NFPA® 3

Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems

2012 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 3

Recommended Practice for

Commissioning and Integrated Testing of Fire Protection and Life Safety Systems

2012 Edition

This edition of NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*, was prepared by the Technical Committee on Commissioning Fire Protection Systems and acted on by NFPA at its June Association Technical Meeting held June 12–15, 2011, in Boston, MA. It was issued by the Standards Council on August 11, 2011, with an effective date of August 31, 2011.

This edition of NFPA 3 was approved as an American National Standard on August 31, 2011.

Origin and Development of NFPA 3

The 2012 edition of NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*, represents NFPA's first document outlining a systematic approach to provide documented confirmation that fire protection and life safety systems function as intended by the owner and the design team. The genesis of this document was a request from the National Institute of Building Sciences (NIBS) to provide a commissioning document for fire protection systems that would be part of a conglomeration of commissioning documents that could be used to create a total building commissioning program.

NFPA 3 addresses the administrative and procedural concepts of fire protection and life safety system commissioning and also provides direction on the integrated system tests.

The document is designed to identify the commissioning team members, their qualifications, and their roles and responsibilities throughout the commissioning process. Chapter 5 addresses the concept of commissioning from the incipient stages of a project through the occupancy and operation of the facility. Throughout the commissioning process there are several key documents that are identified in the recommended practice such as the Owners Project Requirements (OPR) and the Basis of Design (BOD), which provide direction to the commissioning team members as they are executing the commissioning plan. These documents, which are generated during the design phase, are implemented during construction. Chapter 7 addresses integrated testing of fire protection systems as a means of confirming the systems function as intended.

NFPA 3 also addresses retro-commissioning and re-commissioning of existing buildings. For existing buildings that have never been commissioned, a retro-commissioning plan is developed and executed to establish a benchmark for the facility. Existing buildings that have been previously commissioned are periodically re-commissioned and compared to the compliance benchmarks established in the original commissioning plan.

NFPA 3 contains many forms that are available to assist in project documentation and the implementation of the commissioning program.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

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

Contents

NFPA 3

Recommended Practice for

Commissioning and Integrated Testing of Fire Protection and Life Safety Systems

2012 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

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 the recommendations sections of this document are given in Chapter 2 and those for extracts in the informational sections are given in Annex D. 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 should be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope. This recommended practice provides the recommended procedures, methods, and documentation for commissioning and integrated testing of active and passive fire protection and life safety systems and their interconnections with other building systems.

1.2* Purpose. The purpose of this recommended practice is to describe the commissioning process and integrated testing that will ensure fire protection and life safety systems perform in conformity with the design intent.

1.3* Application.

1.3.1* This recommended practice applies to passive and active fire protection and life safety equipment and systems including, but not limited to, the following:

(1)*Infrastructure supporting the building fire protection and life safety systems within the boundaries of the project
(2) Fixed fire suppression and control systems
(3) Fire alarm systems
(4) Emergency communications systems (ECS)
(5) Smoke control and management systems
(6)*Normal, emergency, and standby power systems
(7) Explosion prevention and control systems
(8)*Fire-resistant and smoke-resistant assemblies
(9)*Firestopping
(10) Systems associated with commercial cooking operations
(11) Elevator systems
(12)*Means of egress systems and components
(13) 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

1.3.2* Commissioning should achieve the following:

(1) Documentation of the owner's project requirements (OPR) and the basis of design (BOD) provided
(2) Equipment and systems installed as required
(3) Integrated testing for all integrated fire and life safety systems performed and documented
(4) Delivery of operation and maintenance (O&M) documentation
(5)*Training of facility operating and maintenance staff
(6) Identification and documentation of the requirements for maintaining system performance to meet the original design intent during the occupancy phase

1.3.3 Integrated testing should verify and document the following:

(1) Performance in accordance with applicable codes and standards
(2) Compliance with BOD and OPR
(3)*Sequence of operation
(4) Installation in accordance with manufacturers' published instructions
(5) Accuracy of diagrams of system interconnections and device locations

1.3.4* The recommendations for the commissioning of fire protection and life safety systems and equipment in this document should apply when required by the project specification.

1.3.5* The recommendations for the integrated testing of fire protection and life safety systems and equipment in this document should apply when required by applicable codes or standards or the project specification.

1.4* New Technology. New technology, proposed for installation, for which there is no published product instruction or installation standard, should function as intended throughout its life cycle in accordance with the OPR, BOD, and requirements of the authority having jurisdiction (AHJ).

1.4.1* Design Documentation. Designs using new technology should be submitted to the AHJ for review and approval.

1.4.1.1* Submittals should include documentation, in an approved format, of each performance objective and applicable scenario, together with any calculations, modeling, or other technical substantiation used to establish the fire protection and life safety performance of the design.

1.4.1.2* Tests submitted in support of an application should be performed by an agency approved by the AHJ.

1.4.1.3 The AHJ should be permitted to require the submission of additional information and data necessary to assist in the determination of equivalency.

1.4.1.4* The AHJ should be authorized to engage such expert opinion as deemed necessary to evaluate the new technology at no expense to the jurisdiction.

1.4.2 Acceptance Requirements. Upon completion of the installation, functional and interoperability testing should be conducted demonstrating performance consistent with the OPR and the BOD in a method acceptable to the AHJ.

1.4.3* Maintenance Documentation. Final documentation should contain required inspection, maintenance, and testing methods and intervals.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this recommended practice and should be considered part of the recommendations of this document.

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

NFPA 72®, National Fire Alarm and Signaling Code, 2010 edition.

NFPA 731, *Standard for the Installation of Electronic Premises Security Systems,* 2011 edition.

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

2.4 References for Extracts in Recommendations Sections.

NFPA *101®, Life Safety Code®,* 2012 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,* 2009 edition.

NFPA 5000®, Building Construction and Safety Code®, 2012 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter apply to the terms used in this recommended practice. Where terms are not defined in this chapter or within another chapter, they should 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* Recommended Practice. A document that is similar in content and structure to a code or standard but that contains only nonmandatory provisions using the word "should" to indicate recommendations in the body of the text.

3.2.5 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 applicable standards, laws, and regulations.

3.3.2* Building. Any structure used or intended for supporting or sheltering any use or occupancy. [***101***, 2012]

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.

3.3.3.2* ***Commissioning Authority (CxA).*** The qualified person, company, or agency that plans, coordinates, and oversees the entire commissioning process.

3.3.3.3* ***Commissioning Plan.*** The document prepared for each project that identifies the processes and procedures necessary for a successful commissioning process.

3.3.3.4 ***Commissioning Record.*** The complete set of commissioning documentation for the project that is turned over to the owner at the end of the construction phase.

3.3.3.5* ***Fire and Life Safety Commissioning (Cx).*** A systematic process that provides documented confirmation that fire and life safety systems function according to the intended design criteria set forth in the project documents and satisfy the owner's operational needs, including compliance with requirements of any applicable laws, regulations, codes, and standards requiring fire and life safety systems.

3.3.3.6 ***Fire Commissioning Agent. (FCxA).*** A person or entity identified by the owner, who leads, plans, schedules, documents, coordinates the fire protection and life safety commissioning team, and implements the commissioning process and integrated testing of fire and life safety systems.

3.3.3.7* ***Re-commissioning (Re-Cx).*** The process of verifying the performance of existing fire protection and life safety systems that have been previously commissioned to ensure that the systems continue to operate according to the design intent or current operating needs.

3.3.3.8* ***Retro-commissioning (RCx).*** The process of commissioning existing fire protection and life safety systems that were not commissioned when originally installed.

3.3.4 Component. A part of an architectural, electrical, or mechanical system. [**5000,** 2012]

3.3.5 Construction Document. The plans, specifications, and other documents that describe the construction project.

3.3.6 Drawings.

3.3.6.1 ***Coordination Drawing.*** Reproducible drawings showing work with horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions, equipment, lights, mechanical, electrical, conveying systems, and other services.

3.3.6.2 ***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.

3.3.6.3 ***Shop Drawings.*** Scaled working drawings, equipment cutsheets, and design calculations. [**1031**, 2009]

3.3.6.4 ***Working (Plan) Drawing.*** Those approved plans and drawings that are used for construction of the project.

3.3.7 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]

3.3.8* Installation Contractor. A company that provides labor and materials to install systems and equipment.

3.3.9 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.

3.3.10 Issues Log. A formal and ongoing record of failures, deficiencies, or concerns, as well as associated priorities, implications, and resolutions.

3.3.11* Narrative. A written summary description of the building(s) or structure(s), including exterior property boundaries and all applicable fire protection and life safety systems and related integrated operational features.

3.3.12 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 and operations phase.

3.3.13 Owner's Project Requirements (OPR). The documentation that provides the owner's vision for the planned facility, integrated requirements, expectations for how it will be used and operated, and benchmarks and criteria for performance.

3.3.14 Phase.

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

3.3.14.2 ***Design Phase.*** The phase during which the basis of design is produced, and drawings and calculations, including those for design and fabrication, are produced, and testing procedures are developed.

3.3.14.3 ***Occupancy Phase.*** The phase during which the training and periodic inspection, testing, and maintenance are scheduled and performed.

3.3.14.4 ***Planning Phase.*** The phase during which the fire protection and life safety commissioning team is formed and initial project concepts and the owner's project requirements are developed.

3.3.15 Registered Design Professional (RDP). In commissioning, 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.

3.3.16* Sequence of Operation. A matrix, narrative, or table of system inputs and outputs that can be used to illustrate the interactions of interconnected fire protection systems.

3.3.17 Stakeholder. Any individual, group, or organization that might affect, be affected by, or perceive itself to be affected by the risk.

3.3.18 System.

3.3.18.1* ***Active Fire Protection System.*** A system that uses moving mechanical or electrical parts to achieve a fire protection goal.

3.3.18.2 ***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,** 2009]

3.3.18.3* ***Life Safety Systems.*** Those systems that enhance or facilitate evacuation, smoke control, compartmentalization, and/or isolation. [**1031,** 2009]

3.3.18.4* ***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.

3.3.19 System Connection.

3.3.19.1* ***Integrated System.*** A combination of systems that are required to operate together as a whole to achieve the fire protection and life safety objectives.

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

3.3.19.2.1* ***Switch Connection.*** A subset of interconnected systems in which one system monitors a switch or relay in another system for either normal or not-normal conditions.

3.3.19.2.2* ***Data Sharing System.*** A subset of interconnected systems in which data streams are transferred between two or more control units.

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

3.3.20 Systems Manual. A compilation of all operational and maintenance manuals and description of the integrated fire protection and life safety systems.

3.3.21 Testing.

3.3.21.1 ***Acceptance Testing.*** Tests performed at the completion of installation to confirm compliance with applicable manufacturers' installation specifications, applicable codes and standards, and the project BOD and OPR.

3.3.21.2* ***Integrated Testing.*** An assessment of fire protection and life safety systems function and operation using direct observation or other monitoring methods to verify the correct interaction and coordination of multiple systems in conformance with the fire protection and life safety objectives.

3.3.21.3* ***Pre-Functional Testing.*** Tests performed prior to acceptance testing to confirm compliance with manufacturers' specification, applicable codes and standards, and the project BODs and OPRs.

Chapter 4 Qualifications of Commissioning Personnel

4.1 Applicability. Members of the fire protection and life safety commissioning team should meet the requirements of this chapter.

4.2 Qualifications.

4.2.1 Fire Commissioning Agent (FCxA).

4.2.1.1* General.

4.2.1.1.1 The FCxA should be knowledgeable and experienced in the proper application of commissioning recommendations of this recommended practice and general industry practices.

4.2.1.1.2 The FCxA should be individually identified on the specifications or other enabling documentation.

4.2.1.1.3 The FCxA should provide an objective and unbiased point of view.

4.2.1.2 Requisite Knowledge. A qualified FCxA should have an advanced understanding of the installation, operation, and maintenance of all fire protection and life safety systems proposed to be installed, with particular emphasis on system integrated testing.

4.2.1.3 Requisite Skills. An FCxA should have the ability to do the following:

(1) Read and interpret drawings and specifications for the purpose of understanding system installation, testing, operation, and maintenance.
(2) Analyze and facilitate resolution of issues related to failures in fire protection and life safety systems.
(3) Provide clear, concise written reports and verbal communication, and have the ability to resolve conflicts.

4.2.2 Installation Contractor.

4.2.2.1 Installation contractors should be knowledgeable and experienced in the installation of the type of system proposed to be installed.

4.2.2.2* The installation contractor should submit evidence of required license or certification to the FCxA.

4.2.3 Registered Design Professional (RDP).

4.2.3.1 The RDP should be individually identified in the specifications or other enabling documentation.

4.2.3.2 Requisite Knowledge. A qualified RDP should have comprehensive knowledge of the following:

(1) The design, installation, operation, and maintenance of all systems proposed to be installed
(2) How individual and integrated systems operate during a fire or other emergency

4.2.4* Construction Manager and General Contractor. Construction managers and general contractors should be knowledgeable and experienced in the field of construction project management.

4.2.5 Facilities Management Personnel. Facilities management personnel should include building maintenance and service personnel, building engineering personnel, and similar job functions.

4.2.5.1 Facilities management personnel should have the ability to perform the following:

(1) Assess a facility's need for building systems and recommend building systems.
(2) Oversee the operation of building systems.
(3) Establish practices and procedures.
(4) Administer the allocation of building systems resources.
(5) Monitor and evaluate how well building systems perform.
(6) Manage corrective, preventative, and predictive maintenance of building systems.
(7) Develop and implement emergency procedures and disaster recovery plans.

