23(b) ***Continued***

SEQUENCE OF OPERATION TEST FORM *(continued)*

System Input	System Output	Test Results	Date	Initials
9. Kitchen cafeteria wet chemical system — 1st floor	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	G. Display and print change of status and time of initiating event			
	H. Transmit alarm to FD and central station masterbox			
	L. Release all magnetically held doors			
	P. Elevator hoistway open			
10. Typical duct smoke detector (by device) — by floor	G. Display and print change of status and time of initiating event			
	N. Shutdown associated mechanical equipment			
11. Fire pump running	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			
12. Fire pump power failure	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			
13. Fire pump phase reversal	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			
14. Fire pump connected to emergency power	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			
15. Fire pump circuit breaker at generator output	C. Actuate common supervisory signal indicator			
	D. Actuate audible supervisory signal			
	G. Display and print change of status and time of initiating event			
16. Fire alarm system open circuit	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
17. Fire alarm system ground fault	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			

FIGURE A.3.3.23(b) *Continued*

SEQUENCE OF OPERATION TEST FORM *(continued)*

System Input	System Output	Test Results	Date	Initials
18. Fire alarm system battery disconnect	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
19. Fire alarm system low batttery	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
20. Fire alarm system ac power failure	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
21. Fire alarm system amplifier failure	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			
	G. Display and print change of status and time of initiating event			
22. Generator status indicator	E. Actuate common trouble signal indicator			
	F. Actuate audible trouble signal			

Date system left in service: _____

Test Witnessed by

Owner/authorized agent	Title	Date
Owner/authorized agent	Title	Date

Additional explanations/notes: _____

FIGURE A.3.3.23(b) ***Continued***

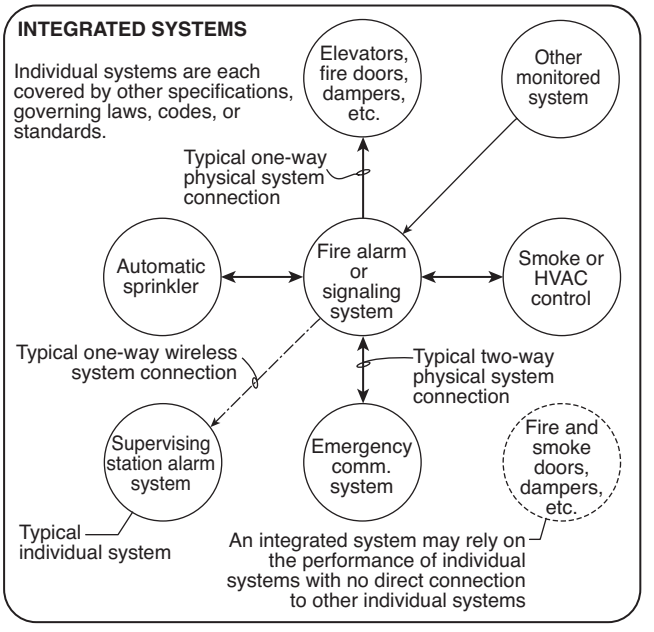

FIGURE A.3.3.25.4 Integrated System. ***(Courtesy R.P. Schifiliti Associates, Inc.)***

sharing system can have components that are switch connections too.

A.3.3.26.3 Interconnection. Interconnections could consist of electrical binary connections (switches) or data sharing connections transfer protocols. Example of data transfers are BACnet or other data exchange protocols.

A.4.2.1 Where required by other sections of this standard, Section 4.2 should be used to develop the team responsible for the integrated system test.

A.4.2.3.1 The ITa is not always required but could be needed on some projects, including, but not limited to, complex projects. The ITa should be selected by the owner during the preliminary stage of the project. Simple projects might not require a large integrated system test team and could be limited to parties involved (i.e., the contractors and the owner). It is also possible on some simple projects to let the owner or owner's representative act as the ITa. Complex projects might require multidisciplinary competencies that will be found only in a large team, organized around an ITa.

A.4.2.4 The integrated system testing team can include the following members,:

(1) Owner's technical support personnel
(2) Facility manager or operations personnel
(3) Installation contractor(s) responsible for the systems involved
(4) AHJ
(5) RDP(s)
(6) Construction manager/general contractor
(7) Manufacturer's representatives
(8) Insurance representative
(9) Third-party test entity
(10) CxA
(11) ITa
(12) FCxA

Entities not included as part of the project should not be required to be part of the integrated system testing team.

A.4.3 The following descriptions are provided for various team members and can be used to determine that team members are qualified:

(1) **Third-Party Test Entities.** The third-party test entity should be individually identified in the integrated systems testing plan, project specifications or other enabling documentation. The third-party test entity should provide an objective and unbiased point of view.
   (a) *Requisite Knowledge.* A qualified third-party test entity should have an advanced understanding of the installation, operation, and maintenance of fire protection and life safety systems proposed to be installed, with particular emphasis on integrated systems testing.
   (b) *Requisite Skills.* A third-party test entity should have the ability to do the following:
      i. Read and interpret drawings and specifications for the purpose of understanding system installation, testing, operation, and maintenance
      ii. Analyze and facilitate resolution of issues related to failures in fire protection and life safety systems
      iii. Provide clear, concise written reports and verbal communication, and have the ability to resolve conflicts

