Southern California SFPE Symposium
October 25, 2022

Understanding Commissioning and System Acceptance Testing

Jack Poole, PE, FSFPE
Poole Fire Protection, Inc.
jpoole@poolefire.com
913-747-2050

Introduction

- **Jack Poole, PE, FSFPE**
- Graduate from Univ. of MD., BS in FPE (1986)
- Poole Fire Protection – Est. in 1991
- Licensed FPE in 49 States and 2 Territories
- SFPE Fellow, and Past President of the BOD
- Member of NFPA Standards Council
- Chair of NFPA 72 SIG-PRO and NFPA 520 Tech. Comm.
- Member of multiple other NFPA TC's including NFPA 3 & 4
- Chair of UMD FPE Board of Visitors
- Past Chair of OSU FPSET Industrial Advisory Board
- 36 Years of Fire Protection Engineering Experience

A few words from the Immediate Past President …

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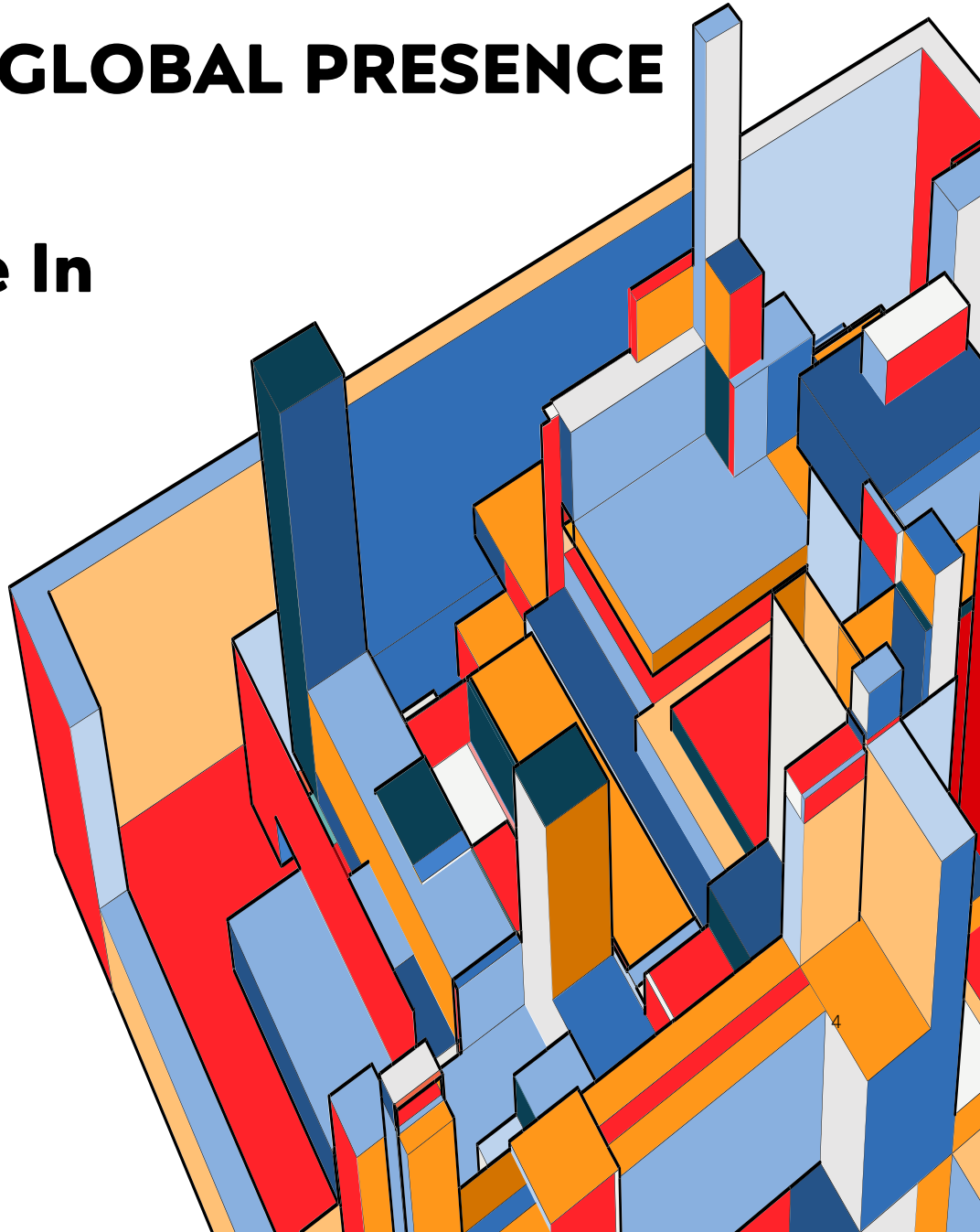

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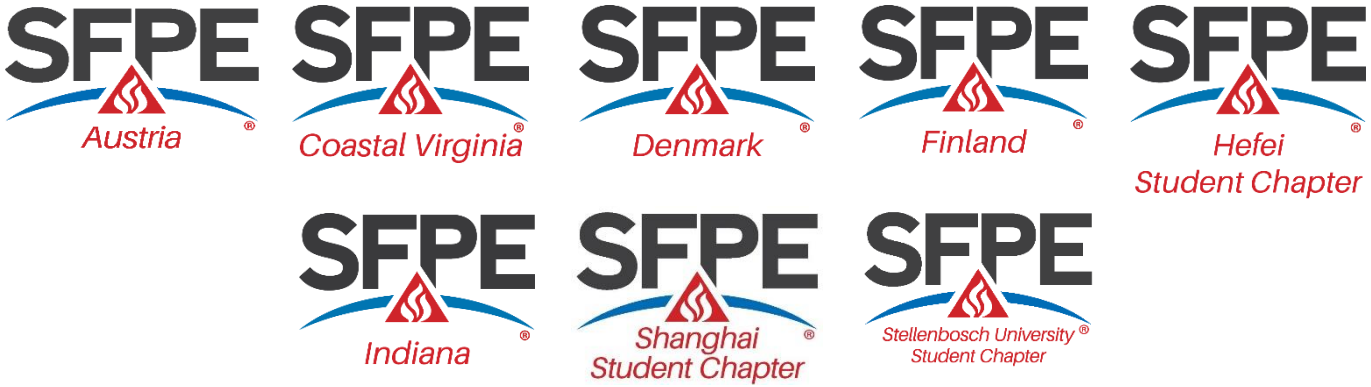

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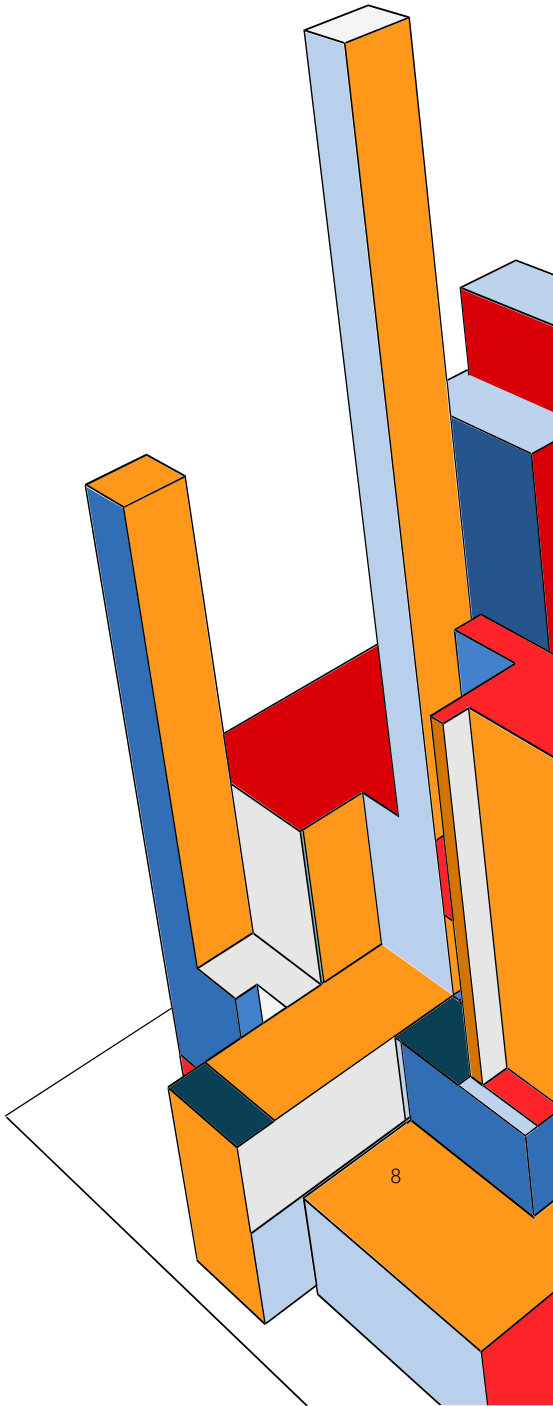