4.2.5.2* 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.

4.2.5.3 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.

4.2.5.4 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.

4.2.6 Third-Party Test Entity.

4.2.6.1 Third-party test entities should have an advanced understanding of the installation, operation, and maintenance of all fire protection and life safety systems proposed to be tested, with particular emphasis on system integrated testing.

4.2.6.2* Third-party test entities should be licensed or certified where required by the AHJ and/or codes and standards.

4.2.6.3 The third-party test entities should have the ability to do the following:

(1) Read and interpret drawings and specifications for the purpose of understanding system installation, testing, operation, and maintenance.
(2) Provide good written, verbal, conflict resolution, and organizational skills.

4.2.7* Authority Having Jurisdiction (AHJ).

4.2.7.1 The AHJ should be knowledgeable in the applicable codes, ordinances, and standards as they relate to the fire protection and life safety systems installed.

4.2.7.2 The AHJ should have the ability to interface with the RDP and the commissioning authority in all phases of the commissioning process.

4.2.7.3 The AHJ should have the ability to determine the operational readiness of the fire protection and life safety systems installed.

4.2.7.4 The AHJ should have the ability to interface with the fire protection and life safety commissioning team in order to verify completion of integrated testing for the purpose of system acceptance.

4.2.8 Integrated Testing Agent (ITa).

4.2.8.1 The ITa should have an understanding of the design, installation, and operation and maintenance of the type of fire protection and life safety systems installed.

4.2.8.2 The ITa should demonstrate experience and knowledge of performance verification methods to validate functionality of integrated systems and components.

4.2.8.3 The ITa should demonstrate knowledge, experience, and understanding of the operating components of all systems and subsystems to the extent they affect the installation and operation of the fire protection and life safety systems in accordance with the approved design.

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

Chapter 5 Commissioning

5.1 General.

5.1.1* This chapter provides the recommendations for commissioning fire protection and life safety systems.

5.1.2* Commissioning of fire protection and life safety systems should include, but not be limited to, the planning phase, design phase, construction phase, and occupancy phase. *[See Figure A.5.1.2(a), Figure A.5.1.2(b), and Figure A.5.1.2(c).]*

5.2 Planning Phase.

5.2.1 Activities.

5.2.1.1* The fire protection and life safety commissioning team should be established during the planning phase.

5.2.1.2 During the planning phase of the project, the fire protection and life safety commissioning team should do the following:

(1) Develop the OPR in accordance with Section 5.2.
(2) Select the FCxA.
(3) Identify the commissioning scope.
(4) Develop the preliminary commissioning plan in accordance with Section 5.2.
(5) Review the planning documents in accordance with Section 5.2.
(6)*Develop regulatory code analysis.
(7) Initiate the commissioning plan.

5.2.2* Fire Protection and Life Safety Commissioning Team. The fire protection and life safety commissioning team should be identified and documented.

5.2.2.1 The exact size and members of the fire protection and life safety commissioning team can vary depending on project type, size, and complexity and could include the following members:

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

5.2.2.2* Entities listed in 5.2.2 not included as part of the project should not be required to be part of the fire protection and life safety commissioning team.

5.2.2.3 The fire protection and life safety commissioning team members should meet the requirements of Chapter 4.

5.2.2.4 Owner.

5.2.2.4.1 The owner should be responsible for the commissioning of all fire and life safety systems.

5.2.2.4.2* The owner should be permitted to delegate the responsibility for commissioning to a designated representative.

5.2.2.4.3 The owner responsibilities should include the following:

(1) Contracting and delegating the commissioning process
(2) Assisting in the development of and approval of the OPR
(3) Assigning operations and maintenance personnel to participate in the commissioning process
(4) Reviewing and approving any changes to the OPR
(5) Reviewing and approving the construction documents
(6) Reviewing and approving commissioning process progress reports
(7) Reviewing and approving the fire protection and life safety commissioning team progress reports
(8) Reviewing and approving the final commissioning report

5.2.2.5* Commissioning Authority (CxA). The CxA should be responsible for coordinating between the FCxA and the remainder of the building commissioning team, when applicable.

5.2.2.6 Fire Commissioning Agent (FCxA). The FCxA responsibilities should include the following:

(1) Organize and lead the fire protection and life safety commissioning team.
(2) Coordinate and attend fire protection and life safety commissioning team meetings.
(3) Facilitate the development of and document the OPR.
(4) Verify that commissioning process activities are clearly stated in all scopes of work.
(5) Identify and integrate the commissioning process activities into the project schedule.
(6) Prepare the commissioning plan.
(7) Prepare the commissioning process activities to be included in the project specification.
(8) Execute the commissioning process.
(9) Review the plans and specifications during the planning and design phases.
(10) Attend pre-bid meeting to detail the commissioning contractor requirements.
(11) Review and approve the O&Ms to compile the systems manual.
(12) Track and document issues and deviations to the OPR and log resolutions in the issues log.
(13) Write and review commissioning process progress reports.
(14) Organize and coordinate system testing.
(15) Witness system testing.
(16) Review installation and record documents.
(17) Recommend acceptance of the systems to the owner.
(18) Track development, accuracy, and compliance with sequence of operation.
(19) Compile and submit the final fire protection and life safety commissioning team report to the owner.
(20) Compile and submit to the owner all fire protection and life safety systems commissioning documents required by the AHJ.

5.2.2.7 Installation Contractor. The installation contractor responsibilities should include the following:

(1) Provide commissioning process requirements and activities as specified in the construction documents.
(2) Attend required fire protection and life safety commissioning team meetings.
(3) Include or comply with commissioning process milestones in the project schedule.
(4) Implement the training program as required by the construction documents.

(5) Provide submittals to the RDP, owner, and fire protection and life safety commissioning team.
(6) Develop an individual system test plan, including acceptance and integrated testing.
(7) Notify the general contractor, third-party test entity, and FCxA when systems are ready for testing.
(8) Demonstrate the performance of the systems, including integration.
(9) Complete the construction checklists as the work is accomplished.
(10) Continuously maintain the record drawings as required by the construction documents.

5.2.2.8 Manufacturer's Representative. The manufacturer's representative responsibilities should include the following:

(1) Provide technical support to the installation contractor.
(2) Provide all information required for the operation and maintenance of the system.
(3) Provide the requirements to maintain the warranty as part of the initial submittal.
(4) Assist the installation contractor in the development of the individual systems test plans.
(5) Assist the installation contractor and fire protection and life safety commissioning team with installation verification and testing.
(6) Assist in development and implementation of system training.

5.2.2.9 RDP. The RDP responsibilities should include the following:

(1) Participate and assist in the development of the OPR.
(2) Create and document the basis of design.
(3) Prepare construction documents.
(4) Respond to the fire protection and life safety commissioning team's design submission review comments.
(5) Specify operation and maintenance of systems in the project specification.
(6) Review and incorporate the fire protection and life safety commissioning team's comments, as appropriate.
(7) Review test procedures submitted by the installation contractor.
(8) Review and comment on the commissioning record.
(9) Review and accept record documents as required by the construction documents.
(10) Review and comment on the final commissioning record.
(11) Recommend final acceptance of the systems to the owner.

5.2.2.10 Construction Manager/General Contractor. The construction manager's/general contractor's responsibilities should include the following:

(1) Include commissioning process requirements and activities in all contracts.
(2) Obtain cooperation and participation of all subcontractors and manufacturers' representatives.
(3) Attend required fire protection and life safety commissioning team meetings.
(4) Include commissioning process milestones in the project schedule.
(5) Notify the FCxA when systems are ready for testing.
(6) Certify that all work has been completed and the facility is operational in accordance with the construction documents.
(7) Remedy deficiencies identified by the fire protection and life safety commissioning team during installation verification or testing.
(8) Review and comment on the final commissioning record.

5.2.2.11* Insurance Representative. The insurance representative(s) responsibilities should include the following services, as contracted with the owner:

(1) Provide fire protection recommendations to RDP for inclusion in the basis of design and other construction documents.
(2) Review the construction documents during the planning and design phases to evaluate alignment with insurance risk management recommendations.
(3) Participate in commissioning team (CxT) meetings, as necessary, to ensure scope of project, responsibilities, and project timeline (including commissioning) is established/agreed to.
(4) Visit project site during installation phase to review physical/actual installation is consistent with reviewed/accepted construction documents, as necessary.
(5) Review and approve proposed inspection, testing, performance criteria, and documentation recommended for acceptance of commissioning.
(6) Witness installation verification and system testing in conjunction with the CxT, as necessary.
(7) Verify any issues detected during commissioning are resolved in timely and appropriate manner.
(8)*Verify adequate training and documentation is provided for onsite personnel.
(9) Review final commissioning documentation.

5.2.2.12 Owner's Technical Support Personnel. The owner's technical support personnel's responsibilities should include the following:

(1) Review and comment on the OPR.
(2) Provide technical assistance to the fire protection and life safety commissioning team, RDP, and installation contractor.
(3) Review any changes to the OPR.
(4) Review the construction documents.
(5) Review the fire protection and life safety commissioning team's commissioning process progress reports.
(6) Review the fire protection and life safety commissioning team's progress reports.
(7) Review the fire protection and life safety commissioning team's commissioning record.
(8) Review the systems manual.

5.2.2.13 Third-Party Test Entity. The third-party test entity's responsibilities should include the following:

(1) Include all commissioning process requirements and activities in the scope of services.
(2) Attend required fire protection and life safety commissioning team meetings.
(3) Include commissioning process milestones in the project schedule.
(4) Develop individual system test plan, including acceptance and integrated testing.
(5) Demonstrate the performance of the systems, including integration.
(6) Complete the construction checklists as the work is accomplished.
(7) Develop and submit final testing documentation.

5.2.2.14 Facility Manager or Operations Personnel. The facility manager or operations personnel's responsibilities should include the following:

(1) Attend systems training sessions.
(2) Review and comment on the OPR.
(3) Review and comment on the systems manuals.
(4) Organize, coordinate, and implement system inspection, testing, and maintenance as required by the systems manuals.

5.2.2.15 AHJ. The AHJ's responsibilities should include the following:

(1) Participate in fire protection and life safety commissioning team meetings as necessary.
(2) Provide all inspection, testing, and performance criteria required for acceptance and issuance of certificate of occupancy to be included in the commissioning plan.
(3) Witness installation verification and system testing in conjunction with the fire protection and life safety commissioning team, as necessary.
(4) Identify AHJ personnel to attend training.

5.2.3 Owner's Project Requirements (OPR).

5.2.3.1 The OPR should form the basis from which all design, construction, acceptance, and operational decisions are made.

5.2.3.2* The OPR should be developed with input from the owner and all key facility users and operators.

5.2.3.3* The OPR should be documented at the planning stage of the project.

5.2.3.3.1 Each item of the OPR should have defined performance and acceptance criteria.

5.2.3.3.2 The OPR should include, but is not limited to, the following:

(1) Infrastructure requirements (utilities, roads, site access)
(2) Facility type, size, height
(3) Intended use
(4) Occupancy classification, number of occupants, number and hours of operation
(5) Future expansion requirements
(6) Applicable codes and standards
(7) Specific user requirements
(8) Training requirements
(9) Warranty, operations, and maintenance requirements
(10) Integrated system requirements in accordance with Chapter 5
(11) Specific performance criteria
(12) Third-party requirements

5.2.3.4 The OPR should be updated as required by the fire protection and life safety commissioning team throughout the planning, design, construction, and occupancy phases of the building life cycle.

5.2.4 Commissioning Plan.

5.2.4.1 The commissioning plan should be continuously updated by the fire protection and life safety commissioning team throughout the planning, design, construction, and occupancy phases of the building life cycle.

5.2.4.2* The commissioning plan should contain the following information:

(1) Commissioning scope and overview specific to the project
(2) General project information
(3) Fire protection and life safety commissioning team members, roles, and responsibilities
(4) General communication plan and protocol
(5) Commissioning process tasks and activities through all phases
(6) Commissioning schedule
(7) Commissioning process documentation and deliverables
(8) Testing procedures, including integrated testing
(9) Recommended training
(10) Establishment of an integrated testing frequency, as applicable

5.2.4.3 The following materials should be added as annex sections of the completed commissioning plan:

(1) A — Owner's project requirements
(2) B — Basis of design
(3) C — Commissioning specifications
(4) D — Design review
(5) E — Submittal review
(6) F — Issues log
(7) G — Construction checklists
(8) H — Site visit and commissioning meeting minutes
(9) I — Systems manual review
(10) J — Training
(11) K — Integrated testing procedures
(12) *L — Warranty review
(13) M — Test data reports
(14) N — Sequence of operation

5.2.4.4 The commissioning plan, including all annexes, should form the commissioning record at the end of the construction phase.

5.2.4.5 A current copy of the commissioning record should be presented to the owner at the end of the construction phase.

5.2.5 Planning Review.

5.2.5.1 The FCxA should review the planning documentation to compare the design concept with the interests and needs of the owner as defined in the OPR.

5.2.5.2 The FCxA should identify required changes and improvements affecting operations and maintenance.

5.2.5.3 It should not be the intent of the planning review to verify compliance with local, state and federal codes, unless specifically identified in the commissioning scope.