(2) **Registered Design Professional (RDP).** The RDP should be individually identified in the integrated systems testing plan.
   (a) *Requisite Knowledge.* A qualified RDP should have comprehensive knowledge of the following:
      i. The design, installation, operation, and maintenance of the fire protection and life safety systems
      ii. How individual and integrated systems operate during a fire or other emergency
   (b) State or local licensure regulations shall be followed to determine qualified personnel. Depending on state or local licensure regulations, qualified personnel should include, but not be limited to, one or more of the following:
      i. Personnel who are registered, licensed, or certified by a state or local authority
      ii. Personnel who are certified by a nationally recognized certification organization acceptable to the authority having jurisdiction (AHJ)
      iii. Personnel who are factory trained and certified for the specific type and brand of system and who are acceptable to the authority having jurisdiction

(3) **Construction Manager and General Contractor.** Construction managers and general contractors should be knowledgeable and experienced in the field of construction project management and the operation of integrated fire protection and life safety systems. State or local licensure regulations should be followed to determine qualified personnel. Depending on state or local licensure regulations, qualified personnel should include, but not be limited to, one or more of the following:
   (a) Personnel who are registered, licensed, or certified by a state or local authority

(b) Personnel who are certified by a nationally recognized certification organization acceptable to the authority having jurisdiction (AHJ)

(4) **Facilities Management Personnel.** Facilities management personnel should include building maintenance and service personnel, building engineering personnel, service contractors hired by the building owner or his representative, and similar job functions.

(a) *Requisite Knowledge.* Facilities management personnel should be knowledgeable and qualified in the operation and maintenance of the fire protection and life safety systems installed in their facility. Facilities management personnel who perform the ongoing system operation, inspection, testing, and maintenance should be thoroughly familiar with the required and recommended operation and maintenance tasks. Facilities management personnel who will be responsible for management of a contract for system operation, inspection, testing, and maintenance should be thoroughly familiar with the tasks to be performed and the frequency of such tasks, but not necessarily the implementation of those tasks.

(b) *Requisite Skills.* Facilities management personnel should have the ability to perform the following:

i. Assess a facility's need for building systems and recommend building systems
ii. Oversee the operation of building systems
iii. Establish practices and procedures
iv. Administer the allocation of building systems resources
v. Monitor and evaluate how well building systems perform
vi. Manage corrective, preventative, and predictive maintenance of building systems
vii. Develop and implement emergency procedures and disaster recovery plans

(5) **Authority Having Jurisdiction (AHJ).** The AHJ should be knowledgeable in the applicable codes, ordinances, and standards as they relate to the fire protection and life safety systems installed. The AHJ should have the ability to determine the operational readiness of the fire protection and life safety systems installed. The AHJ should have the ability to verify completion of integrated system testing for the purpose of system acceptance.

(6) **Insurance Representative**. The insurance representative should be knowledgeable and experienced in property loss prevention and life safety to mitigate possible risk.

A.4.3.4 Documented skills might include a resume with relevant experience in project(s), training, or certification on the system(s) involved, management of team organization and facilitation, or references. Where the integrated testing agent is responsible for testing mechanical and electrical interfaces, the knowledge base of the ITa should be an overall functionality of the system and not just with mechanical, for instance. The ITa should provide an objective and unbiased point of view.

A.4.4.4 Examples of the responsibilities of an ITa are as follows:

(1) Verification of approved design and construction documents and specifications for each fire protection and life safety system and their associated subsystems.
(2) Development of the integrated systems testing plan.
(3) Documentation of the integrated test performance and test results.
(4) Coordination of the scheduling of entities to perform integrated system testing of systems and subsystems.

A.4.5.1 The documentation for existing systems can be different from that for new systems and might include past test reports and information about prior editions of applicable standards. For an existing system, the documentation required might include past test reports. In addition, documentation can differ if acceptance testing is performed simultaneously with integrated system testing. Where acceptance testing of individual systems occurs prior to integrated system testing, the documentation might be required to include copies of the test documentation required by the individual standards.

A.4.5.1(2) Prerequisites to integrated testing should include individual system installation including all active and passive system features and components, interconnections between multiple systems, successful completion of pre-functional testing (where required), successful completion and close-out of all Corrective Action Reports and Commissioning Issues Logs, acceptance testing in accordance with the applicable NFPA installation standards, and notification of substantial completion and integrated testing readiness.

Information provided for the individual systems should include, but not be limited to, the following:

(1) Installation standards, including applicable edition
(2) Test standards, including applicable edition
(3) Date of previous test(s)
(4) Responsible party for the previous test(s)

A.4.5.1(4) Entities should include the ITA, representatives of the owner, individual system installation contractors, registered design professionals, building officials, fire officials, insurance representative, and any other AHJ.

A.4.5.1(7) Riser and/or control diagrams should be provided for the integrated systems. The fire sprinkler system riser diagram should include the location of all major components, including vertical piping, fire pumps, control valves, releasing valves, and electrical switches located by floor. The fire alarm riser diagram should include all fire alarm devices located by floor. The smoke control system control diagram should include the location of all related fans, initiating devices make-up air systems, power supplies, and monitoring devices, including flow direction, by floor, as well as a sequence of operation.

A.4.5.1(8) *Example 1*: Large or high-rise buildings generally contain most, if not all, of the systems listed in A.1.3.1.

The test plan narrative for this type of building should describe the step-by-step process of activating all fire protection and life safety systems in both normal and emergency power mode. For example, a smoke event caused by an electrical fault in a below-grade transformer vault develops into an expanding fire and smoke situation that causes fire alarm signal and notification, emergency communications, sprinkler activation, fire pump startup, stairway pressurization, elevator recall, door release, and a loss of normal power. All systems shut down, and an emergency transfer switch signals a generator start and transfer of power to all systems, which must restart and continue to operate.

Example 2: Low-rise building with no smoke control or fire pump.