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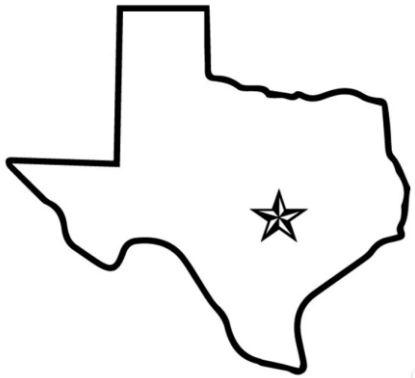

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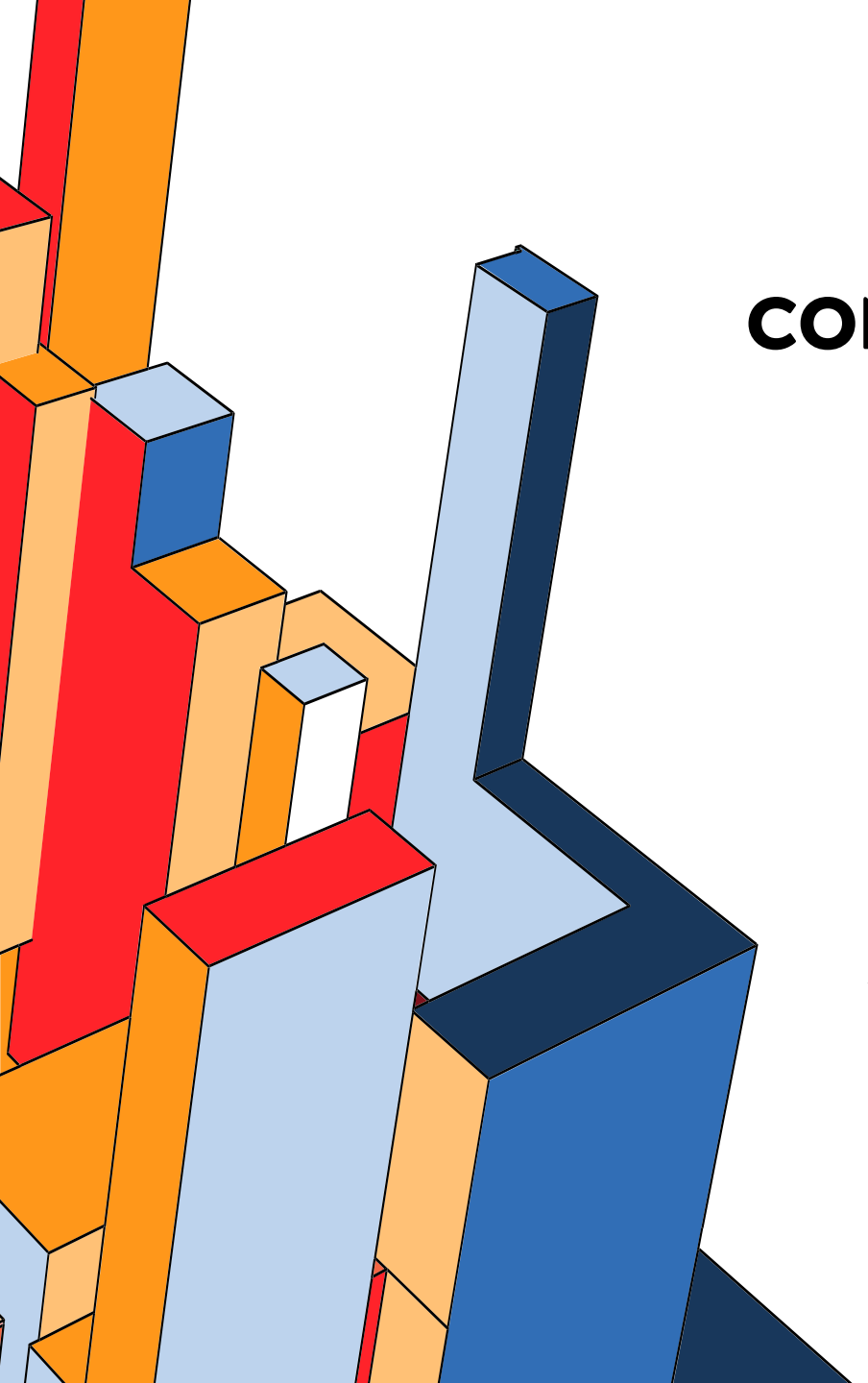

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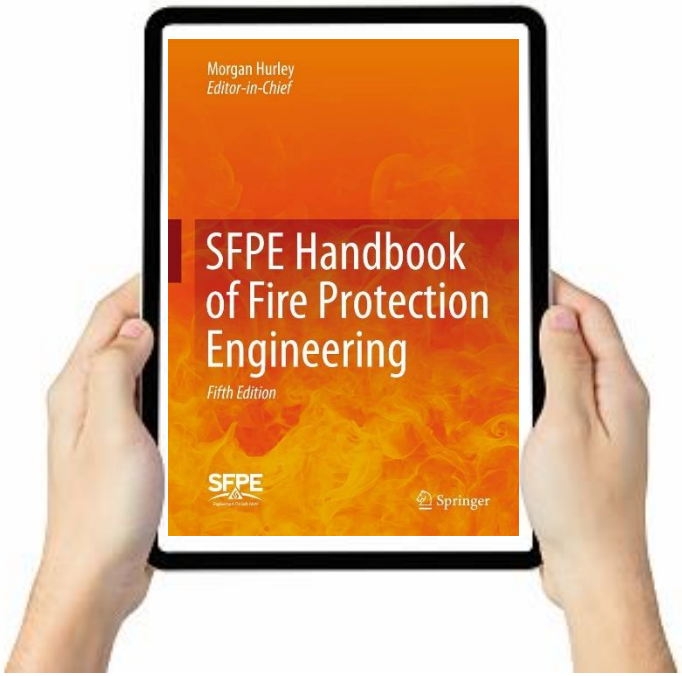
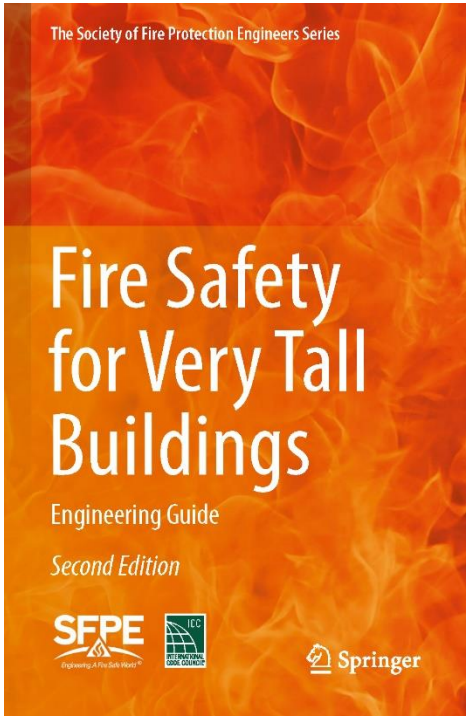
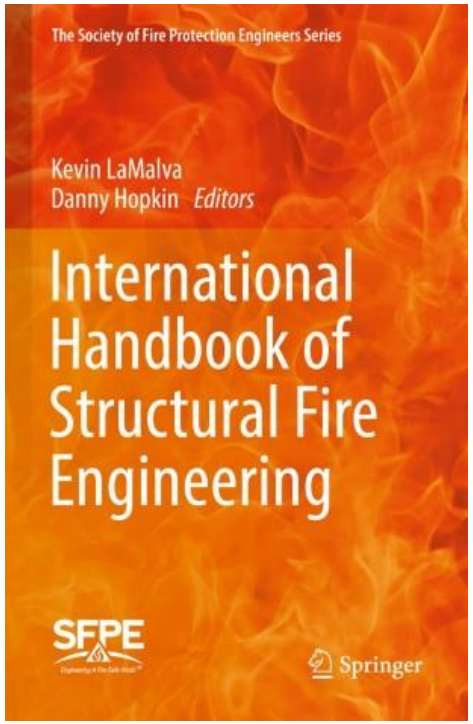
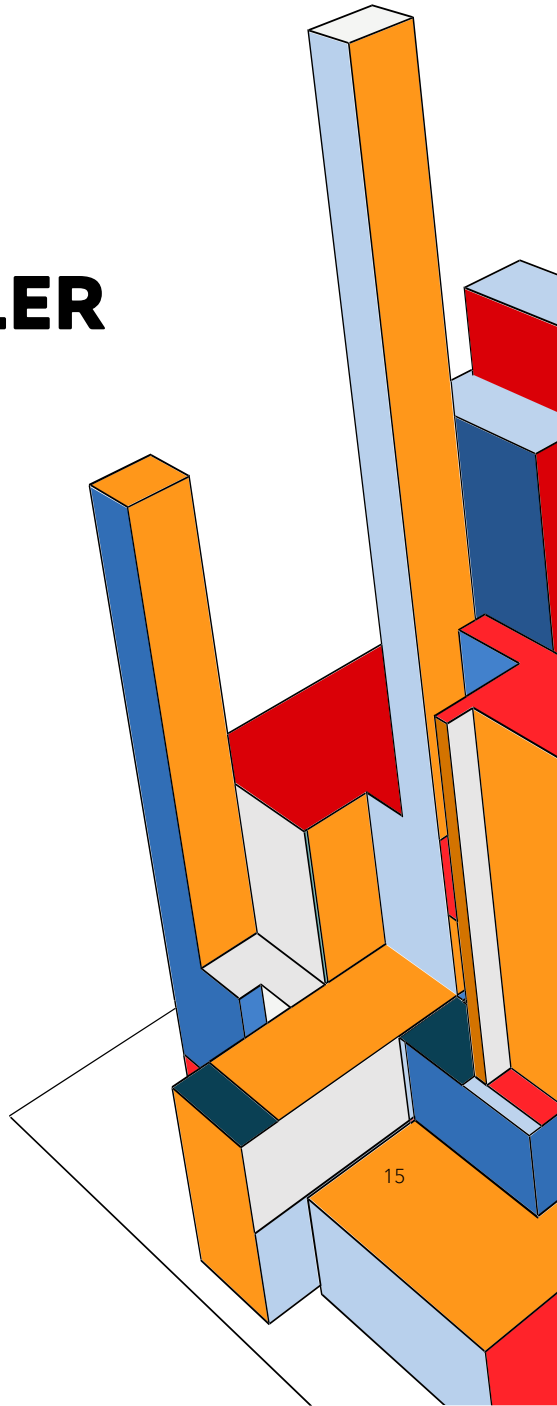