5.2.6 Planning Approval Documentation.

5.2.6.1 The FCxA should submit documentation stating completion and recommending acceptance of the planning requirements to the owner or other designated individual.

5.2.6.2 The documentation should include, but is not limited to, the following information:

(1) Receipt, review, and approval of planning submittal
(2) Updates to the commissioning plan, as applicable
(3) Any additional comments or requests for information considered by the FCxA to be appropriate to the commissioning process
(4) Preliminary sequence of operation

5.3* Design Phase.

5.3.1* Design phase activities should include, but not be limited to, the following:

(1) Developing the BOD
(2) Review and approval of the sequence of operation
(3) Review of project drawings and calculations affecting fire protection and life safety systems
(4)*Documentation of the scope for commissioning activities in the construction documents
(5) Documentation of the commissioning procedures
(6) Developing a commissioning schedule
(7) Verifying that the construction documents comply with the requirements of the BOD
(8) Identifying qualified specialists in accordance with Chapter 4 and their responsibilities
(9) Coordinating and documenting fire protection and life safety commissioning team meetings and progress reports
(10)*Documenting issues and changes
(11) Updating the commissioning plan
(12)*Developing construction checklists

5.3.2 Basis of Design.

5.3.2.1 General.

5.3.2.1.1 The basis of design should be the documentation describing the initial design decision-making process and description of systems.

5.3.2.1.2 The document described in 5.3.2.1.1 should be in the form of a narrative report and should be submitted for review prior to the installation of any system.

5.3.2.1.3 The basis of design should include but not be limited to the following:

(1) A description of the building or structure
(2) A description of fire protection or life safety systems and components
(3) Performance objectives and criteria
(4) Referenced codes and standards
(5) Alternative means and methods incorporated into the original design
(6) Testing and start-up requirements
(7) Inspection, testing, and maintenance requirements

5.3.2.1.4 The BOD should be included with other required submittals to facilitate plan review and approval by the AHJ prior to the issuance of a permit to install the system.

5.3.2.1.5 The BOD should be updated in accordance with the recommendations for OPR in 5.2.3 after every revision of the design documents.

5.3.2.1.6 The outline for the BOD should include the items in 5.3.2.2 through 5.3.2.7.

5.3.2.2* Applicable Standards, Laws, and Regulations. This section should identify the codes and standards that apply to the design, plan review, installation, testing, acceptance, inspection, and maintenance of the proposed fire protection and life safety systems.

5.3.2.2.1 All codes and standards should be referenced as they apply, including, but not limited to, the following:

(1) NFPA standards, including edition used for the design of each fire protection/life safety system
(2) Applicable local, state, and federal laws and regulations (OSHA, ADA, etc.)
(3) Specialized codes and standards (HVAC, plumbing, etc.)
(4) Green building design considerations that affect fire and life safety systems

5.3.2.3 Building Description. The following specific features of fire protection and life safety systems should be identified in the BOD:

(1) Building use group or occupancy classification
(2) Total area of the building
(3) Building height
(4) Number of floors above grade
(5) Number of floors below grade
(6) Area per floor
(7) Type(s) of hazardous areas within buildings
(8) Type(s) of construction
(9) Site access arrangement for emergency response vehicles
(10) Descriptions of fire protection and life safety systems

5.3.2.4 Fire Protection and Life Safety System Objectives and Decisions.

5.3.2.4.1 The BOD should describe the performance objectives of each fire protection and life safety system, including, but not limited to, the following:

(1) Whether each system is required by code or installed voluntarily
(2) Whether it is a complete or partial installation
(3) Whether it is an addition or modification to an existing system

5.3.2.4.2 The BOD should describe the decisions made and the criteria established to achieve the performance objectives, including, but not limited to, the following:

(1) Building occupant notification and evacuation procedures
(2) Emergency personnel response
(3) Site and systems features
(4) Safeguards during construction, including fire prevention and emergency procedures
(5) Impairment plans when modifying existing systems
(6) Methods for inspection, testing, and maintenance of systems

5.3.2.5 Consideration and Description of Alternative Means and Methods. The design intent of any alternatives to prescriptive requirements of the codes and standards, including, but not limited to, the following, should be identified:

(1) Interpretations and clarifications
(2) Waiver or variance sought through the regulatory appeal process

5.3.2.6 Testing Criteria.

5.3.2.6.1 The FCxA should be responsible for all items listed in 5.2.2.6.

5.3.2.6.2 Testing criteria should be established and documented.

5.3.2.6.3 The methods for prefunctional and integrated testing should be documented.

5.3.2.7* Equipment and Tools. The FCxA should identify and document the tools and equipment necessary for testing.

5.3.3 Operation and Maintenance Manuals (O&Ms).

5.3.3.1 O&Ms should be provided.

5.3.3.2 O&Ms should contain, but not be limited to, the following information:

(1) Project name and address
(2) Discipline (i.e., fire protection)
(3) Specification section number
(4) Volume number

5.3.3.3* The RDP should review and approve the O&Ms for conformance with the OPR.

5.3.4 Training of Operations Personnel. The content, duration, and learning outcomes of training for operations personnel should be provided in the design documentation in accordance with Section 5.3.

5.3.5 Design Methodology.

5.3.5.1* The design should take into consideration the final commissioning of the active and passive fire protection systems.

5.3.5.2 The recommendations for design consideration should include, but not be limited to, the following:

(1) Materials and equipment applied in such a manner that will not affect their listing or their intended use where applicable
(2) Materials and equipment have the capacity to perform their intended use
(3) Design documents or details to demonstrate how the systems operate and communicate to attain the desired outcome
(4) Design documents and/or details to demonstrate the application of fire protection systems in the construction
(5) Locations of fire protection systems
(6) The procedures for verification of fire protection systems
(7) Assignment of responsibility for the testing and inspection of the fire protection systems during the construction phase
(8) Specification of the deliverables, including final documentation for the conclusion of the project
(9) Specification of the format of the deliverables

5.4 Construction Phase. During the construction phase the systems should be delivered, installed, and tested in accordance with the OPR, construction documents, shop drawings, and coordination drawings.

5.4.1 Construction Phase Commissioning Activities.

5.4.1.1 The fire protection and life safety commissioning team should complete the following:

(1) Confirm that the commissioning schedule is still valid, and update if required.
(2) Verify that submittals, including, but not limited to, working plans and product data sheets, are in conformance with the BOD and have been reviewed.
(3) Verify that materials, construction, and installation are in conformance with the BOD.
(4) Confirm qualified specialists are performing commissioning activities per commission plan (CP).
(5) Coordinate and document fire protection and life safety commissioning team meetings and progress reports.
(6) Document any issues and changes to the project and update the CP.
(7) Complete Cx construction checklists.
(8) Perform required observation procedures or cause them to be performed by the responsible party.
(9) Update related documents to record and adjust for any revisions and/or changes.
(10) Verify and document testing performed in the construction phase.

5.4.1.2 Construction should take into consideration the final commissioning of the passive fire protection systems.

5.4.1.3 The recommendations for installation should include but not be limited to the following:

(1) Conformance to the approved drawings and specifications
(2) Compliance with the manufacturers' published instructions
(3) Compliance with applicable codes and standards
(4) Materials and equipment of proper rating for the use

5.4.2 Construction Inspections.

5.4.2.1 Pre-Installation or Preconstruction.

5.4.2.1.1 A preconstruction conference should be held to ensure the fire protection and life safety commissioning team and those performing the work all understand the schedule, procedures, and process.

5.4.2.1.2 Schedule commissioning process activities should include the following:

(1) Address any outstanding issues that are best resolved in this venue.
(2) Verify coordination has taken place among trades.
(3) Identify and establish benchmarks to be met during the construction phase.
(4) Verify submittals are in accordance with design intent documents and approvals and permits are secured.
(5) Confirm integrated testing requirements are being addressed.
(6) Develop test data records.
(7) Confirm compliance with sequence of operation.

5.4.2.2 Rough-In Phase. The following tasks should be performed prior to concealment of the installed material:

(1) Inspect and verify delivered materials meet requirements.
(2) Verify installation is proceeding in accordance with coordinated, approved shop drawings.
(3) Complete periodic site visits to verify compliance with the owner's commissioning plan.
(4) Inspect installation as outlined in the commissioning plan.
(5) Perform testing as applicable.
(6) Update owner project requirements and address any outstanding issues.
(7) Update commissioning plan as needed.
(8) Issue rough-in phase commissioning progress report.

5.4.2.3 Finish Phase. The following tasks should be performed after the rough-in phase is complete:

(1) Inspect and verify delivered materials meet requirements.
(2) Verify installation is proceeding in accordance with coordinated, approved shop drawings.
(3) Complete periodic site visits to verify compliance with OPR.
(4) Inspect installation as outlined in the commissioning plan.
(5) Perform testing as applicable (post-concealment).
(6) Update OPR and address any outstanding issues.
(7) Update commissioning plan.
(8) Issue finish phase commissioning progress report.

5.4.3 Testing and Inspection.

5.4.3.1 Testing and inspection should include passive fire protection systems.

5.4.3.2 The recommendations for testing and inspection should include, but not be limited to, the recommendations of Chapters 7 and 9.

5.4.3.2.1* Fire protection systems that have no operating components should be inspected to verify conformance with the BOD.

5.4.3.2.2 Fire protection systems that have operating components should have their functionality tested to demonstrate compliance with the BOD.

5.4.3.2.3 Written documentation of the testing and inspection should be provided.

5.4.3.2.4 Inspection and testing should be repeated if changes are made to systems.

5.4.3.3 Testing and inspection of passive fire protection systems should be completed as required during construction.

5.4.4 Completion and Acceptance Testing. The following tasks should be performed as part of the acceptance of the fire protection and life safety systems:

(1) Verify installation is in accordance with coordinated, approved shop drawings.
(2) Inspect overall installation as outlined in the commissioning plan.
(3) Perform prefunctional testing of all systems to provide proper functionality and to ensure interoperability.
(4) Perform and document testing of all systems to provide proper functionality, to ensure integration, and to ensure the systems were left in a state of operational readiness.
(5) Update owner project requirements and address any outstanding issues.
(6) Update commissioning plan/record.
(7) Issue completion/acceptance phase commissioning progress report.
(8) Verify compliance and accuracy of sequence of operation.

5.4.5* Owner Training. Training should be permitted to take place in the construction phase.

5.4.6* Closeout Documents. Closeout documents should include, but not be limited to, the following:

(1) Compiled list of all deficiencies and resolutions and verification of resolution achieved
(2) Operations and maintenance manuals
(3) Compile test results and certificate
(4) As-built drawings
(5) Warranty and extended warranties
(6) Spare parts list and supplier listings
(7) Re-commissioning plan (integrated testing)
(8) Sequence of operation

5.5 Occupancy Phase.

5.5.1 Occupancy phase should be the final stage of the commissioning process for the fire protection or life safety systems.

5.5.2 The recommendations for occupancy phase should include but not be limited to the following:

(1) Documentation and completion of remaining acceptance testing and inspections
(2) Testing conducted for modifications made during the construction phase commissioning
(3)*Performing deferred testing for seasonal conditions
(4) Submission of the system manual, operation and maintenance manuals, and vendor emergency contact list
(5) Training on the use and operation of the fire protection and life safety systems
(6) Delivery of the record set drawings and documents
(7) Delivery of the test and inspection records for the fire protection and life safety systems
(8)*Delivery of a digital copy of site-specific software for fire protection and life safety systems that is current with the installed system
(9)*Delivery of warranties for the systems and equipment
(10) Submission of recommended preventative maintenance program for fire protection and life safety systems
(11) Delivery of a list of required inspections, tests, and maintenance for fire protection and life safety systems

5.5.3 Administrative Controls. The owner should be responsible for the continued performance of fire protection and life safety systems.

5.5.3.1* Applicable inspection and testing should be performed when modifications are made.

5.5.3.2* When changes are made to the use of the facility, the OPR should be re-evaluated.

5.5.3.3* The design documents should be maintained for future reference.

5.5.3.4 Inspection, testing, and maintenance should be performed as specified in the installation standard or manufacturer's instructions.

5.5.3.5 Integrated systems should be inspected, tested, and maintained in accordance with the commissioning plan.

5.5.4 Training.

5.5.4.1* The training should include, but not be limited to, the following:

(1) The systems, component systems, and devices for which training will be required
(2) The capabilities and knowledge of the occupants and maintenance personnel
(3) The number and type of training sessions
(4) The location and organization of operation and maintenance manuals

5.5.4.2* Systems training should be scheduled to be completed at or as close as possible to final systems acceptance.

5.5.4.3* Training session scope and attendees should be documented as part of the commissioning record.

5.5.4.4* Facilities personnel or their designated representatives should receive periodic re-training as determined by the commissioning agent.

Chapter 6 Integrated Systems Commissioning

6.1 General. This chapter should apply to the functions of integrated systems provided for fire protection or life safety in the design phase, construction phase, and occupancy phase of the commissioning process of Chapter 5.