The test plan narrative for this type of building should describe the step-by-step process of activating all fire protection and life safety systems in both normal and emergency power mode. A single initiating device begins a sequence of operating all systems as a fire develops. For example, a fire caused by flammable materials in the main electric room or closet develops and expands to surrounding rooms, which causes a fire alarm signal and notification, sprinkler activation, elevator recall, and loss of normal power. All systems shut down, and an emergency transfer switch signals a generator start and transfer of power to all systems, which must restart and continue to operate, including fuel signaling, and operation of transfer pumps.

Example 3: Single-story restaurant with no smoke control, fire pump, elevator, or generator.

The test plan narrative for this type of building should describe the step-by-step process of activating all fire protection and life safety systems in both normal and emergency power mode. A single initiating device begins a sequence of operating all systems as a fire develops into a worst-case event. For example, a fire in the kitchen hood exhaust develops into a grease fire in the hood and surrounding kitchen, activating the fire alarm system, the hood suppression system, the sprinkler system, and fire-resistant assemblies.

Example 4: Elevator operation (normal and emergency power).

The test plan narrative for this integrated system test should clearly define and describe the step-by-step process for functional performance testing of the elevator life safety features. The narrative should clearly define the following:

(1) Which functional performance testing must be complete prior to integrated testing
(2) Extent of testing (i.e., sample of elevators or all elevators)
(3) How testing will be performed

The purpose of integrated testing is not to increase redundant testing. Rather, the intent is to verify that the testing that was performed and documented properly and to perform any integrated testing that has not been performed. The test plan narrative should state that all functional performance testing of elevator and emergency power systems must be complete prior to integrated testing of the elevator recall system. If elevator functional performance testing includes testing elevator recall (Phase I), fire fighter's operation (Phase II), and cab telephone (as is typically performed by an elevator inspector), integrated testing should only be provided for a random sample of the elevators. For example, there is no need to test all elevator cab telephones if the telephones were previously tested and documented. If, during random sample testing, it is determined that failures have occurred, further testing might be warranted. The same approach should be utilized for verification of elevator recall. If elevator lobby smoke detectors and primary and alternate recall were tested as part of the elevator FPT, random sampling of that integrated test should be performed, not complete redundant testing.

A.4.5.1(9) Direction in this instance means on-site coordination and orchestrating of the test events. The ITa is not intended to physically perform system initiation, operation, or results measurement but rather should observe and document test results.

A.4.5.1(10) The integrated systems testing schedule should consider the schedule of the individual systems required to be tested and accepted prior to integrated systems testing.

A.4.5.2 For existing buildings, obtaining all of the information required for a new test plan can be prohibitively difficult. Due to this difficulty, the requirements for developing a test plan for an existing facility are purposely relaxed in this section of the standard. This does not alleviate the requirement to provide a proper test plan, but rather it recognizes that some of the information that would typically be provided within the test plan cannot be available.

A.4.5.3 Buildings that have a limited number of simple systems integrated together typically have integrated testing performed as part of the normal inspection, testing, and maintenance required by other NFPA standards. When determining what "limited number of simple systems" means for the purpose of this section, similar individual systems can be considered "one system". For example, a fire sprinkler system, standpipe system, and fire pump system can be considered "one system" for the purpose of this section based on their complexity. Whether an integrated system test plan is necessary for a particular building should be determined on a case by case basis. Some examples are noted in the following paragraphs.

Example 1.

A building with only a sprinkler system, a fire alarm system, and elevators would have integrated testing performed as part of normal inspection and testing required by NFPA 25, *NFPA 72*, and the elevator code. The integration between the sprinkler system and the fire alarm system (i.e., waterflow switch activation initiates audible/visual device activation and transmission of signal off-site) is typically tested during the individual system testing requirements of NFPA 25 and *NFPA 72*. The integration between the fire alarm system and the elevator system (i.e., elevator lobby smoke detector activation initiates alternate level elevator recall) is typically tested during the individual system testing requirements of *NFPA 72* and the elevator code. Therefore, an integrated system test plan should not be necessary. In order to accomplish this, it might be necessary for each individual system's inspection and testing personnel to perform their respective integrated portions concurrently.

Example 2.

A building with a sprinkler system, a fire alarm system, and emergency generator system connected to the life safety systems would also have integrated testing performed as part of the normal inspection and testing required by NFPA 25, *NFPA 70*, *NFPA 72*, NFPA 110, and NFPA 111. The integration between the sprinkler system and the fire alarm system is discussed in Example 1. The integration of the fire alarm system and the emergency generator system (i.e., loss of normal power activates a transfer switch that starts the generator and provides emergency power to the fire alarm system and activates a supervisory condition at the fire alarm control panel) is typically tested during the individual system testing requirements of *NFPA 72*, NFPA 110, and NFPA 111. Therefore, an integrated system test plan should not be necessary. In order to accomplish the integrated testing, it can be necessary for each individual system's inspection and testing personnel to perform their respective integrated portions concurrently.

Example 3.

A building with a sprinkler system, a fire alarm system, elevators, an emergency generator system, a stair pressurization system, and automatic closing fire resistance–rated doors is more complex than Examples 1 and 2 and would not have integrated system testing performed as part of the normal inspection and testing required by NFPA 25, *NFPA 70*, *NFPA 72*,

NFPA 80, NFPA 92, NFPA 110, and NFPA 111, and the elevator code. While the integration between the sprinkler system and the fire alarm system, between the fire alarm system and elevators, and between the fire alarm system and the emergency generator are verified during individual system inspection and testing, the integration between the fire sprinkler system, stair pressurization, and automatic closing of fire resistance–rated doors is not (i.e., waterflow switch activation initiates audible/visual device activation and transmission of signal off-site, starts the stair pressurization system, and releases automatic closing of doors). An integrated system test plan should be developed for this building due to the complexity of the integration as well as the number of systems involved.