NEW HANDBOOK & A BEST SELLER







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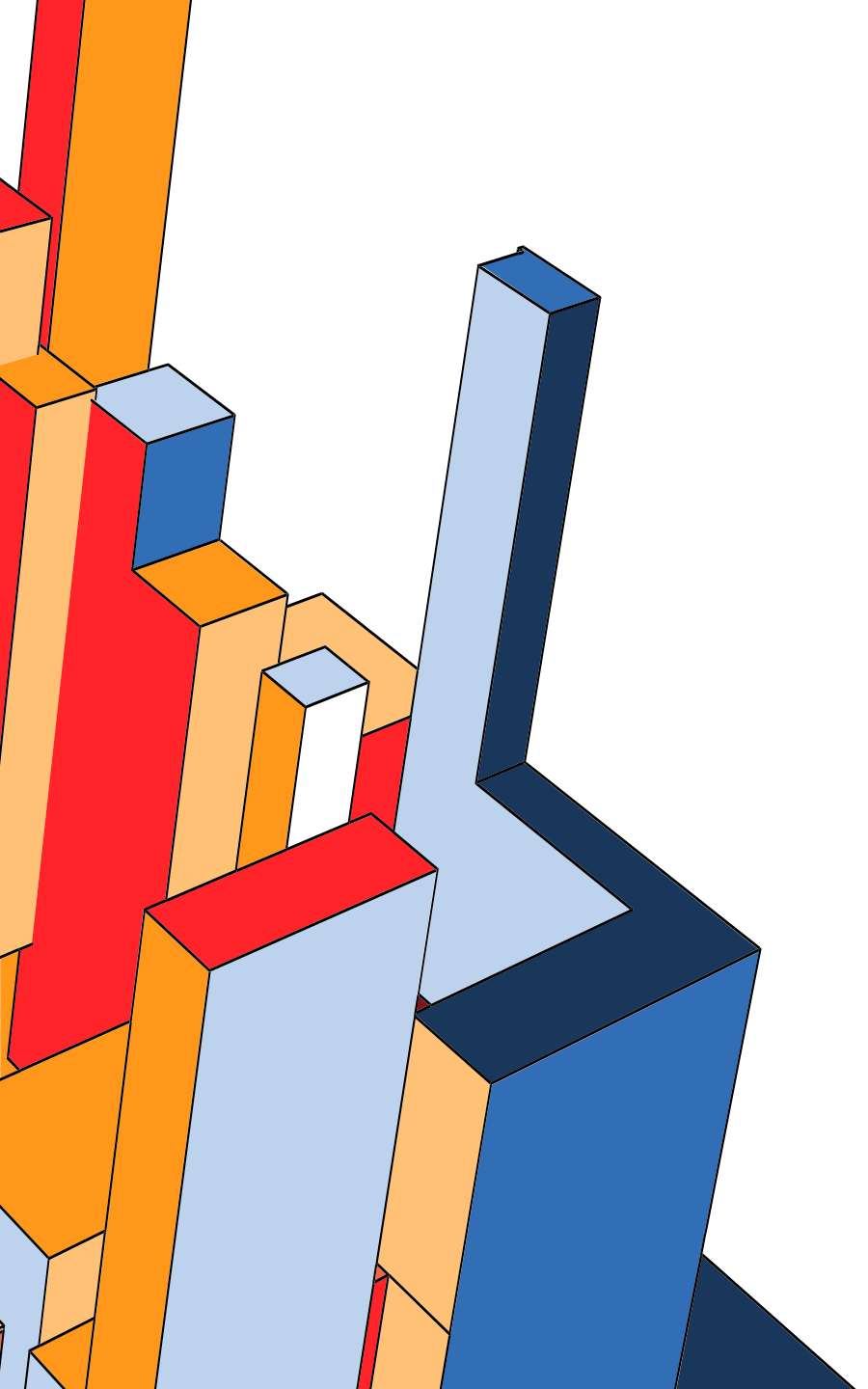