6.2 Design Phase.

6.2.1 Narrative Report. Construction documents should include a narrative report of the system interactions, including but not limited to the following:

(1) Sequence of operations of integrated fire protection or life safety systems
(2) Performance objectives of system interactions

(3) Analysis of the impact that interactions will have on the proper operation of each independent fire protection or life safety system
(4) Owner's expectation of how fire protection or life safety systems work together

6.2.2 Design Methodology.

6.2.2.1 The design should take into consideration the interconnections of the fire protection or life safety systems.

6.2.2.2 The recommendations for design consideration should include, but not be limited to, the following:

(1) Materials and equipment interconnected in such a manner that will not affect their listing or their intended use where applicable
(2)*Materials and equipment have the capacity to perform their intended use
(3)*Design documents or details to demonstrate how the systems operate and communicate to attain the desired outcome
(4)*Design documents or details to demonstrate how operations of integrated systems do not impair the functionality of other component systems, unless designed to impair another system
(5)*Sequence of operation for integrated systems
(6)*Locations of interconnections
(7) Procedures for integrated testing
(8)*Required frequency for integrated testing
(9) Assignment of responsibility for the testing and inspection of the systems and interconnections during the construction phase
(10) Specification of the deliverables, including final documentation for the conclusion of the project
(11)*Specification of the format of the deliverables

6.2.2.3* The methods for pre-functional and integrated testing should be included in the construction and systems manual.

6.3 Construction Phase. The recommendations for installation of integrated systems should include but not be limited to the following:

(1) Conformance to the approved drawings and specifications
(2) Compliance with the manufacturers' published instructions
(3) Compliance with applicable codes and standards
(4) Review of material and equipment submittals of proper rating for the use
(5) Coordination of all contractors' submittal drawings, sequence of operation, and procedures

6.4 Occupancy Phase.

6.4.1 The recommendations for occupancy consideration should include but not be limited to the following:

(1) Verification that individual system testing and inspection is complete and documented in accordance with applicable codes and standards and the design specifications for the project
(2) Verification that integrated system testing and inspection is complete and documented in accordance with the design specifications and the commissioning plan for the project
(3) Approval of modifications made to the system or interconnections by the design professional
(4) Retesting as determined by the ITa
(5) Interconnections documented in operation and owner manuals
(6) Training as recommended in 5.3.4, 5.4.5, and 5.5.4 on the use and operation of the systems and interconnections
(7) The vendor emergency contact list
(8) The as-built documents for the systems and interconnections
(9) A copy of test and inspection records of the systems and interconnections
(10) A copy of site-specific software of the systems and interconnections that is current with the installed system
(11) A copy of warranties for the systems and interconnections
(12) A copy of a recommended preventative maintenance program for the systems and interconnections
(13) A list of recommended periodic inspections and tests for the systems

6.4.2* The design documents should be maintained for future reference.

6.5 Data Sharing Systems. During the design phase, the fire protection and life safety commissioning team should document the following:

(1) Where data sharing systems occur in the project
(2) Compatibility of data sharing systems
(3) Where gateways or interfaces are recommended between data sharing systems
(4) The responsible parties for each portion of the interconnection
(5) Degrade mode for each data sharing system upon loss of communication

Chapter 7 Integrated System Testing

7.1 General.

7.1.1 This chapter applies to the testing of integrated systems provided for fire protection or life safety.

7.1.2 Personnel responsible for integrated testing should meet the qualifications listed in 4.2.8 for ITa.

7.2 Test Frequency.

7.2.1* In new construction, integrated testing of fire protection and life safety systems should occur following:

(1) Verification of completeness and integrity of building construction
(2)*Individual system functional operation and acceptance as required in applicable installation standards tests
(3) Completion of pre-functional tests of integrated systems

7.2.2 Existing fire protection and life safety systems should have periodic integrated testing.

7.2.2.1 Integrated systems that were commissioned upon installation in accordance with Chapter 6 should have integrated testing at the interval specified in the commissioning plan.

7.2.2.2 For integrated systems that were not commissioned, an integrated testing plan should be developed to identify the appropriate extent and frequency of integrated system testing.

7.2.3 In addition to periodic integrated testing, integrated system testing should be done when any of the following events occurs:

(1) New component fire protection or life safety systems are installed and interconnected to existing fire protection and life safety systems.
(2) Existing fire protection or life safety systems are modified to become components of interconnected systems.
(3) Interconnections or sequence of operations of existing integrated fire protection and life safety systems are modified.

7.3 Test Method.

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

7.3.2* Integrated testing of fire protection and life safety systems should verify the interconnections function properly.

7.3.3* During integrated testing, equipment should be tested in accordance with the applicable installation standard to verify systems perform according to their design function.

7.3.4 Written documentation of the testing and inspection should be provided.

7.3.5* Testing should be repeated if changes are made to systems.

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

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

7.3.7.1 Loss of power to monitored circuits should 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*

7.3.8 Integrated testing of data sharing systems should 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

7.4 Testing Responsibility.

7.4.1 The owner should be responsible for integrated testing of fire and life safety systems.

7.4.2 The owner should be permitted to delegate the authority and responsibility for integrated testing of the fire protection and life safety systems to the management firm or managing individual through specific provisions in the lease, written use agreement, or management contract.

7.4.3* The ITa should be responsible for planning, scheduling, documenting, coordinating, and implementing the integrated testing of the fire protection and life safety systems and their associated subsystems.

7.4.4 Where a commissioning plan does not exist, the ITa should prepare a test plan providing, but not limited to, the following information:

(1) A comprehensive functional matrix depicting all system inputs and associated output functions
(2) The extent of systems to be tested under the direct supervision of the ITa
(3) The testing of component systems required by associated NFPA standards conducted separately under contract to the owner
(4) Test processes to be incorporated
(5) Test scenarios developed to verify appropriate system responses to the functional matrix
(6) A test event schedule with the applicable stakeholders

7.4.5* Documentation.

7.4.5.1 The ITa should maintain a record of faults, failures, and discrepancies discovered through the testing process in an official issues log (IL).

7.4.5.1.1 The IL should list each separate finding and its corresponding resolution, including dates of discovery and resolution.

7.4.5.2 Corrective action reports (CAR) should provide a specific and detailed description of actions taken to remediate faults, failures, and discrepancies discovered during the testing process.

7.4.5.3 Upon completion of testing, the ITa should submit a final test report to the owner and other stakeholders as requested.

7.4.5.4 The final test report should summarize the results of the integrated testing and should include ILs and CARs.

Chapter 8 Re-commissioning (Re-Cx) and Retro-commissioning (RCx) of Fire Protection and Life Safety Systems

8.1* General. This chapter provides recommendations for the re-commissioning and retro-commissioning recommendations of active and passive fire protection and life safety systems where installed in existing structures.

8.2 Re-commissioning.

8.2.1* Fire protection and life safety systems that have been commissioned upon installation in accordance with the commissioning process of Chapter 5 of this standard should be re-commissioned as specified by a re-commissioning plan.

8.2.2 Recommendations for Re-commissioning. The following should be achieved during re-commissioning:

(1) A fire protection and life safety commissioning team should be established and responsibilities should be assigned in accordance with 5.2.2.
(2) The fire protection and life safety commissioning team should complete the applicable recommendations of 5.2.1.2, 5.3.1, 5.4.1, and 5.5.2.

8.3 Retro-commissioning.

8.3.1* Where testing of existing fire protection and life safety systems has not been conducted in accordance with the commissioning process of Chapter 5 of this recommended practice,

retro-commissioning should only be specified by a retro-commissioning plan.

8.3.1.1 A fire protection and life safety commissioning team should be established.

8.3.1.2 The responsibilities of the fire protection and life safety commissioning team should be assigned in accordance with 5.2.2.

8.3.1.3 The fire protection and life safety commissioning team should complete the applicable recommendations of 5.2.1.2, 5.3.1, 5.4.1, and 5.5.2.

8.3.2 The retro-commissioning plan should be developed from a survey and evaluation of installed fire protection and life safety systems design and existing conditions.

8.3.3 Integrated testing of fire protection and life safety systems should be performed in accordance with Chapter 6.

Chapter 9 Commissioning Documentation and Forms

9.1* Documentation. Approved commissioning documents and forms should be used to record commissioning and integrated testing of fire and life safety systems.

9.2 Allowable Documents. Documents from NFPA and other approved installation standards referenced in the BOD should be utilized.

9.3 Forms and Checklists. Where no form or checklist exists, specific forms or checklists should be developed to document successful testing of systems and components.

9.4* Document Retention. Test documents should be retained by the owner for the life of the system.

Annex A Explanatory Material

Annex A is not a part of the recommendations 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.1.2 System commissioning and integrated testing is critical to ascertain that systems are installed and function in accordance with the BOD and OPR and that testing is documented. It is not the intent of this recommended practice to supplant the existing requirements of other codes and standards, but this recommended practice can provide the appropriate guidance for a specific system or component where testing is not otherwise addressed. Such guidance should be developed by the fire protection and life safety commissioning team.

A.1.3 Planning for fire protection and life safety in and around a building or structure involves an integrated system approach that enables the system designer to analyze all of the components as a total fire safety system package.

A.1.3.1 This recommended practice is not intended to be applied unless required by applicable codes or standards, the OPR, or an AHJ.

A.1.3.1(1) 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:

(1) Access roadways for general ingress and egress and those necessary for fire department access in accordance with local codes, standards, and policies
(2) Utility systems for the provisions of electric power, fuel gas, water, and waste water; communication systems; and any other utility system deemed essential for the support of project operations
(3) 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

A.1.3.1(6) Emergency power supply systems to be commissioned include, but are not limited, to those powering the following:

(1) Smoke control systems
(2) Stair pressurization systems
(3) Smoke-proof enclosure ventilation systems
(4) Electric driven fire pumps
(5) Fire service access elevators
(6) Fire suppression system controllers

A.1.3.1(8) 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.

A.1.3.1(9) Examples include, but are not limited to, fire and smoke resistant–rated assemblies protected by a firestop system or device for through-penetrations and membrane penetrations.

A.1.3.1(12) Egress system and egress components should include the following:

(1) Emergency lighting and exit signs
(2) Major egress components, such as corridors, stairs, ramps, and so forth
(3) Exit path marking systems

A.1.3.2 Fire and life safety systems can have problems during startup and installation. When implemented correctly, a realistic commissioning plan minimizes startup and long-term problems, reduces operational costs, and minimizes future maintenance requirements.

A.1.3.2(5) Consideration should be given to providing training for emergency response personnel.

A.1.3.3(3) See Figure A.3.3.16(a) for a sample sequence of operation.

A.1.3.4 In order to invoke the commissioning recommendations in NFPA 3, specifications should read, "The building fire protection systems shall be designed, installed, tested, commissioned, and maintained in accordance with commissioning process of NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*."

A.1.3.5 For some buildings, the integrated testing recommendations of NFPA 3 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 building with a small automatic sprinkler and fire alarm systems can meet the integrated testing recommendations of NFPA 3 by meeting the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, 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.1.4 This section provides guidance for new technologies or alternative materials, devices, methods, or arrangements that are not covered by other sections of this document.

A.1.4.1 The burden of proof of equivalency lies with the applicant who proposes the use of alternative materials or methods. The authority having jurisdiction should determine whether identified performance objectives of the proposed new technology are appropriate and have met the intent of the performance objectives of this document, the OPR, BOD, and applicable codes and ordinances of the jurisdiction. The type of information required includes test data in accordance with referenced standards, evidence of compliance with the referenced standard specifications, and design calculations.

A.1.4.1.1 Supporting data and tests, where necessary to assist in the approval of materials or assemblies not specifically provided for in this recommended practice, should consist of valid research reports from approved sources. A research report issued by an authoritative agency is particularly useful in providing the authority having jurisdiction with the technical basis for evaluation and approval of new and innovative materials and methods of construction.

Sufficient technical data, test reports, and documentation should be provided for the AHJ to make a decision as to the appropriateness of an alternative material or method. Reports providing evidence of this equivalency should be required to be supplied by an approved source, meaning a source that the AHJ confirms is considered to be reliable and accurate.

A.1.4.1.2 Approval should be based on evidence that the agency has the technical expertise, test equipment, and quality assurance to properly conduct and report the necessary testing. In the absence of recognized and accepted test methods, the AHJ can approve the test methods required. Methods of testing should be preapproved by the AHJ.

A.1.4.1.4 The AHJ can require design submittals for new technologies to bear a third-party review and approval when the complexity of the design exceeds the capabilities of the AHJ to determine the appropriateness of the proposed design, operation, process, or interoperability.

A.1.4.3 The applicant should provide system design and operational documentation containing testing methods and intervals to assist in the continued operation and interoperability of system components and associated equipment.

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.3.2.4 Recommended Practice. A document that is similar in content and structure to a code or standard but that contains only nonmandatory provisions using the word "should" to indicate recommendations in the body of the text.

A.3.3.1 Basis of Design (BOD). The BOD is normally used to assist the commissioning authority and the AHJ 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 Authority (CxA).*** A commissioning authority is typically provided and leads the overall fire protection and life safety commissioning team when the commissioning process is applied to more than one building system — that is, building commissioning. When the commissioning process is only applied to fire and life safety systems, the FCxA can assume the role of the commissioning authority.

A.3.3.3.3 Commissioning Plan. The commissioning plan establishes the framework for how commissioning will be handled and managed on a given project.

A.3.3.3.5 Fire and Life Safety Commissioning (Cx). Commissioning is achieved in the design phase by documenting the design intent and continuing throughout construction, acceptance, and the warranty period with actual verification of performance, O&M documentation verification, and the training of operating personnel.

A.3.3.3.7 Re-commissioning (Re-Cx). Re-commissioning can be initiated periodically or in response to building renovation or a change in building use.