A.5.2.1 The goal of integrated testing is to verify that fire protection and life safety systems operate as designed and as required by codes and standards. The scope of work can include, but is not limited to, the following:

(1) Review of building plans and specifications.
(2) Review of applicable codes and standards.
(3) Review of one line riser diagram of smoke control and exhaust systems, schedules for ducts, fans, dampers, and submittals for damper operators and sequence of operation. Each piece of equipment should be numbered and identified.
(4) Review of system testing matrices and as-built drawings.
(5) Review of testing matrix checklist of integrated systems.
(6) Review of final individual testing reports (including TAB).
(7) Review of one line riser diagrams of normal and emergency electric system (EPSS).
(8) Review of equipment software submittals.
(9) Establishment of a team of testing participants and assignment of duties.
(10) Coordination of pre-test meetings with stakeholders.
(11) Implementation of integrated testing by appropriate methods and verification and documentation of operation of interface equipment under normal and emergency power after all trades complete their work.
(12) Correction of problems and retest.
(13) Submission of final report and documentation.

A.5.2.2.1 Where required ITM has been performed in accordance with NFPA standards, simulating the function of initiating devices shall be permitted for periodic integrated system testing.

A.5.2.4 These functions can include, but not be limited to, the following:

(1) Sprinkler system alarms and notifications
(2) Egress lighting
(3) Smoke control
(4) Elevator control and operation
(5) Fire alarm signaling
(6) Fire pump operation
(7) Security systems
(8) HVAC control and operation
(9) Suppression
(10) Emergency and standby power

A.5.2.6 Fire protection or life safety systems can operate equipment that is not necessarily part of the fire protection or life safety system. One such example is shunt trip breakers that should be tested for proper operation.

A.5.2.8 Additions, modifications, or alterations to systems can cause unintended consequences of operation to the interactions of integrated systems. The testing procedure should be re-evaluated to ensure repeat testing is adequate to determine the correctness of the revision.

A.6.2.1 Integrated testing can be permitted to be conducted in conjunction with the acceptance testing of the individual systems or after completion of the acceptance testing of the individual systems.

A.6.3.2 Intervals for periodic integrated systems testing should be determined based upon a risk analysis. The risk analysis to determine the frequency should be based on the life safety implications of the building such as a high-rise or large area building, the complexity of the interconnected systems, and the property protection implications based on the hazards contained in the building such as flammable liquid storage, and so forth. Case studies of similar occupancies and component failure rates should also be considered when determining the periodic integrated testing frequency. The number of design and construction modifications following initial commissioning should also be a factor in the determination of periodic integrated testing. Other factors that should be considered include the environment in which the system and equipment is expected to operate. Harsh environments such as corrosive atmospheres or areas subject to wide temperature variations should require more aggressive testing programs.

A.6.3.3 Typically all integrated systems are unique to the structures they protect. It is recommended an integrated test plan for the integrated system be developed as part of the commissioning of the building as defined in the commissioning plan.

For integrated systems that have not been commissioned in accordance with NFPA 3, an integrated testing plan should be developed to identify the appropriate extent and frequency of periodic integrated system testing. With the adoption of this standard, an integrated testing plan should be developed and submitted to the AHJ within a time frame set by applicable laws, regulations, codes, and standards. A number of factors and/or risks should be considered in determining the frequency of testing integrated systems. The factors and/or risks include, but are not limited to, the following:

(1) The size of the system
(2) The number of interconnected systems
(3) The frequency of system modifications
(4) The risk of fire or other hazards, based on occupancy

This assessment of factors and/or risks gives the system owner the latitude to develop an integrated system test plan acceptable to the AHJ. Different aspects of the integrated system might have different test cycle times due the evaluation of the all factors and/or risks. For example, the end-to-end interconnection testing of a fire alarm system and gaseous suppression system might require one test frequency, but the end-to-end interconnection testing of a fire alarm system to the smoke control system might require a different test frequency.

A.6.3.4 The test plan should be agreed upon by all stakeholders and should consider the complexity of the integrated fire protection, the life safety systems, and the size of the building.

A.6.3.5.2 It is not the intent of this standard to require complete testing of the entire integrated system when only a portion of the facility undergoes modification, remodel, refurbishment or tenant improvement work. When only a portion of the facility or integrated system has been modified, only

those areas or portions of the integrated system that have been impacted should be tested.

For example, modifications such as adding a sprinkler to a branch line or replacing a non-addressable smoke detector would not trigger an integrated system test because the addition of this system component does not affect the performance of the system interconnection.

A.6.4.1 Whenever a system is changed in any way, the operation of integrated systems can be affected. In addition to the known and intended changes, unintended consequences can occur. The intent of this section is to ensure that all known changes that affect operation of the interface device are tested. This includes changes to one individual system that are intended to affect operation of another individual system. It also includes testing of changes to an individual system that are not intended to affect any other individual system that is interconnected to form an integrated system. In addition to testing the known changes, the standard specifies testing a statistical sample of other integrated operations.

Site-specific software is the custom database software programmed into a system to affect its operation. Executive software is the BIOS or operating system software that is provided by the individual system manufacturer and that is generally not customized for a specific project. However, changes to the executive software, such as upgrading to a new version or revision, can create incompatibilities or other unintended consequences on the operation of a system.

A.6.4.1.2 It is not the intent of this standard to require complete testing of the entire integrated system when only a portion of the facility undergoes modification, remodel, refurbishment, or tenant improvement work. When only a portion of the facility or integrated system has been modified, only those areas or portions of the integrated system that have been impacted should be tested.