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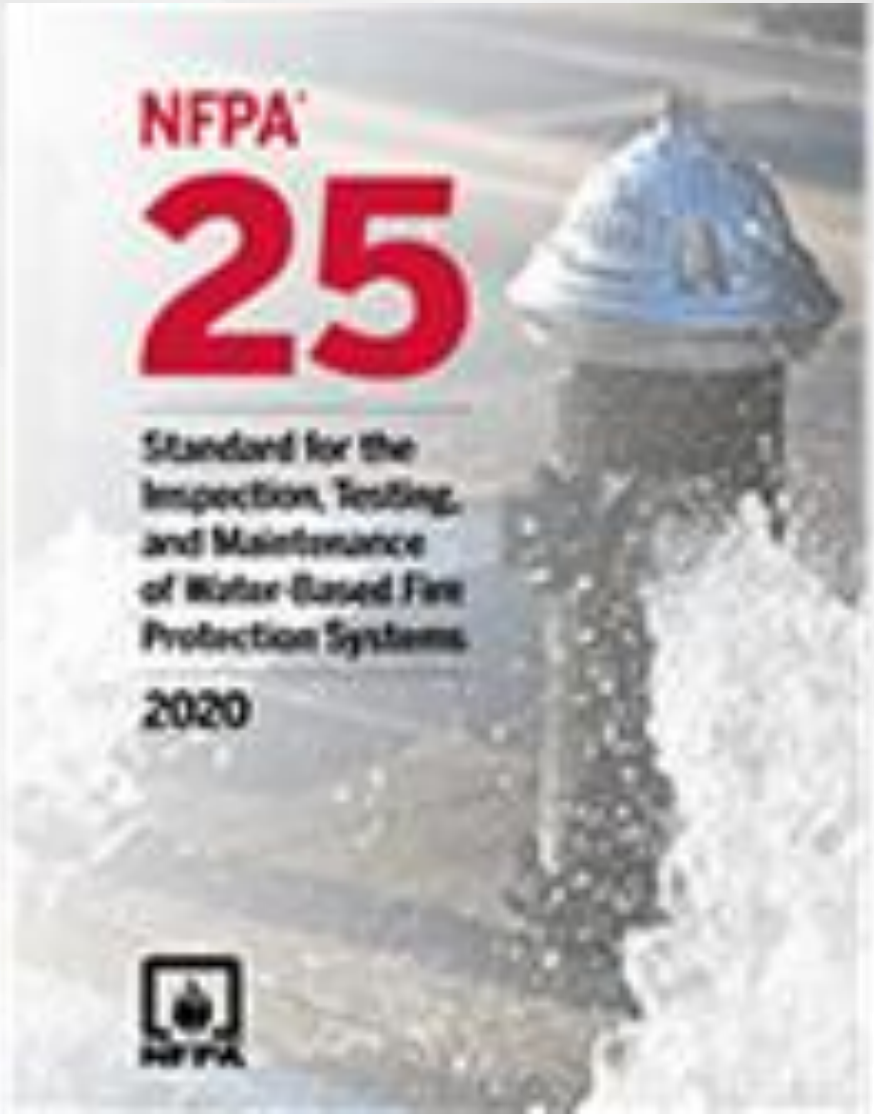
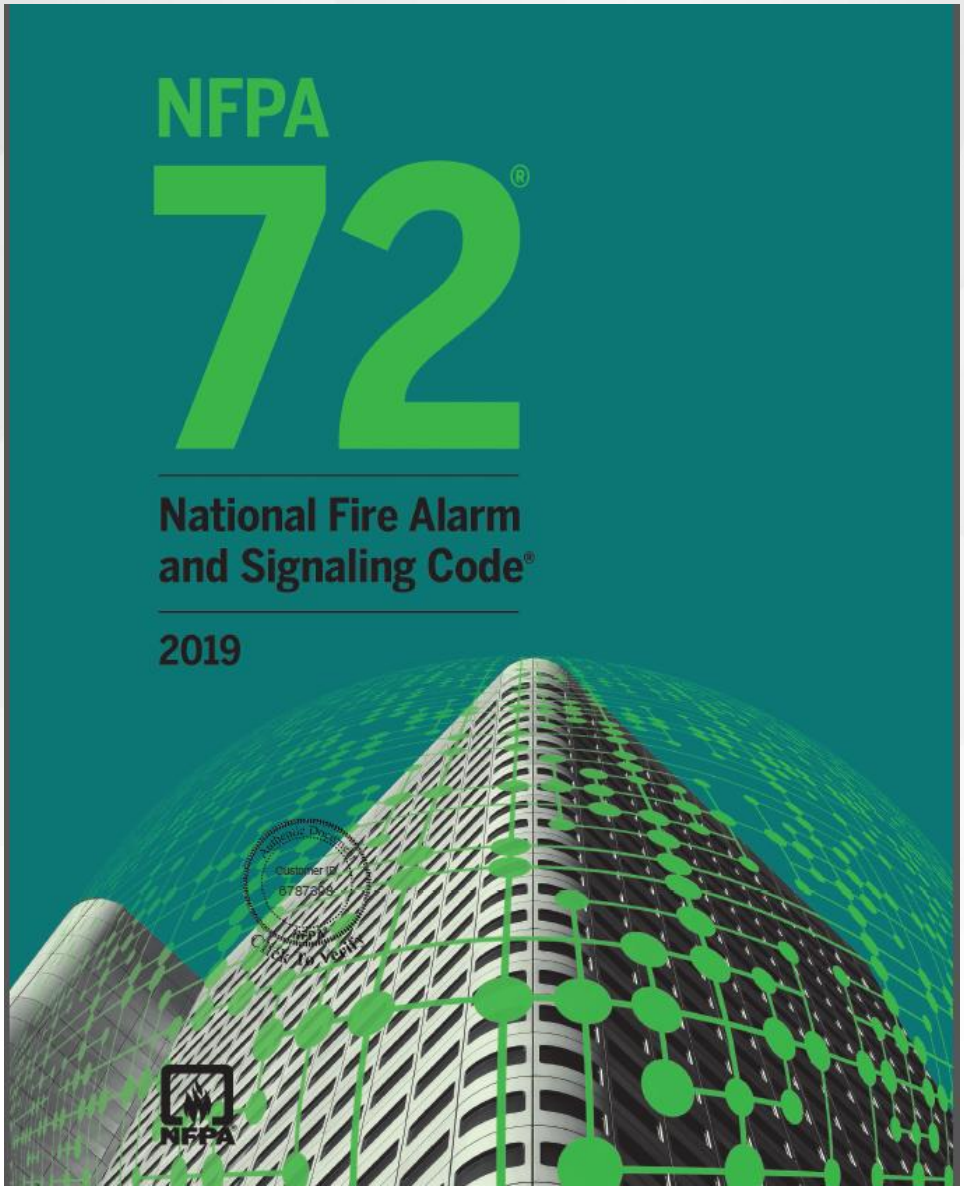
Presentation Outline

- What is Acceptance Testing?
- What is Integrated FP/LS System Testing?
- What is Commissioning?
- Why do we do any of this?
- Cx Team
- Cx Plan
- Testing to Be Performed
- Documentation Requirements