A.3.3.3.8 Retro-commissioning (RCx). Retro-commissioning is a process that ensures that building systems perform interactively according to the design intent and/or to meet the owner's current operational needs. This is achieved by documenting the design intent where possible and the current operational needs, measuring the existing performance, and implementing necessary operational and/or

system modifications, followed by actual verification of performance, verification of O&M documentation, and training of operating personnel.

Retro-commissioning explains the analogy and methodology used by the designers in the design of the systems for the protection of the building, occupants, and emergency response personnel.

A.3.3.8 Installation Contractor. Installation contractors often provide shop drawings, working plans, and other related documents.

A.3.3.11 Narrative. The narrative is written to assist and expedite the plan review and inspection process by the AHJ. 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 authority having jurisdiction 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 authority having jurisdiction, 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.3.3.16 Sequence of Operation. See Figure A.3.3.16(a) and Figure A.3.3.16(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.3.3.18.1 Active Fire Protection System. Examples of active systems include, but are not limited to, gaseous extinguishing systems, sprinklers, standpipes, dampers, or fire alarm systems.

A.3.3.18.3 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.3.3.18.4 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.3.3.19.1 Integrated System. An integrated system contains systems that are physically connected and others that are not. An integrated system can contain a combination of fire protection and life safety systems and non–fire protection and life safety 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 is 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 are to close upon activation of smoke control systems or stair pressurization systems. See Figure A.3.3.19.1 for examples of integrated systems.

System Inputs			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							
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P							
Fire Alarm System	Fire Alarm Inputs	1	Typical manual pull station (by device) — levels 1–5	X	X					X	X		X	X	X					1				
		2	Typical elevator recall smoke detector (by device) — by floor (lobby)	X	X					X	X		X	X	X	X			X	2				
		3	Elevator machine room smoke detector	X	X					X	X	X	X	X	X				X	3				
		4	Typical smoke detector (by device) — computer room (third floor) — preaction system	X	X					X	X		X	X	X	X				4				
		5	Typical wet sprinkler system flow control valve assembly flow switch — by floor	X	X				X	X	X		X	X	X					5				
		6	Typical wet sprinkler system flow control valve assembly tamper switch — by floor			X	X			X										6				
		7	Typical preaction sprinkler system flow control valve assembly flow switch — by floor	X	X				X	X	X			X	X					7				
		8	Typical preaction sprinkler system flow control valve assembly tamper switch — by floor			X	X			X										8				
		9	Kitchen cafeteria ansul system — first floor	X	X					X	X				X				X	9				
		10	Typical duct-in smoke detector (by device) — by floor							X							X			10				
Fire Alarm Inputs	Building	11	Fire pump running			X	X			X										11				
		12	Fire pump power failure			X	X			X										12				
		13	Fire pump phase reversal			X	X			X										13				
		14	Fire pump connected to emergency power			X	X			X										14				
		15	Fire pump circuit breaker at generator output			X	X			X										15				
	FACP	16	Fire alarm system open circuit					X	X	X										16				
		17	Fire alarm system ground fault					X	X	X										17				
		18	Fire alarm system battery disconnect					X	X	X										18				
		19	Fire alarm system low battery					X	X	X										19				
		20	Fire alarm system ac power failure					X	X	X										20				
	Misc.	21	Fire alarm system amplifier failure					X	X	X										21				
		22	Generator status indicator					X	X											22				
				A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P					

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.3.3.16(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.3.3.16(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.3.3.16(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.3.3.16(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.3.3.16(b) ***Continued***

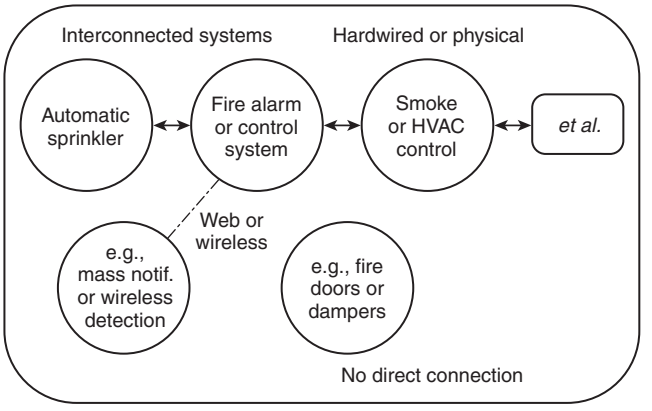

FIGURE A.3.3.19.1 Integrated System.

A.3.3.19.2.1 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.3.3.19.2.2 Data Sharing System. 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 sharing system can have components that are switch connections too.

A.3.3.19.3 Interconnection. Interconnections could consist of electrical binary connections or data transfer protocols. Example of data transfers are BACnet or other data exchange protocols.

A.3.3.21.2 Integrated Testing. Integrated testing can include other building systems integrated to fire and life safety systems such as elevator recall or HVAC control.

A.3.3.21.3 Pre-Functional Testing. Pre-functional testing is conducted in preparation for other types of testing, including integrated testing and acceptance testing. This testing is typically conducted according to a checklist developed by the FCxA that incorporates manufacturers' requirements and ensures that equipment and components are functioning as intended prior to final acceptance testing. These tests can be complete or partial. In many cases, such as with fire pumps per NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, this is required prior to acceptance testing, as the coordination of attendance by multiple members of the commissioning team may be required. Pre-functional testing is synonymous with the term *preliminary testing*.

A.4.2.1.1 Examples of individuals qualified to provide FCxA services can include, but are not limited to, the following individuals:

(1) Registered professional fire protection engineers
(2) Registered professional engineers in other disciplines with sufficient knowledge in the applicable fire protection and life safety systems
(3) Professionals experienced in the design, operation, or construction of the type of facility to be commissioned
(4) Professionals experienced in the design, operation, or installation of the type of fire and life safety systems installed

The FCxA should have no financial interest (owner, division or subsidiary, partner, operating officer, distributor, salesman, or technical representative) in any fire protection or life safety equipment manufacturers, suppliers, or installers for any such equipment provided as part of this project. As such, qualified independent third-party firms or individuals should be considered for designation as the FCxA. The FCxA should have a minimum of five years' experience in facility construction, inspection, acceptance testing, or commissioning as it relates to fire protection and life safety.

A.4.2.2.2 Installation contractors should be certified by an organization responsible for certification of technical installation personnel and approved by the AHJ.

A.4.2.4 Construction managers and general contractors should possess skills in the following categories of construction management:

(1) Project management planning
(2) Cost management
(3) Time management
(4) Quality management
(5) Contract administration
(6) Safety management
(7) Professional practice

This should include specific activities such as defining the responsibilities and management structure of the project management team, organizing and leading by implementing project controls, defining roles and responsibilities and developing communication protocols, and identifying elements of project design and construction likely to give rise to disputes and claims.

A.4.2.5.2 The level of knowledge required should be commensurate with the level of interaction with the systems.

A.4.2.6.2 License and/or certification requirements can be provided by the AHJ or other applicable NFPA or industry standards.

A.4.2.7 Governmental AHJs (fire inspection personnel) should have the ability to determine the operational readiness of fire detection and alarm systems and fire suppression systems, given test documentation and field observations, so that systems are in an operational state. Fire inspection personnel should be able to verify code compliance of heating, ventilating, and air conditioning (HVAC) equipment and operations so that the systems and other equipment are maintained in accordance with applicable codes and standards. In addition, fire inspection personnel involved in fire protection system commissioning should be able to witness an acceptance test for integrated fire protection systems so that the test is conducted in accordance with the approved design and applicable codes and standards, and the system performance can be evaluated for compliance. Individuals should be able to demonstrate knowledge of the codes and standards related to the installation and operational requirements of integrated fire and life safety systems, such as elevator recall or operation of a smoke removal system upon activation of fire detection

devices, or other integrated operations of fire protection systems in a structure in accordance with the applicable building, mechanical, and/or fire codes of the jurisdiction.

A.5.1.1 The fire protection and life safety commissioning team should review with the owner and AHJ to determine the systems that should be subject to commissioning. Commissioning might not be required for all facilities, systems, or components. However, acceptance and integrated testing should still be performed. A reasonable degree of protection for life and property can be provided by acceptance and integrated testing for small systems or those integrated systems having simple logic. For examples of roles and responsibilities, see Table A.5.1.1.

Table A.5.1.1 Roles and Responsibility Matrix

	Owner	Facility Manager or Operations Personnel	Insurance Rep	Owner Technical Support	Construction Manager	Installation Contractor	Cx Agent	RDP
Planning Stage								
Identify commissioning team	L/A	S	S	P/S	—	—	—	—
Develop owner's project requirements	L/A	S	S	S	—	—	—	—
Develop preliminary commissioning scope	L	S	S	P/S	—	—	—	—
Develop preliminary commissioning plan	L	S	S	S	—	—	—	—
Establish budget for all Cx work and integrate costs for commissioning into project budget	L	S	—	S	—	—	—	—
Include time for Cx in initial project schedule	L	I	I	I	—	—	—	—
Include Cx responsibilities in architect/engineer and construction manager scope of services	L/A	S	—	S	—	—	—	—
Design Stage								
Contract for commissioning agent services	L/A	P	—	P	L	—	—	—
Hold design stage Cx meetings	P	P	P	P	P	—	L	P
Identify project-specific responsibilities	L	L	—	S	S	—	P	P
Review owner's project requirements documentation for completeness and clarity	S	S	I	—	I	—	L	I
Develop basis of design	A	P	P	S/A	I	—	I	L
Perform focused Cx reviews of design drawings and specifications	P	P	P	P	S	—	L	S
Perform project constructability reviews	P	—	—	I/P	L	—	I/S	S
Incorporate appropriate changes to construction documents based upon design reviews	A	P	—	I	I	—	I	L

(continues)

Table A.5.1.1 *Continued*

	Owner	Facility Manager or Operations Personnel	Insurance Rep	Owner Technical Support	Construction Manager	Installation Contractor	Cx Agent	RDP
Refine owner's project requirements based upon design stage decisions	A	P	—	S	I	—	L	S
Create Cx specifications including testing protocols for all commissioned equipment systems	I	I	I	P/S	S	—	L	S
Integrate Cx activities into project schedule	A	I	—	I	L	—	S	I
Coordinate integration issues and responsibilities between equipment, systems, and disciplines	A	I	—	P/S	S	—	V	L
Update commissioning plan	A	I	I	I	S	—	L	I
Incorporate commissioning requirements into construction contractor's scope of work	A	—	—	I	L	—	S	S
Construction Stage								
Revise commissioning plan as necessary	A	I	—	I	I	S	I	L
Review submittals applicable to equipment/systems being commissioned	I	—	A	P	A	S	S	L
Review project submittals for construction quality control and specification conformance	I	—	—	I/P	A	L	S	V
Develop functional test procedures and documentation formats for all commissioned equipment and assemblies	A	I	I	S/A	S	S	I	L
Include Cx requirements and activities in each purchase order and subcontract written	A	—	—	—	—	A	L	V
Develop construction checklists for equipment/systems to be commissioned	A	—	—	P	I	I	I	L
Install components and systems	I	I	—	—	A	A	L	V

Table A.5.1.1 *Continued*

	Owner	Facility Manager or Operations Personnel	Insurance Rep	Owner Technical Support	Construction Manager	Installation Contractor	Cx Agent	RDP
Review requests for information and changes for impacts on Cx	A	I	—	I/S	S	L	S	V
Demonstrate operation of systems	I	—	P/I	—	I	P	L	V
Complete construction checklists as the work is accomplished	I	I	—	I	I	S	L	A
Continuously maintain the record drawings and submit as detailed in the construction documents	A	S	—	—	I	S	L	V
Coordinate functional testing for all commissioned systems and assemblies	I	I	—	P/A	I	S	S	L/A
Perform quality control inspections	I	—	I	I/P	—	L	S	P/I
Maintain record of functional testing	I	I	I	I/P	I	S	S	L
Prepare Cx progress reports	A	I	—	I/P	I	P	S	L
Hold construction phase Cx meetings	P	P	P	P	P	P	P	L
Maintain master issues log	I	I	—	I	I	S	I	L
Review equipment warranties to ensure owner responsibilities are clearly defined	I	I	—	—	—	S	S	L
Implement training program for operating personnel	I	P	P	I/S	P	S	S	L
Compile and deliver turnover package	A	A	—	—	S	S	L	S/V
Deliver commissioning record	A	P	—	I	S	S	S	L
Occupancy Stage								
Coordinate and supervise deficiency corrections	A	P	—	I	I/S	L	S	I
Coordinate and supervise deferred and seasonal testing	A	P	—	I	—	S	—	I
Review and address outstanding issues	A	P	I	I	I/S	S	S	I
Review current building operation at 10 months into 12-month warranty period	A	P	I	I	S	S	—	I
Address concerns with operating facility as intended	A	P	I	I	S	S	S	S

(continues)

Table A.5.1.1 *Continued*

	Owner	Facility Manager or Operations Personnel	Insurance Rep	Owner Technical Support	Construction Manager	Installation Contractor	Cx Agent	RDP
Complete final commissioning report	A	P	—	—	I/P	I	—	I
Perform final satisfaction review with customer agency 12 months after occupancy	A	S	I	S	—	S	—	S

L: Lead. P: Participate. S: Support. I: Inform. A: Accept. V: Verify.
Note: The following definitions apply to Table A.5.1.1:
Lead (L) = Direct and take overall responsibility for accomplishment
Support (S) = Provide assistance
Accept (A) = Formally accept either in writing or verbal communication depending on the situation
Participate (P) = Take part in the activity (e.g., attend meetings)
Inform (I) = Make the party aware of the activity or result or provide a copy of the deliverable
Verify (V) = Confirm the accuracy or completeness of the task

A.5.1.2 Figure A.5.1.2(a), Figure A.5.1.2(b), and Figure A.5.1.2(c) are offered to provide an example of how to perform a commissioning plan.