For example, modifications such as adding a sprinkler to a branch line or replacing a non-addressable smoke detector would not trigger an integrated system test because the addition of this system component does not affect the performance of the system interconnection.

A.6.4.2 Each individual system that is interconnected to form an integrated system is usually governed by a stand-alone standard. For example, fire alarm and signaling systems have testing requirements specified in *NFPA 72, National Fire Alarm and Signaling Code*.

A.6.4.3 The percentage of the additional tests should be agreed upon by all stakeholders and should consider the integrated system size and complexity.

It should be understood that for software-based systems some software changes might require more than 10 percent testing to ensure that any changes that might affect the integrated operation of the systems are verified. The percentage of tests depends on the system complexity. A system can have a large number of inputs to an interface device but have a relatively simple logic. In that case, 10 percent might be adequate and can have an upper limit on the actual number of non-affected test points — for example, 10 percent up to a maximum of 50 inputs. Alternatively, a system with complex logic might require a higher number of tests of non-affected inputs.

A.7.2.2.1 The status of an individual system might be "all normal." For some tests, the status might be "operating on secondary power" or "operating with an open circuit condition on SLC#2 between device 102 and 103." It is important to document the system status so that test results can be properly interpreted.

A.7.4.8 Document security should consider both physical security of the information that they contain and security against hazards such as fire and flood.

Annex B Integrated Test Plans and Forms

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Sample Forms. See Figure B.1(a) through Figure B.1(f) for integrated system testing sample forms.

B.2 Examples. See Figure B.2(a) and Figure B.2(b) for integrated test plan and test scenario examples.

TESTING OF INTEGRATED FIRE AND LIFE SAFETY SYSTEMS RECORD OF COMPLETION

This is to be completed by the designated Integrated Testing Agent (ITa), and/or the Enforcing Authority, following the completion of the testing of Integrated Fire and Life Safety Systems within the property listed below.

1. Property Information

Name of property: _____

Addresses covered by integrated systems: _____

Description of property: _____

Occupancy type: _____

Property owner name: _____

Address: _____

Phone: _____ Email: _____

Enforcing authority having jurisdiction over property: _____

Phone: _____ Email: _____

2. Integrated Systems Installed and Their Responsible Contractor Covered by This ROC

List each system installed within the building that is covered by this Record of Completion (or mark N/A).

System 1: Fire Alarm System Contractor: _____ N/A ❑

System 2: Fire Sprinkler System Contractor: _____ N/A ❑

System 3: HVAC Contractor: _____ N/A ❑

System 4: Kitchen Fire Suppression System Contractor: _____ N/A ❑

System 5: Elevator Phase I/Power Shutdown Contractor: _____ N/A ❑

System 6: _____ Contractor: _____ N/A ❑

System 7: _____ Contractor: _____ N/A ❑

System 8: _____ Contractor: _____ N/A ❑

3. Individual System Testing Completion* *(See Annex for individual system documentation)*

It shall be verified that individual systems installed within the building and covered by this Record of Completion are tested in accordance with the applicable code or standard before Integrated Testing occurs.

System 1: Acceptance testing completed in accordance with NFPA 72 _____? Yes ❑ No ❑

System 2: Fire Sprinkler System – Testing completed in accordance with NFPA _____? Yes ❑ No ❑

System 3: HVAC System – Testing completed in accordance with NFPA _____? Yes ❑ No ❑

System 4: Kitchen F.S. System – Testing completed in accordance with NFPA _____? Yes ❑ No ❑

System 5: Phase I and Power Shutdown (if applicable) – Testing completed in accordance with ASME A17.1 _____? Yes ❑ No ❑

System 6: Testing in accordance with _____? Yes ❑ No ❑

System 7: Testing in accordance with _____? Yes ❑ No ❑

System 8: Testing in accordance with _____? Yes ❑ No ❑

4. Results of Integrated System Acceptance Testing* *(See Annex for acceptance testing guidance)*

Document the testing of integrated systems by verifying if the operation of the integration systems occurred as designed, and/or as required by applicable codes and standards, and/or as approved by the enforcing authority.

System _____ integrated with System _____ - Performed as required, designed, and/or approved. Yes ❑ No ❑

System _____ integrated with System _____ - Performed as required, designed, and/or approved. Yes ❑ No ❑

System _____ integrated with System _____ - Performed as required, designed, and/or approved. Yes ❑ No ❑

System _____ integrated with System _____ - Performed as required, designed, and/or approved. Yes ❑ No ❑

5. Certifications

Integrated fire and life safety systems listed in Section 2 have been satisfactorily proven to function as designed, required, and/or approved as indicated in Section 4.

Yes ❑ No ❑ (If No, Attach Deficiency Report)

Owner, Owner's Representative, ITa: _____ Date: _____

Enforcing Authority: _____ Date: _____

FIGURE B.1(a) Sample Record of Completion.

ACCEPTANCE TEST NOTIFICATION

BUILDING INFORMATION	
Building Name	
Building Address	
Owner's Name	
Owner's Address	
Owner's Phone/Fax/Email	

INSTALLATION CONTRACTOR INFORMATION	
Company Name	
Address	
Contact Person	
Phone/Fax/Email	

SYSTEM INFORMATION						
System Description	**Specification Section**	**Permit Issued**	**Submittals Approved**	**Plans Approved**	**Rough-in Complete**	**Pre-functional Testing Complete**

The above-referenced system(s) are certified as substantially complete and are ready for acceptance testing.

Integrated Testing Agent _____ Date _____

Owner's Representative _____ Date _____

FIGURE B.1(b) Sample Acceptance Test Notification Form.