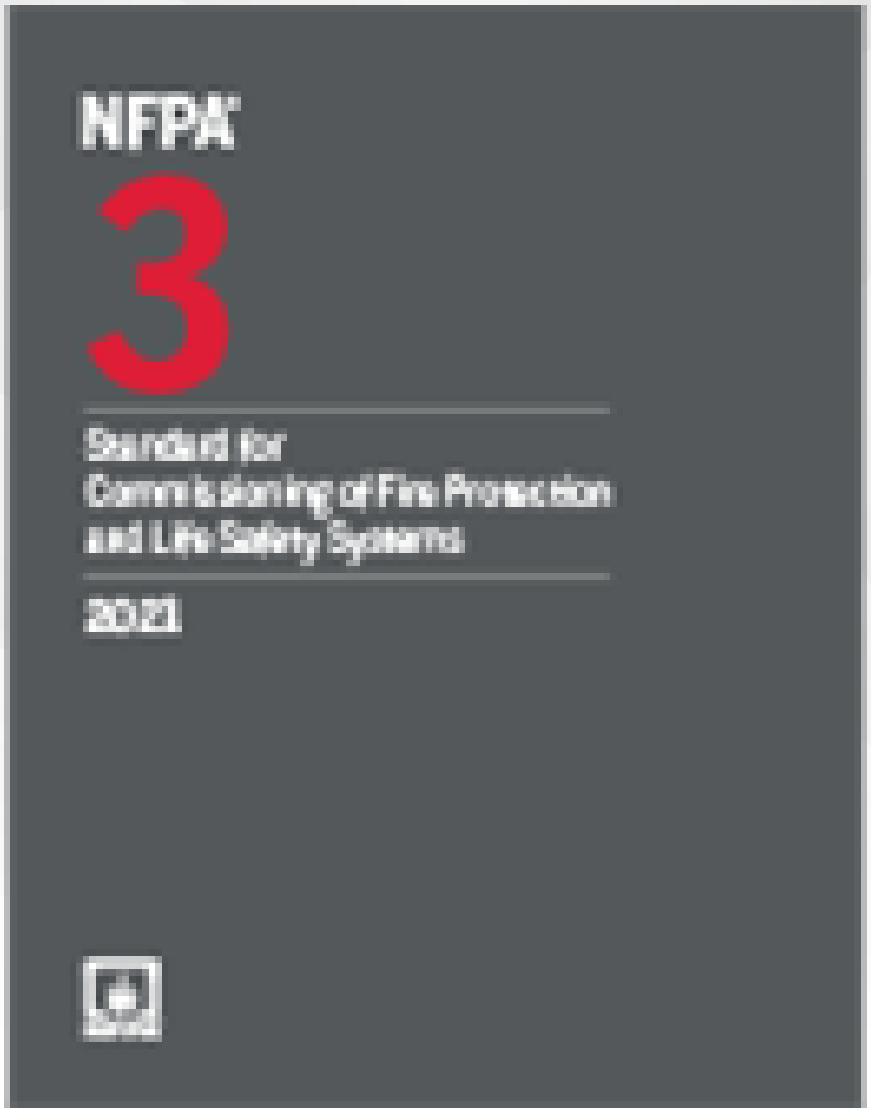
NFPA 25 – ITM of Water-Based Systems



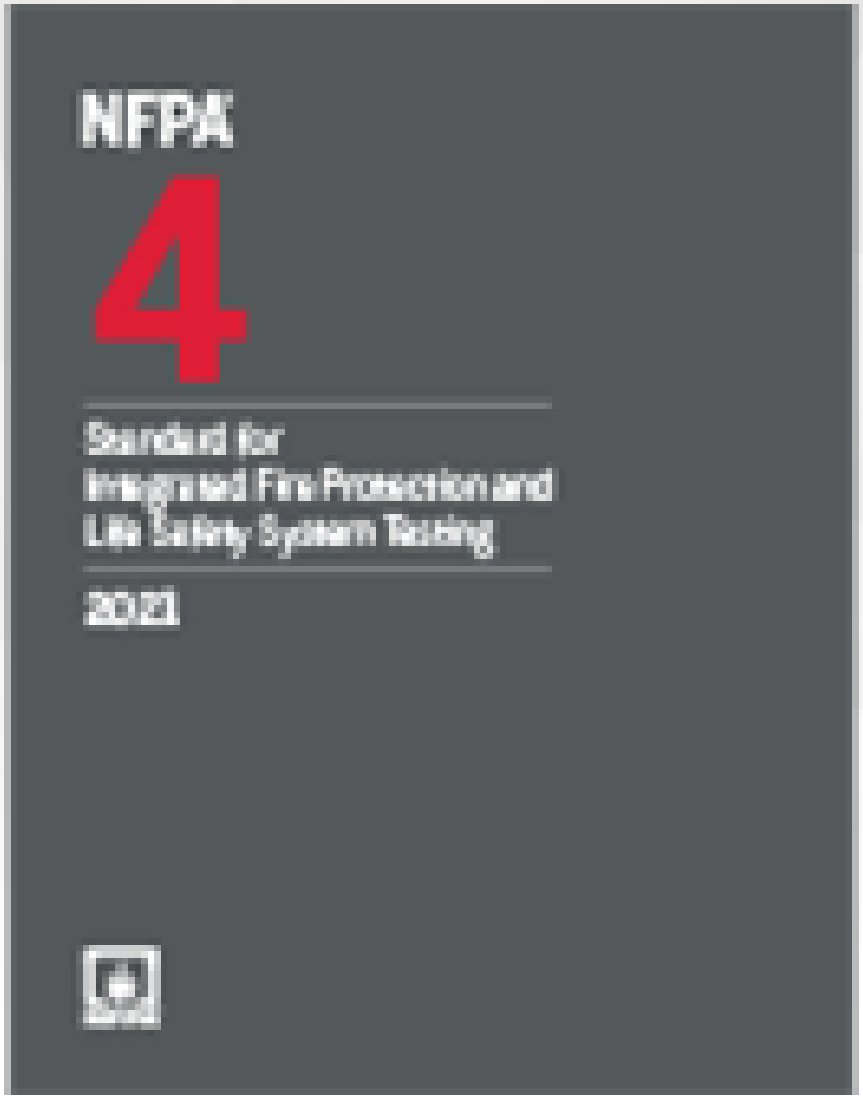
National Fire Alarm & Signaling Code



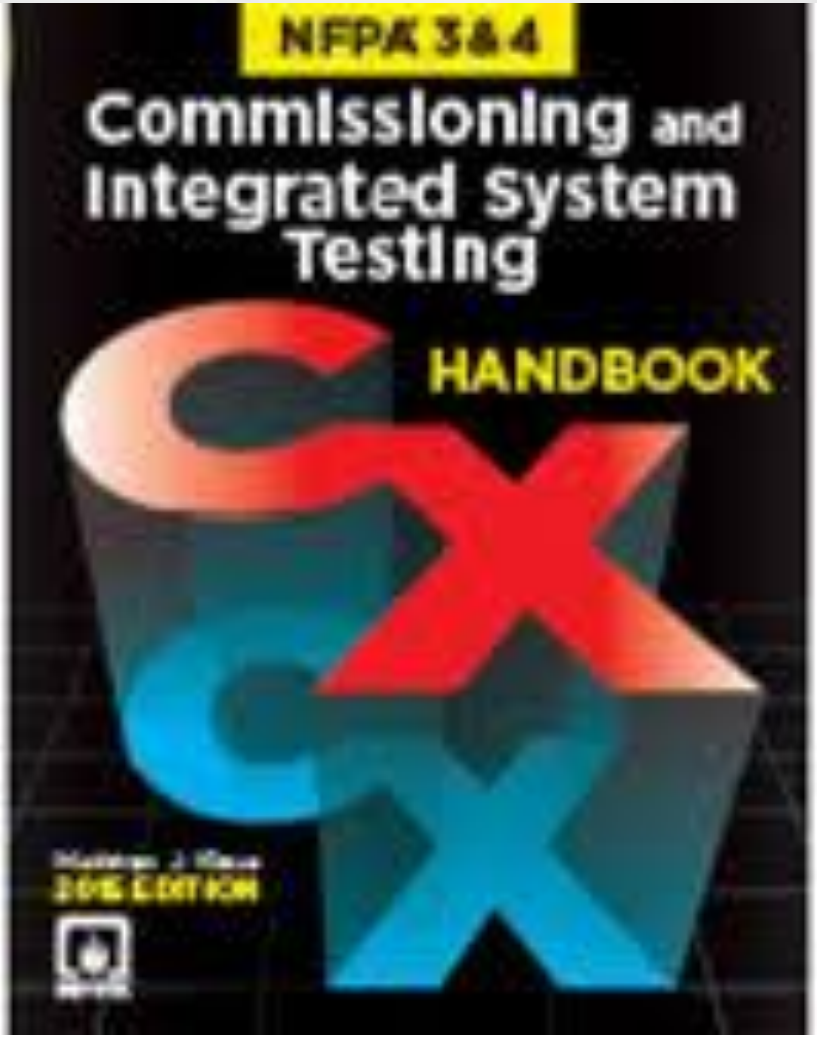
Commissioning of FP & LS Systems



Integrated FP & LS Testing



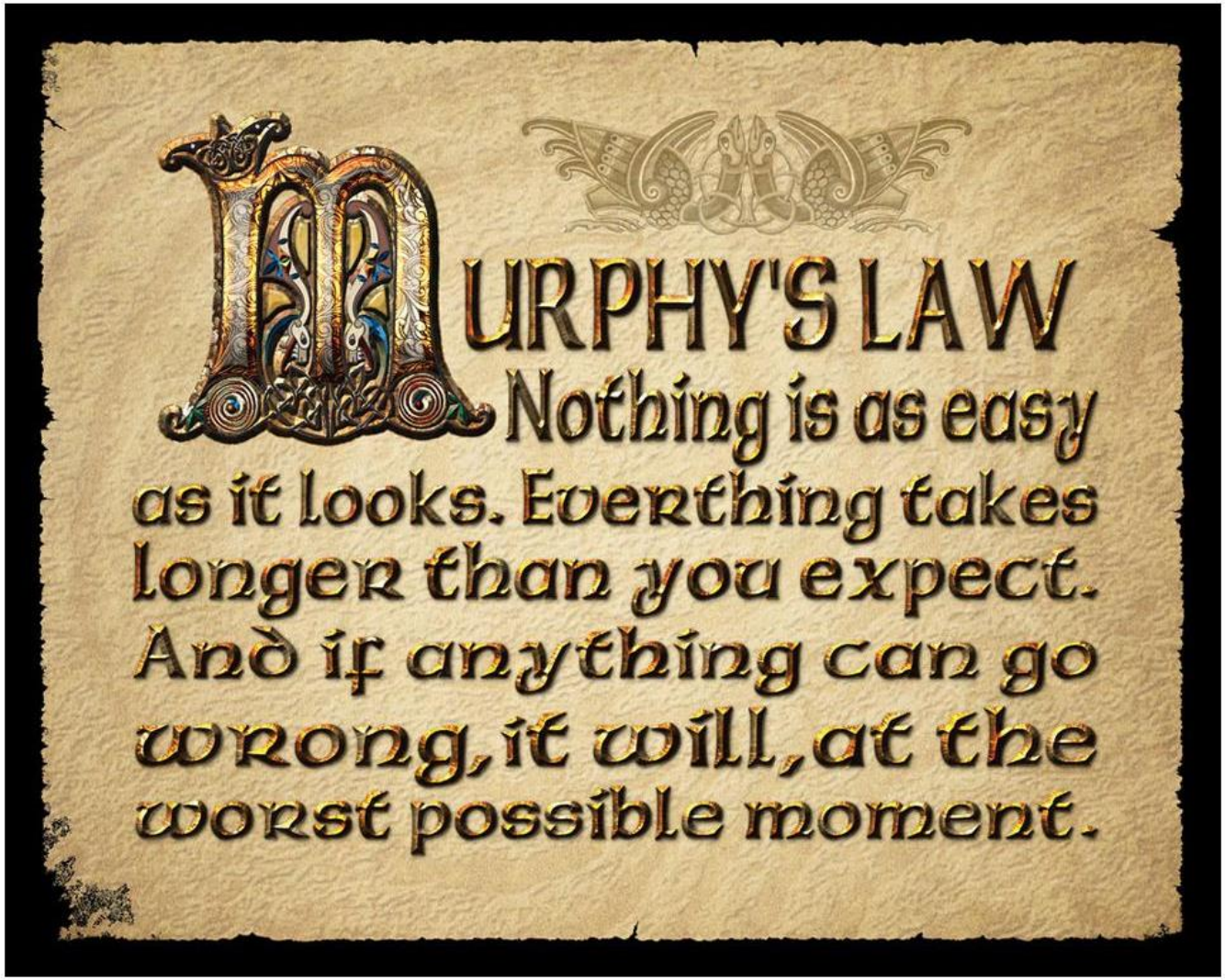
The Handbook



What kind of systems and equipment are we talking about?

- Two Categories
  - Fire Protection
    - Automatic Sprinkler Systems
    - Water Supply – Tanks, Pumps, …
    - Alarm, Detection & Evacuation System
    - Special Hazard Systems (Foam, CO_2, Clean Agent), etc.
  - Life Safety
    - Emergency Exits
    - Emergency Lighting
    - Door Closers
    - Stairway Pressurization
    - Smoke Control Systems

"Murphy's Law ....


MURPHY'S LAW
Nothing is as easy as it looks. Everything takes longer than you expect. And if anything can go wrong, it will, at the worst possible moment.

Inspection, Testing & Maintenance (ITM)……WHY???

Purpose

- To provide requirements that ensure a reasonable degree of protection for life safety and property through minimum ITM methods

Why do we do testing and/or commissioning?

- Testing - Measures taken to VALIDATE the quality, performance, and reliability of an installed system.
- Verify System Operation
- Reduce our Liability

What Is Acceptance Testing?

- **3.3.23.1 Acceptance Testing:** Testing performed on an individual system to verify compliance with approved design documents and to verify installation in accordance with governing laws, regulations, codes, and standards.