A.5.2.1.1 The fire protection and life safety commissioning team can be part of a larger building commissioning team with team members whose focus is on commissioning electrical, mechanical, plumbing, and electronics systems. The overall team can be led by a commissioning authority whose responsibility is defined in ASHRAE Guideline 0, *The Commissioning Process*. The individuals and entities listed are not all inclusive and should be modified on a project by project basis. If the entity listed is not part of the project, it is not the intent of this standard to require those entities to become part of the project fire protection and life safety commissioning team. The number of members of the fire protection and life safety commissioning team should be determined by project type, size, and complexity.

A.5.2.1.2(6) This analysis should involve making direct contact with the various federal, state, and local regulatory agencies to verify what laws, rules, regulations, codes, standards, policies, and practices are in force and applicable to the project.

A.5.2.2 Fire protection and life safety commissioning team members should be selected as their role in the project is established.

A.5.2.2.1(4) The installation contractor cannot be identified until the construction phase and therefore would not be a participant in the planning or design phases.

A.5.2.2.1(5) Manufacturer's representatives cannot be identified until the design phase and therefore would not be a participant during the planning phase.

A.5.2.2.1(12) The definition of AHJ as set forth in 3.2.2 and A.3.2.2 provides information as to the large range of entities and individuals that can be an AHJ. Any and all AHJs should be included as part of the fire protection and life safety commissioning team to the extent they are deemed to need to be involved.

A.5.2.2.1(13) See 7.4.3 for the responsibilities of the ITa. The responsibilities of an ITa can be fulfilled by the FCxA.

A.5.2.2.2 The owner, FCxA, and RDP should be part of the fire protection and life safety commissioning team at this phase. Other key team members will be identified and selected as the project progresses and as their roles and responsibilities require their participation.

A.5.2.2.4.2 Examples of a designated representative include the occupant, management firm, or managing individual. Delegation can be through specific provisions in a lease, written use agreement, or management contract.

A.5.2.2.5 A CxA will only be part of the fire protection and life safety commissioning team when the fire protection and life safety systems are included in a larger building commissioning process. If the scope of the project includes fire protection and life safety systems only, then a CxA will not be present nor part of the fire protection and life safety commissioning team.

A.5.2.2.11 Discussions should be performed between insurance representatives and the fire protection and life safety commissioning team during the planning phase to determine the overall scope of services to be provided by the insurance representative.

A.5.2.2.11(8) This includes adequate signage on equipment for operation of a fire protection system and complete record drawings.

A.5.2.3.2 The OPR development should include the AHJ in order to provide input regarding issues of fire department operations and access to the site and facility. Other appropriate issues for review might include emergency medical response and police issues.

A.5.2.3.3 The OPR should include the following sections: introduction, owner's key project requirements (i.e., insurance underwriter's standards), general project description, project objectives, functional uses, occupancy requirements, budget considerations and limitations, performance criteria, and project history. The fire and life safety OPR can be a section of the overall building commissioning documentation. *(See Annex C for a sample OPR.)* The OPR is intended to be a living document that is regularly updated and modified. During the design phase the OPR can change significantly based on the needs of the proposed design.

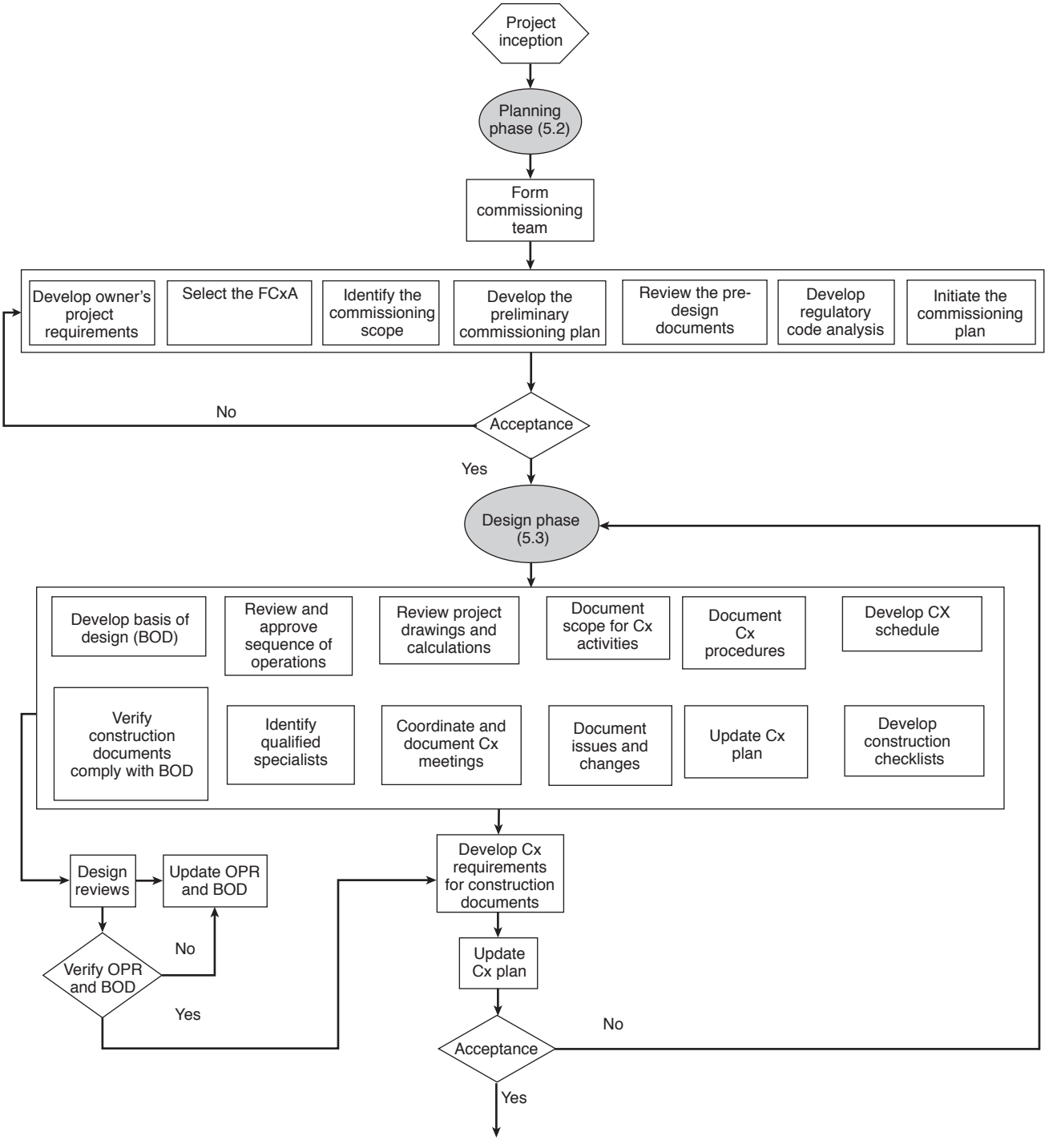

FIGURE A.5.1.2(a) The Commissioning Process — Design Phase.

A.5.2.4.2 All information in the commissioning plan must be project specific. The suggested structure of the commissioning plan is as follows:

(1) Introduction — purpose and general summary of the plan
(2) Commissioning scope — identifies which building assemblies, systems, subsystems, and equipment will be subjected to the commissioning processes identified in Chapter 5
(3) General project information — overview of the project, emphasizing key project information and delivery method characteristics, including the OPR and project BOD
(4) Team contacts — project-specific fire protection and life safety commissioning team members and contact information
(5) Communication plan and protocols — documentation of the communication channels to be used throughout the project

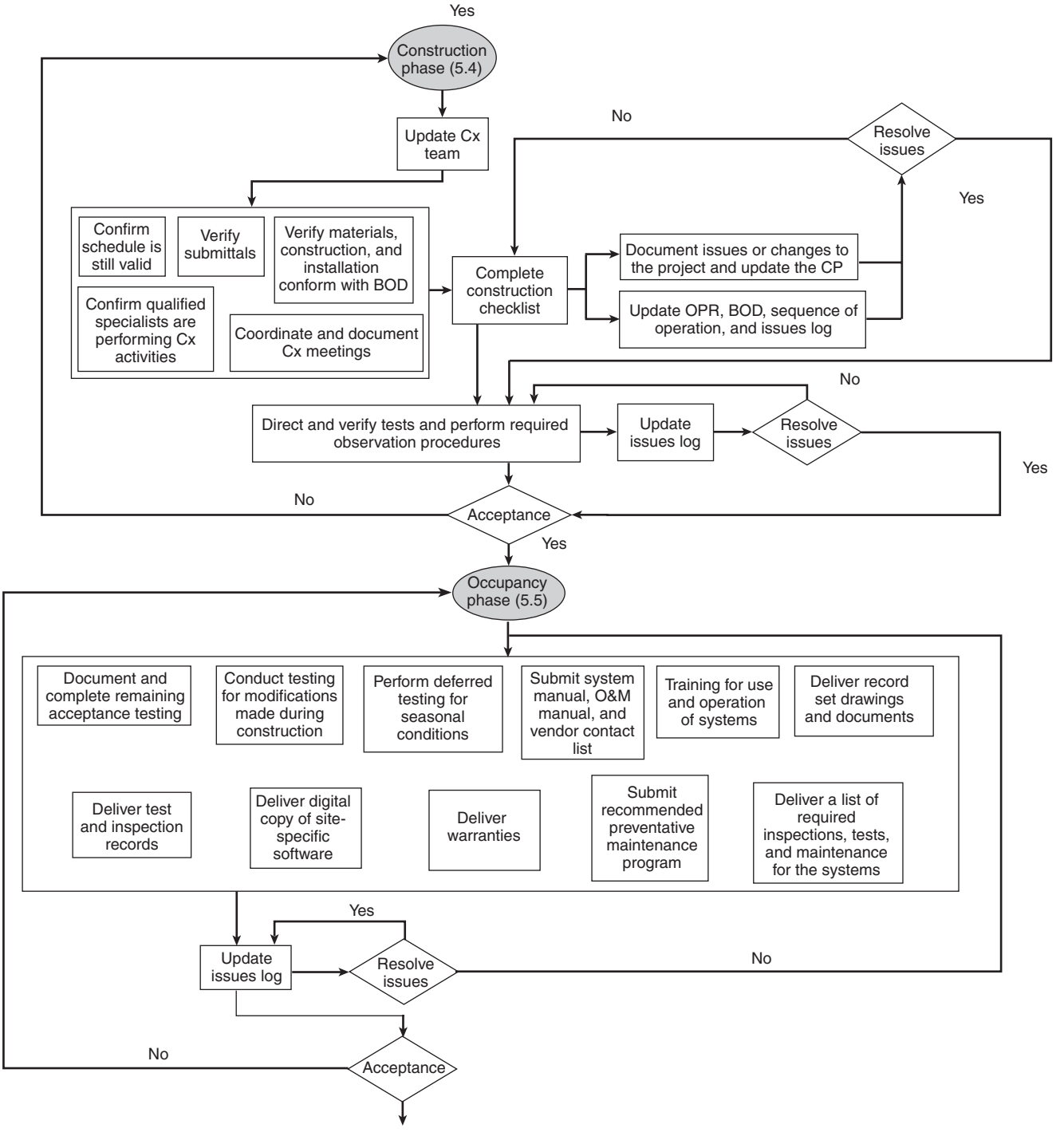

FIGURE A.5.1.2(b) The Commissioning Process — Construction and Occupancy Phase.

(6) Commissioning process — detailed description of the project specific tasks to be accomplished during the planning, design, construction, and tenant occupancy stages with associated roles and responsibilities
(7) Commissioning documentation — list of commissioning documents required to identify expectations, track conditions and decisions, and validate/certify performance
(8) Commissioning schedule — specific sequences of operation of events and relative timeframes, dates, and durations

A.5.2.4.3(12) Warranty review includes a review of all documentation relating to inspection, testing, maintenance, repair, and/or inadvertent system activation that occurred during the warranty period. The purpose of the warranty review is

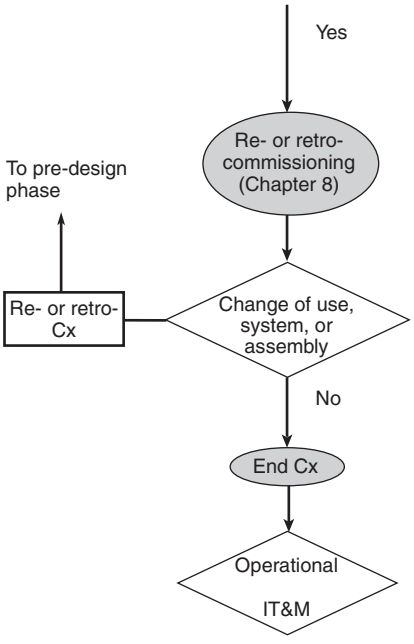

FIGURE A.5.1.2(c) The Commissioning Process — Ongoing Commissioning.

to determine if any modifications or adjustments to the system(s) are required.