SMOKE CONTROL SYSTEM PRE-FUNCTIONAL TEST REPORT

1. Fire alarm system

a. Overall fire alarm system tests were performed by and certifications provided to the owner dated _____

b. Successful testing of the automatic smoke control inputs were performed on _____

Completed by: _____

c. Test reports are attached.

2. HVAC equipment

a. Final balancing of the smoke exhaust fans in both the normal building operation and smoke exhaust mode were performed on _____

b. Final balancing of smoke control system makeup fans in the both the normal building operation and smoke exhaust mode were performed on _____

c. Automatic shutdown of building air handling systems in the smoke control mode was tested on _____

Completed by: _____

d. Test reports are attached.

3. Sprinkler system

a. Overall testing of the sprinkler system was performed on _____

Completed by: _____

b. Final certifications are attached.

4. Smoke control makeup doors, windows, louvers, etc.

a. Testing of operation of doors, windows, dampers, etc., used for smoke control makeup was performed on _____

Completed by: _____

b. Test reports are attached.

5. Electrical equipment/standby power sources

a. Overall testing of the electrical system was performed on _____

b. Overall testing of the electrical standby generator was performed on _____

c. Testing of the smoke control system under standby power was performed on _____

Completed by: _____

d. Test reports and short circuit study are attached.

Owner _____ _____ , _____

Project _____ Integrated Testing Agent _____

FIGURE B.1(c) Sample Smoke Control Pre-Functional Test Form.

SMOKE CONTROL SYSTEM ACCEPTANCE TESTS

1. Persons present for testing

a. SC Testing agent _____ _____
b. Owner _____ _____
c. Architect _____ _____
d. Engineer _____ _____
e. Code official _____ _____
f. Contractors
GC _____ _____
Fire alarm _____ _____
Mechanical _____ _____
Balancer _____ _____
Electrical _____ _____
Comm. agent _____ _____

2. Test measurements

a. Ambient conditions
(1) Wind speed _____
(2) Wind direction _____
(3) Outside temperature _____
(4) Ambient space temperature _____

b. System in normal mode

(1) Exhaust fan/damper status	ON/OPEN	OFF/CLOSE
EF-1		
EF-1 Inlet damper		
EF-2		
EF-2 Inlet damper		
EF-3		
EF-3 Inlet damper		
M-1 Damper		
M-2 Damper		

(2) Main AC status	ON/OPEN	OFF/CLOSE
AHU-1 Supply fan		
AHU-1 Vent OA damper		
AHU-1 Econ OA damper		
AHU-1 RA damper		
AHU-1 Steam valve		
AHU-2 Supply fan		
AHU-2 Return fan		
Smoke damper — 1st to 2nd		
MAD-1		
MAD-2		
MAD-3		
First floor NW return smoke damper		
First floor SE return smoke damper		
Second floor NW return smoke damper		
Second floor SE return smoke damper		
Third floor NW return smoke damper		
Third floor SE return smoke damper		
Fourth floor NW return smoke damper		
Fourth floor SE return smoke damper		

Owner _____ _____ , _____
Project _____ Integrated testing agent _____

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FIGURE B.1(d) Sample Acceptance Test Form.

(3) VAV box status

	ON/OPEN	OFF/CLOSE
First floor		
Second floor		
Third floor		
Fourth floor		

(4) Door opening forces

	Latch	Start	Full
4th Floor stair – ST-A			
4th Floor stair – ST-B			
3rd Floor stair – ST-A			
3rd Floor stair – ST-B			
2nd Floor stair – ST-A			
2nd Floor stair – ST-B			
1st Floor stair – ST-A			
1st Floor stair – ST-B			

(5) Pressure differentials

4th Floor stair – ST-A	
4th Floor stair – ST-B	
3rd Floor stair – ST-A	
3rd Floor stair – ST-B	
2nd Floor stair – ST-A	
2nd Floor stair – ST-B	
1st Floor stair – ST-A	
1st Floor stair – ST-B	

(6) Velocities at atrium perimeter

	North	East	South	West
2nd Floor				
3rd Floor				
4th Floor				

c. Equipment in smoke exhaust mode — normal power

(1) Device used to initiate _____

(2) Time for system to full operation _____

(3) Total flow — exhaust _____ Makeup _____

(4) Exhaust fan/damper status

	ON/OPEN	OFF/CLOSE
EF-1		
EF-1 Inlet damper		
EF-2		
EF-2 Inlet damper		
EF-3		
EF-3 Inlet damper		
M-1 Damper		
M-2 Damper		

Owner _____ _____ , _____

Project _____ Integrated testing agent _____

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FIGURE B.1(d) ***Continued***

(5) Main AC status

	ON/OPEN	OFF/CLOSE
AHU-1 Supply fan		
AHU-1 Vent OA damper		
AHU-1 Econ OA damper		
AHU-1 RA damper		
AHU-1 Steam valve		
AHU-2 Supply fan		
AHU-2 Return fan		
Smoke damper — 1st to 2nd		
MAD-1		
MAD-2		
MAD-3		
First floor NW return smoke damper		
First floor SE return smoke damper		
Second floor NW return smoke damper		
Second floor SE return smoke damper		
Third floor NW return smoke damper		
Third floor SE return smoke damper		
Fourth floor NW return smoke damper		
Fourth floor SE return smoke damper		

(6) VAV box status

	ON/OPEN	OFF/CLOSE
First floor		
Second floor		
Third floor		
Fourth floor		

(7) Door opening forces

	Latch	Start	Full
4th Floor stair – ST-A			
4th Floor stair – ST-B			
3rd Floor stair – ST-A			
3rd Floor stair – ST-B			
2nd Floor stair – ST-A			
2nd Floor stair – ST-B			
1st Floor stair – ST-A			
1st Floor stair – ST-B			