- **3.3.23.2 Integrated Systems Testing:** Test performed on fire protection and life safety systems to confirm that operation, interaction, and coordination of multiple individual systems perform their intended function.
- **3.3.3.1 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 governing laws, regulations, codes, and standards.

Accomplishing Acceptance Testing

- Basically - Single System Testing
- Verify that installation is in accordance with drawings
- Inspect overall installation
- Perform prefunctional testing to ensure interoperability
- Perform and document testing of all systems as required by applicable NFPA Codes & Standards
- Update project requirements and address any issues
- Issue completion/acceptance report
- Verify compliance and accuracy of sequence of operation

Integrated Testing (NFPA 4)

- NFPA 4 is intended to provide the minimum requirements for testing of integrated FP-LS Systems where such testing is required by the design documents, commissioning plan, governing laws, codes, regulations, or standards.
- Shall verify the proper operation and function of all interconnected FP-LS Systems.
- Testing the connections between systems.
- If A happens in System 1, B should happen in System 2.
- Integrated testing should demonstrate that the final integrated system installation complies with the specific design objectives for the project and applicable codes and standards.
- Written documentation of the testing and inspection should be provided.

Integrated Testing Overview

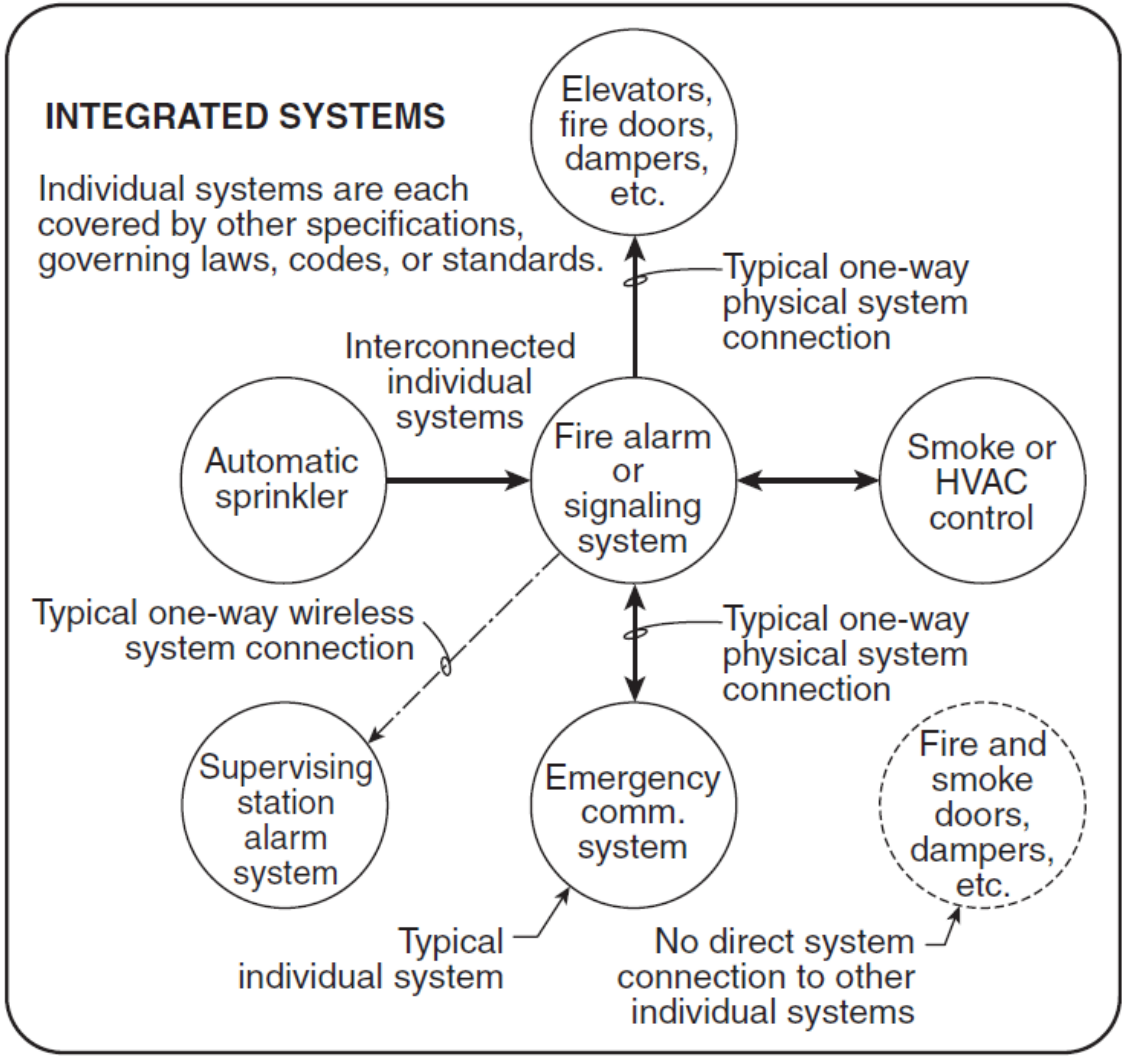


FIGURE A.3.3.21.1 Integrated Systems.