A.5.3 Construction phase documents can be started during the design phase. These documents are intended to include working plans, shop drawings, or fabrication drawings, as well as operations and maintenance manuals. These documents can be created during the design or construction phases of a project without changing the responsibilities of those charged with creating these documents.

A.5.3.1 If commissioning starts later in the design or construction process, the requirements of the previous commissioning phases should be reviewed and implemented to the extent practical.

A.5.3.1(4) It is important to document the scope and extent of commissioning activities in the construction documents, typically via the specification. This allows members of the commissioning team, not yet part of the project, to understand the commissioning scope prior to joining the project.

A.5.3.1(10) The issues and changes should be included in a log that documents the date the issue was raised, the responsibility for resolution of the issue, the resolution of the issue, and the date the issue was resolved.

A.5.3.1(12) Include checklists requiring when AHJs and Cx team members are to be present during acceptance testing.

A.5.3.2.2 Editions referenced in this document are the latest available during the development of this recommended practice. The user should always consult the AHJ to ensure compliance with local requirements.

A.5.3.2.7 FCxA should review manuals, standards, manufacturers' documents, and other sources to determine the equipment and tools necessary for each phase of testing. FCxA should also confirm which contractors or other appropriate parties should calibrate and schedule the availability of the tools and equipment for the testing dates.

A.5.3.3.3 O&Ms should be organized and written in a complete and concise manner to improve the ability of the building operator or maintenance technician to fully understand the performance characteristics of the system and the maintenance requirements necessary to achieve the intended performance.

O&Ms should be of durable materials and contain complete project identification including, but not limited to, the following:

(1) Title sheet including the complete name and address of the project and the complete name and address of the installing contractor (including telephone number for emergency service)
(2) Complete table of contents
(3) Systems design intent documentation
(4) Complete list of equipment
(5) List of equipment suppliers and/or manufacturers
(6) Operation and maintenance instructions for major components
(7) Inspection and test reports
(8) Recommended spare parts
(9) Riser diagrams or schematic drawings
(10) "As-built" drawings and calculations
(11) Warranty
(12) Other special requirements of the installation specification or installation standard such as valve tags and charts, hydraulic data nameplate information (for sprinkler systems), and so forth

A.5.3.5.1 Passive fire protection systems include, but are not limited to, the following:

(1) Fire and smoke dampers
(2) Fire and smoke doors
(3) Through penetration fire stops
(4) Smoke vents
(5) Smoke drafts
(6) Smoke and fire assemblies

A.5.4.3.2.1 Examples of fire protection systems with no operating components include, but are not limited to, the following:

(1) Through-penetration firestop systems
(2) Rated fire and smoke assemblies
(3) Spray-applied fire-resistant material

A.5.4.5 Training often needs to begin in the construction phase; however, some systems can require ongoing training during the occupancy and post-construction phases.

A.5.4.6 This can include documents required by other codes and standards or by AHJs.

A.5.5.2(3) For example, it can be appropriate to test stair pressurization in both winter and summer conditions.

A.5.5.2(8) This would include a digital copy of site-specific software for building automation or other integrated systems.

A.5.5.2(9) The building owner or a designated representative should police the building systems through inspection, testing, and maintenance prior to the expiration of the warranty. This helps identify needed repairs.

A.5.5.3.1 Additions, modifications, or alterations to systems can cause unintended consequences. The testing procedure

should be re-evaluated to make sure that the repeat testing is adequate to determine the correctness of the revision.

A.5.5.3.2 Significant changes to the OPR can precipitate a need to do a re-commission process.

A.5.5.3.3 Design documents should be kept for the life of the facility. When there is a change in ownership, the documents should be transferred to the new owner.

A.5.5.4.1 A quality training session for system operation and maintenance will generally include the following components:

(1) Practical examples and hands-on operation of the system
(2) A course agenda
(3) The expected system performance
(4) Problems or modifications encountered during construction
(5) Routine testing and maintenance requirements
(6) Operation and maintenance manuals

Additional training should be conducted after several years. This will allow the facility staff to be trained on system upgrades or modifications. This can be accomplished in conjunction with lesson-learned workshops.

A.5.5.4.2 An appropriate time to schedule the initial training is at system acceptance in order to maximize its value to the participants. Secondary systems training should be held after integrated testing has been completed to allow follow-up questions and the opportunity to ask questions about situations and problems that have occurred after final acceptance.

A.5.5.4.3 Sign-in sheets are useful for the contractor and fire protection and life safety commissioning team to demonstrate that training was conducted. Training sessions can be recorded to allow for future reference of the material and training for new employees.

A.5.5.4.4 Continuous training can ensure the systems are maintained and tested properly and the building or structure operates successfully.

A.6.2.2.2(2) Examples of equipment capacity ratings are as follows:

(1) Electrical: amperage, voltage, wattage, and so forth
(2) Strength: working pressure, tensile, structural, and so forth
(3) Life expectancy: years, number of cycles, and so forth

A.6.2.2.2(3) A system description should be produced as an engineering document to describe system integration and functions. Each component system within the integrated system should be defined. Each interconnection should be defined. A fire hazard analysis should be produced to describe active and passive fire protection features and describe the interactions between the fire protection features of the building.

A.6.2.2.2(4) For individual systems to work together there must be consideration of the various interconnections that can occur. Some interconnections can be directly connected, and others can be more remotely involved. An example of the first is an emergency power off (EPO) system that in its operation causes loss of power to a fire protection system or the EPO system itself. An example of the second is an atrium smoke control system that functions correctly mechanically, but the air movement prevents the automatic doors from closing.

A.6.2.2.2(5) This is often done by using a sequence of operation to plot inputs and outputs.

A.6.2.2.2(6) In addition to noting the location of the interconnection on the drawing, it is helpful to have a labeling system to identify the interconnections in the installation.

A.6.2.2.2(8) The interactions within integrated systems need to be tested often enough to ensure reliability.

A.6.2.2.2(11) Examples of formats for deliverables are as follows:

(1) Drawings on paper or electronic format
(2) Electronic format such as PDF or DWG
(3) Media format such as floppy disk, flash drive, CD, or FTP
(4) Owner's manuals on paper, accessible from Internet hyperlink, and so forth

A.6.2.2.3 It is important to document the scope and extent of pre-functional and integrated testing activities in the construction documents, typically via the specification. This allows the general contractor and installation subcontractors, not yet part of the project, to understand the testing scope prior to joining the project.

A.6.4.2 It is recommended that design documents be retained for the life of the appropriate systems.

A.7.2.1 Interconnected systems have component systems that can operate alone for a specific purpose and can be independent of other systems. Integrated systems contain multiple systems that must work in concert to achieve the fire protection and life safety goals. These interconnections need to be tested for proper operation in addition to the acceptance testing of the individual components.

A.7.2.1(2) Components of interconnected systems should be installed, maintained, and tested in accordance with the applicable codes and standards. Examples include, but are not limited to, those systems listed in Section 1.3.

A.7.3.1 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) Provision of a testing matrix checklist of integrated systems.
(6) Review of final testing and balancing (TAB) reports.
(7) Review of one line riser of emergency electric system.
(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.7.3.2 The following are examples of subsystems that can be interconnected in integrated systems:

(1) Fire alarm system
(2) ECS
(3) Building automation management system
(4) Means of egress systems and components
(5) Heating, ventilating, and air conditioning (HVAC) system
(6) Gas detection system

(7) Normal, emergency, and standby power systems
(8) Automatic sprinkler system
(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.7.3.3 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.7.3.5 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.7.4.3 Examples of the responsibilities of an ITa are as follows:

(1) Review the installation contractor requirements.
(2) Review the design and construction documents and specifications for each fire protection and life safety system and their associated subsystems.
(3) Develop the integrated systems testing plan.
(4) Document integrated test performance.
(5) Coordinate the scheduling of trades to perform integrated testing of systems and subsystems.

A.7.4.5 Refer to Annex C for sample forms. See also the sample matrix and form in Figure A.3.3.16(a) and Figure A.3.3.16(b).

A.8.1 Re-commissioning and retro-commissioning should be considered where expansions, improvements, or additions to existing structures require commissioning of the new fire protection and life safety systems in accordance with the commissioning process of Chapter 5 of this recommended practice. Integrated testing should be considered at intervals appropriate to the structure and systems present.

A.8.2.1 Re-commissioning should be conducted only if design or installation flaws or other operational issues are revealed through either the normal inspection, testing, and maintenance process or following a design review by a registered design professional. Re-commissioning might also be required by the AHJ if changes to the building structure have occurred such as expansions, improvements, or additions or the building occupancy have changed since the system was first placed into service. Re-commissioning is only performed on systems that were previously commissioned.

A.8.3.1 Retro-commissioning should be conducted only if design or installation flaws or other operational issues are revealed through either the normal inspection, testing, and maintenance process or following a design review by a registered design professional. Retro-commissioning might also be required by the AHJ if changes to the building structure have occurred such as expansions, improvements, or additions or the building occupancy have changed since the system was first placed into service. Retro-commissioning is only performed on systems that were not previously commissioned.

A.9.1 The forms shown in Annex C are examples of the documentation required by this recommended practice.

A.9.4 The documents should be maintained at the site, but this might not always be practical. If the test documents are kept somewhere other than on site, then the owner should be knowledgeable of the storage method and location of the records.

Annex B Sample Basis of Design Narrative Report

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

B.1 The narrative should be written in a three-section format including subsections as necessary (methodology, sequence of operation, and testing criteria sections) for clarity and should be limited to a summary. This annex presents a sample format for a narrative report.

B.2 Methodology Section.

B.2.1 Subsection 1: Description. This section should identify specific features of a building that contribute to the overall understanding of the fire protection and life safety systems and features to be provided as part of the design and construction, as follows:

(1) Building and/or structure use group classification in accordance with applicable building code of the jurisdiction
(2) Total aggregate square footage of building
(3) Building height
(4) Number of floors above grade
(5) Number of floors below grade
(6) Square footage per floor
(7) Type(s) of occupancies, hazard classifications, processes
(8) Type(s) of construction
(9) Hazardous material usage and storage
(10) Method of storage arrangements of commodities
(11) Site access arrangement for emergency response vehicles

B.2.2 Subsection 2: Applicable Laws, Regulations, Codes, Ordinances, and Standards. This section identifies regulatory requirements of the jurisdiction that have or can have an impact in the design and approval of fire protection and life safety systems. This section requires the preparer of the narrative to conduct a comprehensive regulatory research such as the following:

(1) Building code fire protection and life safety system requirements
(2) NFPA standards or other applicable recognized standards and edition used for design and or installation of each specific fire protection system
(3) Applicability of any special laws of the jurisdiction that can supersede a code or standard
(4) Applicability of local by-laws or ordinances of the jurisdiction
(5) Applicability of other codes such as plumbing, elevator, and electrical codes that can have an impact on the design, installation, and testing of the fire protection and life safety systems
(6) Applicability of any federal laws such as OSHA, ADA, or other governmental entity

B.2.3 Subsection 3: Design Responsibility for Fire Protection and Life Safety Systems. This section identifies the accountability (required by the jurisdiction) for a specific fire protection and life safety system design and the accountability for the integration of the fire protection systems constituting a building or structures fire protection and life safety system(s). There could be options permitted by the jurisdiction.

B.2.3.1 The RDP fully designs (complete layout and calculation) and specifies the fire protection and life safety system or systems to be installed, reviews and approves the installing contractor's shop drawings, and certifies system installation(s) for code compliance at completion. There could be multiple RDP associated with a project and should be identified as appropriate.

B.2.3.2 The RDP provides a partial design and specifies the design criteria to be used by the installing contractor(s), who finalizes the system layout and provides calculations to confirm the design criteria. The RDP certifies system installation for code compliance at completion.

B.2.3.3 At design-build, the installing contractor for a specific fire protection and life safety system completely designs and specifies if permitted by the governmental jurisdiction (develops a full system layout, design criteria, and calculations), installs the system, and certifies system installation for regulatory and applicable standard compliance at completion. There can be a RDP involved but not necessarily.

B.2.3.4 Whichever method from B.2.3.1 through B.2.3.3 is selected, the project requires a qualified person to assume responsibility for the coordination of fire protection and life safety systems requiring integration, forming an entire building fire protection and life safety system.