(8) Pressure differentials

4th Floor stair – ST-A	
4th Floor stair – ST-B	
3rd Floor stair – ST-A	
3rd Floor stair – ST-B	
2nd Floor stair – ST-A	
2nd Floor stair – ST-B	
1st Floor stair – ST-A	
1st Floor stair – ST-B	

(9) Velocities at atrium perimeter

	North	East	South	West
2nd Floor				
3rd Floor				
4th Floor				

Owner _____ _____, _____

Project _____ Integrated testing agent _____

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FIGURE B.1(d) ***Continued***

b. Equipment in smoke exhaust mode — transfer to emergency

(1) Time for system to transfer _____

(2) Total flow — exhaust _____ Makeup _____

(3) Exhaust fan/damper status

	ON/OPEN	OFF/CLOSE
EF-1		
EF-1 Inlet damper		
EF-2		
EF-2 Inlet damper		
EF-3		
EF-3 Inlet damper		
M-1 Damper		
M-2 Damper		

(4) Main AC status

	ON/OPEN	OFF/CLOSE
AHU-1 Supply fan		
AHU-1 Vent OA damper		
AHU-1 Econ OA damper		
AHU-1 RA damper		
AHU-1 Steam valve		
AHU-2 Supply fan		
AHU-2 Return fan		
Smoke damper — 1st to 2nd		
MAD-1		
MAD-2		
MAD-3		
First floor NW return smoke damper		
First floor SE return smoke damper		
Second floor NW return smoke damper		
Second floor SE return smoke damper		
Third floor NW return smoke damper		
Third floor SE return smoke damper		
Fourth floor NW return smoke damper		
Fourth floor SE return smoke damper		

(5) VAV box status

	ON/OPEN	OFF/CLOSE
First floor		
Second floor		
Third floor		
Fourth floor		

(6) Door opening forces

	Latch	Start	Full
4th Floor stair – ST-A			
4th Floor stair – ST-B			
3rd Floor stair – ST-A			
3rd Floor stair – ST-B			
2nd Floor stair – ST-A			
2nd Floor stair – ST-B			
1st Floor stair – ST-A			
1st Floor stair – ST-B			

Owner _____ _____, _____

Project _____ Integrated testing agent _____

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FIGURE B.1(d) ***Continued***

(7) Pressure differentials

4th Floor stair – ST-A	_____
4th Floor stair – ST-B	_____
3rd Floor stair – ST-A	_____
3rd Floor stair – ST-B	_____
2nd Floor stair – ST-A	_____
2nd Floor stair – ST-B	_____
1st Floor stair – ST-A	_____
1st Floor stair – ST-B	_____

(8) Velocities at atrium perimeter

	North	East	South	West
2nd Floor	_____	_____	_____	_____
3rd Floor	_____	_____	_____	_____
4th Floor	_____	_____	_____	_____

c. Shut down system and restart while on emergency power

(1) All equipment return to smoke exhaust mode? _____

(2) List failures _____

_____

_____

d. Spot check of other fire alarm inputs

	Start - Yes?	Start - No?
(1) Smoke control panel manual switch	_____	_____
(2) Spot smoke detectors		
Basement	_____	_____
First floor	_____	_____
Second floor	_____	_____
Third floor	_____	_____
Fourth floor	_____	_____
(3) Fourth floor beam detector	_____	_____
(4) Sprinkler waterflow		
Basement	_____	_____
First floor	_____	_____
Second floor	_____	_____
Third floor	_____	_____
Fourth floor	_____	_____
(5) Pull station		
Basement	_____	_____
First floor	_____	_____
Second floor	_____	_____
Third floor	_____	_____
Fourth floor	_____	_____
(6) Duct detectors		
1st floor return – SE	_____	_____
1st floor supply – SE	_____	_____
2nd floor return – SE	_____	_____
3rd floor return – SE	_____	_____
4th floor return – SE	_____	_____

Owner _____ _____ , _____

Project _____ Integrated testing agent _____

FIGURE B.1(d) ***Continued***

SMOKE CONTROL PANEL TEST FORM

1. Tests from smoke control panel

A. AHU-1 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

B. EF-1 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

C. EF-2 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

D. EF-3 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

E. EF-1 Inlet damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

F. EF-2 Inlet damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

G. EF-3 Inlet damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

H. M-1 Damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

I. M-2 Damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

J. Damper between 1st and 2nd floors LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

K. MAD-1 Damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

L. MAD-2 Damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

M. MAD-3 Damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

N. 4th floor return damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

O. 3rd floor return damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

P. 2nd floor return damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

Q. 1st floor return damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

R. AHU-1 Return damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

S. AHU-1OAD Vent damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

T. AHU-1 OA Econ damper LIGHT STATUS
- i. Damper in "Auto" _____
- ii. Damper in "Open" _____
- iii. Damper in "Close" _____

Owner _____ Date (mm/dd/yyyy) _____

Project _____ Integrated testing agent _____

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FIGURE B.1(e) Sample Smoke Control Panel Test Form.