How Cx Is Accomplished

- **A.3.3.3.6 FP-LS Systems 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, operation and maintenance manual documentation verification, and the training of operating personnel.

What Commissioning Isn't

Commissioning ≠ Integrated Testing

Commissioning ≠ Acceptance Testing

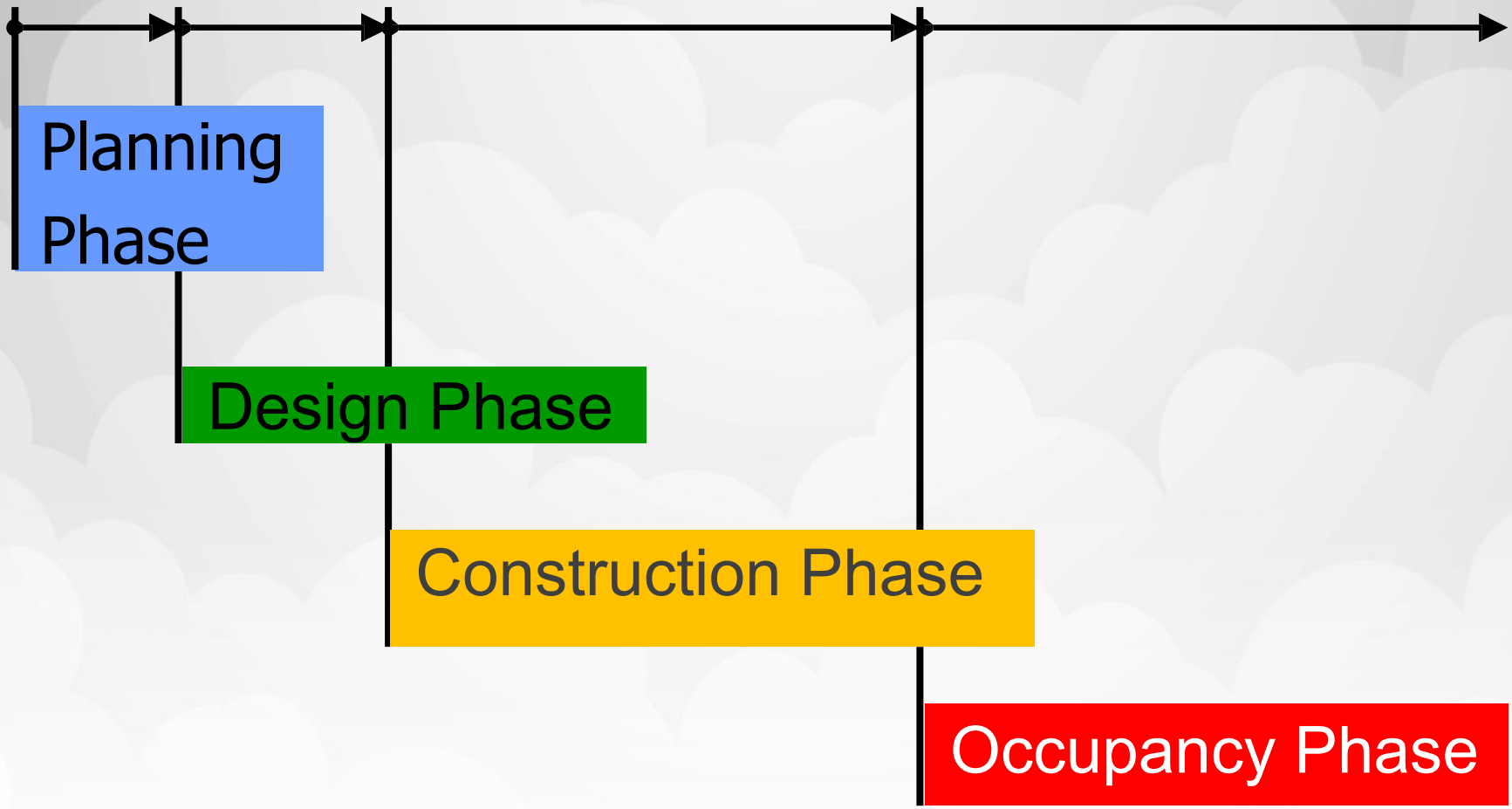
Commissioning – Remember?

- Systematic process
- Documented confirmation that systems function per design criteria
- Satisfy the owner's operational needs
- Compliance with applicable laws, regulations, codes and standards

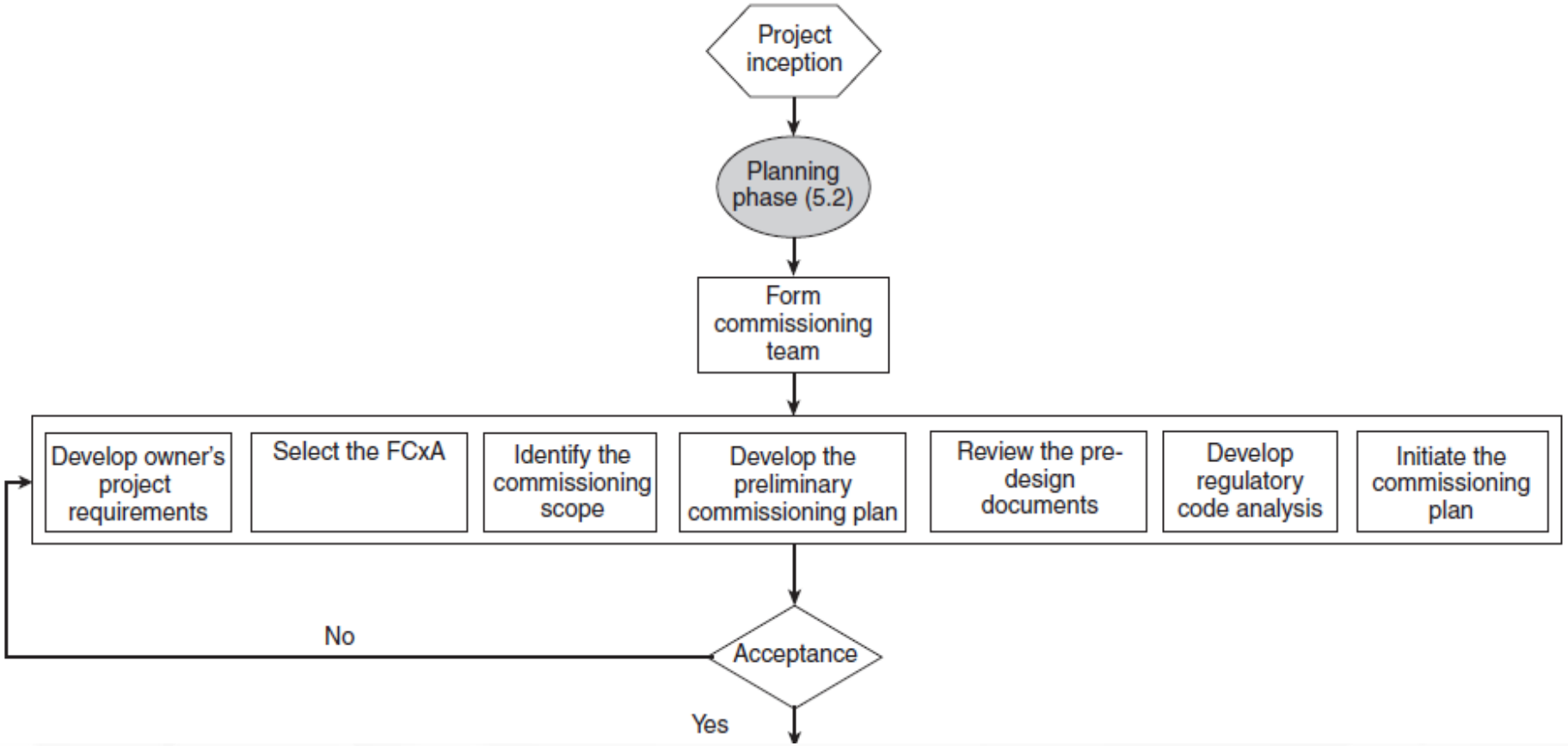
Goals & Objectives

- Documentation of:
  - Owners Project Requirements (OPR)
  - Basis of Design (BOD)
  - Systems installed as required
  - Performance and documentation of integrated testing
  - As-built drawings & O&M's
  - Training
  - IT&M