B.2.4 Subsection 4: Fire Protection and Life Safety Systems to be Installed. This section should identify key performance design criteria and features for each specific fire protection system, as follows:

(1) Water supply system such as municipal or private systems, fire mains and hydrants, storage tanks, and fire pumps
(2) Automatic sprinkler systems, such as wet, dry, pre-action
(3) Standpipe systems, such as wet, dry, and classification
(4) Fire alarm systems, such as manual, automatic detection, evacuation signals
(5) Automatic fire extinguishing systems, such as dry chemical, clean agent
(6) Manual suppression systems
(7) Smoke control/management systems, such as automatic smoke exhaust, stair pressurization
(8) Commercial cooking equipment and exhaust system fire suppression system(s), such as wet chemical or automatic sprinklers
(9) Emergency power systems, such as applicability to fire protection and life safety systems
(10) Hazardous material and process protection, special protection
(11) System supervision, such as method of 24-hour monitoring conditions of fire protection and life safety systems
(12) Passive systems including doors, walls, floors, ceilings, and roof decks

The description (specific features) for the fire protection systems listed above should also indicate if the system(s) are as follows:

(1) Required by laws, codes, standards, ordinance, and so forth
(2) Non-required, building owner provides voluntarily and/or requirement of insurance entity
(3) A complete new system
(4) An addition or expansion to existing system
(5) A modification/repair to existing system
(6) Level of protection to be provided, 100 percent or partial protection or exempt by regulatory code

B.2.5 Subsection 5: Consideration Used in the Design Methodology. This section identifies the designer's intent in the overall design and criteria development of the fire protection and life safety systems, as follows:

(1) Building occupant notification and evacuation procedures
(2) Emergency response personnel, site, and systems features
(3) Safeguards, fire prevention, and emergency procedures during new construction and impairment plans associated with new and/or existing system modifications
(4) Method for future testing and maintenance of systems and documentation
(5) Special requirements or request of the authority having jurisdiction

B.2.6 Subsection 6: Alternatives. This section identifies the designer's intent to deviate from prescriptive requirements of regulatory codes and standards with alternative methods, as follows:

(1) Application of performance-based design in lieu of prescriptive code requirement
(2) Interpretation/clarification between designer and authority having jurisdiction
(3) Waiver or variance sought and or required by the authority having jurisdiction through the regulatory appeal process

B.3 Sequence of Operation Section. This portion of the narrative is generally a difficult section to write as it entails the specific operation of the fire protection and life safety systems, system devices, and equipment and their related integration, depending on the complexity of the systems installed. The preparer of the narrative should have an overall understanding and knowledge of how all the fire protection and life safety systems should function when integrated together.

B.3.1 Subsection 1. The operational description should include the following:

(1) An operational description of either a system or specific devices within a system and the resulting action associated with the operation of the system or specific devices should be provided.
(2) The operational description should include all interconnected (integrated) fire protection and life safety systems and devices required or non-required forming an entire building fire protection and life safety system.
(3) All signage indicating equipment location, operational and design features, and certified documents attesting to system installation integrity should be provided.
(4) The narrative sequence of operation description should be specifically coordinated with the input and output sequence of operation developed for the systems operation.

This section of the narrative report can be brief as in a simple system such as a one-story, 15,000 ft^2 mercantile building with only a sprinkler system and manual fire alarm pull boxes, notification devices, and system supervision, or complex, such as in a 25-story high-rise with fire pumps, emergency generator, fire alarm and sprinkler zones, automatic standpipes, automatic voice and manual evacuation signals, smoke management system, automatic elevator recall, special extinguishing systems, remote annunciation, automatic locking devices, alarm retransmission methods, and emergency response procedures.

The sequence of operation of a building fire protection and life safety system, particularly with complicated systems, must be reviewed and understood by the building owner, the AHJ, and

the entities responsible for installation (generally the fire alarm and building automated systems programming technicians) and future testing and maintenance after the building has been issued a certificate of occupancy. A team approach should be used by developers, designers, equipment suppliers, and contractors including the AHJ (more specifically emergency response personnel, such as the local fire department) to clearly describe and understand the proper operation and use of the integrated fire protection and life safety systems.

When a complex system is proposed, the initial narrative report of the sequence of operation should be viewed as a draft. At various stages of system installation(s), modifications could be made due to design changes, equipment changes, new technology availability, and/or changes to codes and standards that would require system modifications. The preparer of the narrative should be familiar with any and all changes to the systems and submit a final accurate narrative for approval and/or acceptance by the AHJ, building owner, and other entities prior to witnessing system(s) operational acceptance and commissioning testing.

Communication between the building owner, designers, builders, and the AHJ is an important element particularly in this phase, as the codes and the standards tend to be flexible and interpretative relative to sequences of operation of the integrated fire protection and life safety systems.

B.4 Testing Criteria Section. This section of the narrative report should be broken down into three sections, B.4.1, B.4.2, and B.4.3.

B.4.1 Subsection 1: Testing Criteria. This section identifies the individual in charge who will coordinate the final acceptance testing and witnessing by the authority having jurisdiction, as follows:

(1) Identification of qualified person(s) in charge (should be the FCxA and/or multiple agents if applicable) for setting up and coordinating all prefunctional testing and final testing.
(2) Method of verification and confirmation by the qualified person(s) in charge that all fire protection systems, equipment, and devices have been individually tested and tested as an entire system when specific systems are integrated to form a building fire protection and life safety system.
(3) Method of coordination by qualified person in charge of all designers, contractors, equipment distributors, owners' representatives, and the AHJ required to perform and/or witness all testing, testing dates and times, notification to public utilities, and personnel required to perform all required testing as a system or individual system component testing.

B.4.2 Subsection 2: Equipment and Tools. This section will identify the necessary equipment available on site at time of witnessing the operational features and/or integrated performance of the fire protection and life safety systems that require validation by the owner and/or the AHJ to expedite the acceptance and commissioning testing, as follows:

(1) Identification of equipment, documents, and procedures to be used to verify system performance and confirm design methodology and specifications, code and standards compliance, and accuracy of fire protection and life safety system(s) sequence of operation.
(2) Examples include but are not limited to the following:
    (a) Manufacturer's instructions
    (b) Specification instructions
    (c) Requirements of the AHJ
    (d) Narrative, sequence of operation section
    (e) Smoke machines, smoke candles
    (f) Sound meters
    (g) Fire hoses, nozzles
    (h) Flow measuring devices
    (i) Gauges
    (j) Air balancing and air measuring meters
    (k) Door force closing and opening measuring devices
    (l) Voltage meters
    (m) Magnets
    (n) Communication radios
    (o) Fire department equipment
    (p) Special tools, keys
    (q) Ladders
    (r) Safety equipment
    (s) Notifications announcements
    (t) Signs
    (u) Charts, forms, checklist, logs
    (v) Acceptance test forms

B.4.3 Subsection 3: Approval Requirements. This section identifies all the closeout documents required by the owner and the AHJ as part of the overall commissioning process, as follows:

(1) Identify method of approval (acceptance) required (verbal or written) from the owner and the AHJ if system satisfied all applicable code and standards compliance requirements
(2) Identify method of remedial action when a system or portion of a system fails to operate as specified and or as required by codes and standards or the sequence of operations
(3) Documentation to be submitted at completion verifying that systems are in compliance with all applicable codes and standards, requirements of the AHJ, narrative, design and specifications, and sequence of operations
(4) Documentation to be submitted to the AHJ listing names, addresses, and telephone numbers of personnel for emergency notification

Annex C Sample Commissioning Documentation

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

C.1 The forms listed in this annex are recommended as useful tools to document critical path activities related to systems commissioning and project management. It is not the intent of this recommended practice to mandate the use of these forms. The user is encouraged to modify the forms or use other documentation to capture and document pertinent commissioning-related activities.

C.1.1 Basis of Design. Figure C.1.1 can be used to capture the OPR as recommended by 5.2.3.

C.1.2 Equipment Scope and Responsible Parties. Figure C.1.2 is intended to identify the area and application of each fire and life safety system. The form can be used in conjunction with the BOD.

C.1.3 Project Schedule. The project schedule can be any adaptation of a spreadsheet. The example shown in Figure C.1.3 should be modified to suit the specific parameters of each project.

C.1.4 Project Management Forms. Figure C.1.4(a) through Figure C.1.4(i) are examples of project management documentation that should be used on most projects where commissioning is required. Any adaptation of these forms should be permitted to document appropriate commissioning activities.

BASIS OF DESIGN

Project name _____

Contract number _____

BUILDING

Intended use _____

Construction type(s) _____

Building height _____ Total area (ft^2) _____

Number of floors above grade _____ Number of floors below grade _____

Area per floor (ft^2) _____

DESCRIPTION OF OCCUPANCIES OR HAZARDS WITHIN BUILDING

DESIGN CODES *(Indicate editions.)*

SITE ACCESS FOR EMERGENCIES *(Include changes during construction stages.)*

RESOURCES FOR FIRE FIGHTING *(List when available during construction stages.)*

SPECIAL CONSIDERATIONS

FIGURE C.1.1 Sample Basis of Design.

EQUIPMENT SCOPE AND RESPONSIBLE PARTIES

Equipment	Required (Y/N)	Area Protected	New, Addition, or Modification	Design	Plan Review	Installation	Acceptance
				(List responsible party and specific codes, standards, laws, and regulations applicable for each stage from design to acceptance.)			
Fire alarm							
Water-based sprinkler systems							
Standpipe and hose systems							
Water spray fixed systems							
Foam water systems							
Water mist systems							
Wet chemical systems							
Dry chemical systems							
Inert gas systems							
Low expansion foam systems							
Private fire service mains							
Private hydrants							
Water tanks							
Stationary pumps for fire protection							
Smoke-control systems							
Emergency power systems							
Other							
Other							

FIGURE C.1.2 Equipment Scope and Responsible Parties.

PROJECT SCHEDULE

Project name ______________________ Contract number ____________________ Date _________

Building System						

D = Design A = Approval F = Fabrication I = Installation

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FIGURE C.1.3 Sample Project Schedule.

COMMISSIONING SUBMITTAL / APPROVAL

Project: _____ Submittal No.: _____
❑ New ❑ Resubmittal

From (initially): _____ To: _____

Equipment / system name: ID #:

_____ _____ Cx Section No: _____

_____ _____

_____ _____

Submittal Type:

❑ Documentation (describe): _____

_____

❑ Functional test procedure forms: _____

❑ Completed functional test procedure record or report: _____

❑ Prefunctional checklist: _____

❑ Startup and initial checkout forms: _____

❑ Completed startup documentation or report: _____

Submissions / Returns

Path	To: _____ From (initially): _____	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____
Comments by submitter	❑ Notes attached	❑ Notes attached	❑ Notes attached	❑ Notes attached	❑ Notes attached
Copies					
Submitter signature					
Title					
Date					
Code					

Submitting Codes:
I = Initial submittal: The attached submittal has been reviewed, and the equipment, documents, or performance represented comply with the correct documents.
A = Approved as complying with the contract documents.
C = Note corrections. Approved, but need to resubmit for the record, after correcting.
NA = Not acceptable. Resubmittal required for review.

FIGURE C.1.4(a) Commissioning Submittal/Approval.

SEQUENCES OF OPERATION AND FUNCTIONAL TEST PROCEDURES SUBMITTAL

Project: _____ Submittal No: _____

❑ New ❑ Resubmittal

From (initially): _____ To (initially): _____

Equipment / System tag and name: _____

Included:

❑ Sequences of operation (enlarged from original control drawings and specification documents)

❑ Functional test procedures and forms

Submissions / Returns

The following checked individuals will receive these documents for review and/or approval:

Party	For review and comment only	For review and approval	For record only
General contractor	❑	❑	❑
Mechanical contractor	❑	❑	❑
Electrical contractor	❑	❑	❑
Controls contractor	❑	❑	❑
Construction manager	❑	❑	❑
Owner's representative	❑	❑	❑
AHJ	❑	❑	❑

Path	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____
Comments by submitter	See Key (1) ❑ Notes attached	See Key (1) ❑ Notes attached	See Key (1) ❑ Notes attached	See Key (1) ❑ Notes attached	See Key (1) ❑ Notes attached
Copies					
Submitter signature					
Title					
Date					
Review code					

Key: (1) Review and comment on the sequences and/or test procedures as to their compliance with the specs.
(2) Check tests for personnel safety and to keep equipment warranty in force.

Review Codes:
AM = Approved by mechanical contractor (or electrical contractor) as complying with the contract documents. Tests will not void warranty or damage equipment and do not present unsafe conditions for personnel.
AC = Approved by controls contractor as complying with the contract documents.
AE = Approved by the design engineer as complying with the contract documents.
NC = Note corrections. Approved, but need to resubmit for the record, after correcting.
NA = Not acceptable. Resubmittal required for review.

Abbreviations: CA = commissioning agent/authority, CM = construction manager, GC = general contractor's rep., A/E = architect or engineer of record, Sub = responsible subcontractor or vendor

FIGURE C.1.4(b) Sequence of Operation and Functional Test Procedures Submittal.

COMMISSIONING TEST OR DOCUMENT APPROVAL

Project: _____ To: _____

From: _____

❑ Completed functional test approval

Equipment/System name: _____ Equipment tag: _____

Functional test description: _____

_____

❑ Document review

Document name and ID: _____

Review description: _____

_____

The test(s) of the above equipment or the review of the referenced document(s) have been completed and performance of the component, system, or documents complies with the acceptance criteria in the testing or document requirements of the Specifications and Contract Documents, subject to the changes being made as listed below or on an attached sheet.

_____ Sheets attached

A copy of the completed test or document review is attached. ❑ Yes ❑ No

Commissioning Agent Approval:

_____ _____

Commissioning Agent Date

Construction Manager Approval:

The test or review results relating to the above equipment has been reviewed and approved as complying with the contract documents.

_____ _____

Construction Manager Date

Exclusions:

_____

_____

_____

_____

_____

cc:

FIGURE C.1.4(c) Cx Test or Document Approval.

COMMISSIONING PROGRESS REPORT

Project: _____ Date: _____

Prepared by: _____ Reporting period: _____ Report #: _____

Commissioning tasks worked on since last report and general progress: _____

Areas where schedule is not being met: _____

Recommended actions: _____

Requested schedule adjustments: _____

Next steps: _____

Other comments (include general comments and field notes): _____

Issues log attached. ❑ Yes ❑ No

_____
Commissioning Agent

FIGURE C.1.4(d) Cx Progress Report.