SMOKE CONTROL PANEL TEST FORM

2. Tests from fan starters

A. AHU-1 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

B. EF-1 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

C. EF-2 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

D. EPF-3 LIGHT STATUS
- i. Fan in "Auto" _____
- ii. Fan in "On" _____
- iii. Fan in "Off" _____

3. Tests of fan failure CT's

A. SF-1
Failure light on panel _____

B. SF-2
Failure light on panel _____

C. SF-3
Failure light on panel _____

D. AHU-1
Failure light on panel _____

4. Tests of damper end switches

A. M-1 Damper
Failure light on panel _____

B. M-2 Damper
Failure light on panel _____

C. MAD-1 Damper
Failure light on panel _____

D. MAD-2 Damper
Failure light on panel _____

E. MAD-3 Damper
Failure light on panel _____

F. 4th floor return damper
Failure light on panel _____

G. 3rd floor return damper
Failure light on panel _____

H. 2nd floor return damper
Failure light on panel _____

I. 1st floor return damper
Failure light on panel _____

J. AHU-1 Return damper
Failure light on panel _____

K. AHU-1OAD Vent damper
Failure light on panel _____

L. AHU-1 OA Econ damper
Failure light on panel _____

5. Tests of power failure relays

A. SF-1
Failure light on panel _____

B. SF-2
Failure light on panel _____

C. SF-3
Failure light on panel _____

D. AHU-1
Failure light on panel _____

E. AHU-1 Return damper
Failure light on panel _____

F. AHU-1OAD Vent damper
Failure light on panel _____

G. AHU-1 OA Econ damper
Failure light on panel _____

Owner _____ Date (mm/dd/yyyy) _____

Project _____ Integrated testing agent _____

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FIGURE B.1(e) ***Continued***

ATRIUM SMOKE CONTROL SYSTEM TESTING NOTIFICATION

BUILDING INFORMATION	
Building Name	
Building Address	
Owner's Name	
Owner's Address	
Owner's Phone/Fax/Email	

CONTRACTOR INFORMATION	
Company Name	
Address	
Contact Person	
Phone/Fax/Email	

SYSTEM INFORMATION						
System Description	Specification Section	Permit Issued	Submittals Approved	Plans Approved	Rough-in Complete	Pre-functional Testing Complete
HVAC system						
Fire alarm system						
Sprinkler system						
Electrical system						
Standby power generator						
Makeup doors/windows/louvers						
The above-referenced system(s) are certified as substantially complete and are ready for acceptance testing.						
_____ Integrated Testing Agent			_____ Date			
_____ Owner's Representative			_____ Date			

FIGURE B.1(f) Sample Smoke Control Test Readiness Form.

SAMPLE TEST PLAN FOR ATRIUM SMOKE CONTROL SYSTEM

Prior to Integrated Test

1. **Review system documentation**
   a. Architectural, mechanical, electrical, fire suppression, fire alarm drawings
   b. System specifications
   c. System design analysis
   d. Equipment cuts
      i. Fans
      ii. Intake louvers
      iii. Intake doors
      iv. Intake fans
      v. Dampers
      vi. Fire alarm equipment and shop drawings
      vii. Fire alarm program
      viii. Electrical distribution
      ix. Smoke control panel
   e. Proposed sequence of operations
2. **Note any modifications necessary to assure system operability**
3. **Prepare test plans for system test and smoke control panel test**
4. **Prepare checklist for component test verification**
5. **Meet with stakeholders to review testing plans**

Smoke Control Test Procedure

1. **Persons to be in attendance**
   a. Smoke control testing agent
   b. Owner's representative
   c. Architect
   d. Engineer(s)
   e. Code official
   f. Construction manager (general contractor)
   g. Mechanical contractor
   h. Air balancing contractor
   i. Electrical contractor
   j. Fire alarm contractor
   k. Sprinkler contractor
2. **Prior to initiating test**
   a. Measure outside temperature and wind velocity
   b. Measure inside temperature and velocities in the direction of the design fire
   c. Measure operating forces on all exit doors in the atrium
   d. Note operating status of mechanical equipment affecting the smoke control operation
3. **Initiate smoke control system operation**
   a. Operate one of the initiating devices
   b. Note operating status of mechanical equipment affecting the smoke control operation
   c. Note the status of all makeup equipment, doors, dampers, louvers, etc.
   d. Measure airflow in all exhaust and makeup ducts/fans and compare to calculations
   e. Measure velocities in directions of the design fire
   f. Measure operating forces on all exit doors in the atrium
4. **Transfer to emergency power with smoke control system in operation**
   a. Measure time for system to ramp down and back up to operating speed
   b. Note operating status of mechanical equipment affecting the smoke control operation
   c. Note the status of all makeup equipment, doors, dampers, louvers, etc.
   d. Measure airflow in all exhaust and makeup ducts/fans and compare to calculations
   e. Measure velocities in directions of the design fire
   f. Measure operating forces on all exit doors in the atrium
5. **Shut smoke control system and restart on emergency power**
   a. Verify that all functions return to smoke control operation condition
6. **Test all remaining initiating devices in the atrium (smoke detectors, sprinkler flow switches)**
   a. Verify that all devices initiate the smoke control system operation
7. **Test representative sampling of initiating devices outside of the atrium (pull stations, smoke detectors, sprinkler flow switches)**
   a. Verify that smoke control operation is not initiated

Smoke Control Panel Test

1. **Operate each operating switch on the smoke control panel**
   a. Verify that equipment controlled operates
   b. Verify that proper indicating lights on panel light
2. **Operate fans from fan starter**
   a. Verify that proper indicating lights on panel light
3. **Operate each control function from the smoke control panel. Verify that controlled equipment operates as commanded.**
4. **Simulate power failure on each item monitored on the smoke control panel**
   a. Verify that proper "fault" indicating lights on panel light
5. **Simulate failure to operate for each item monitored on the smoke control panel**
   a. Verify that proper "fault" indicating lights on panel light

FIGURE B.2(a) Atrium Smoke Control System Test Plan Example.