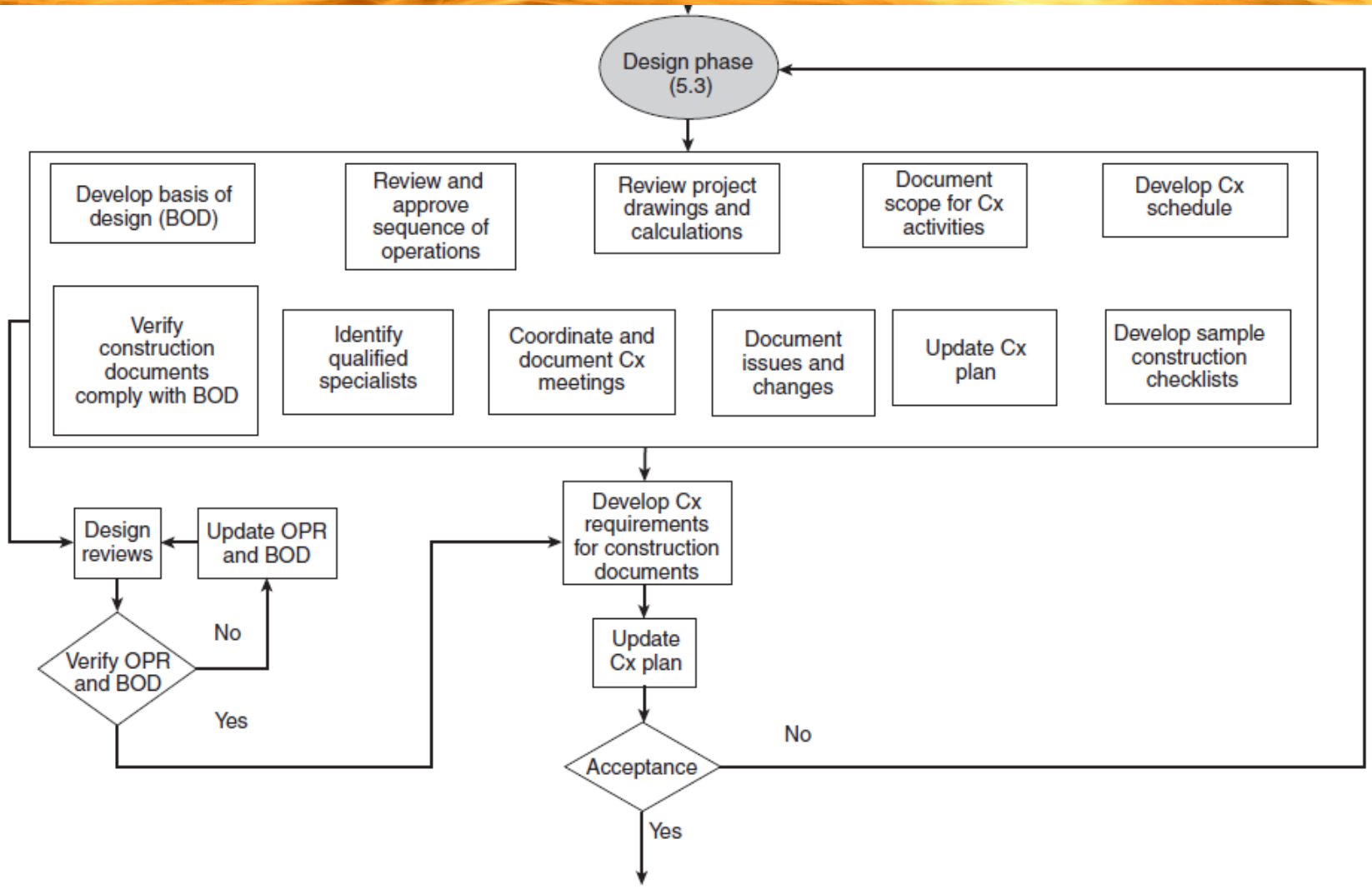
Chapter 5 – The Cx Process



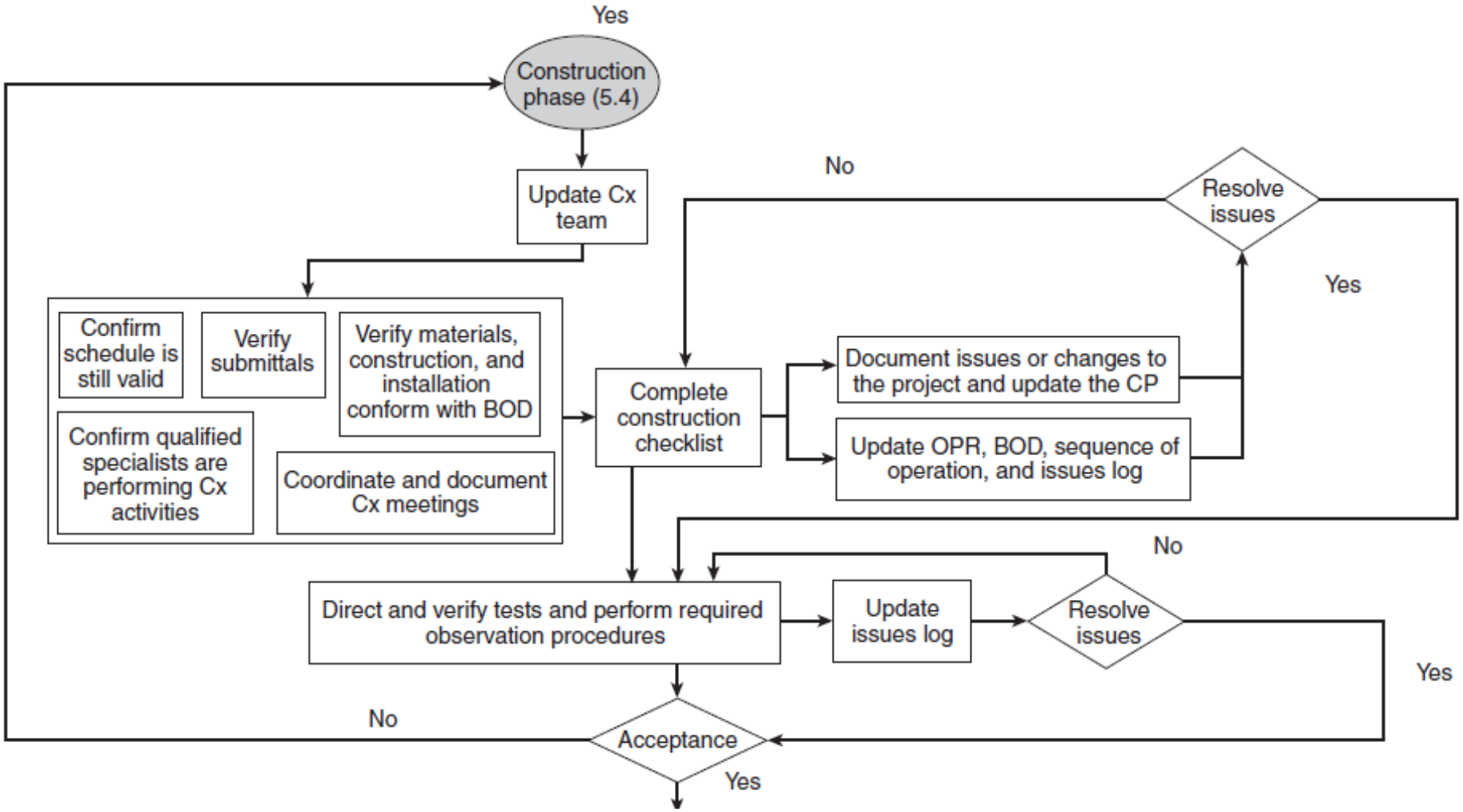
Planning Phase



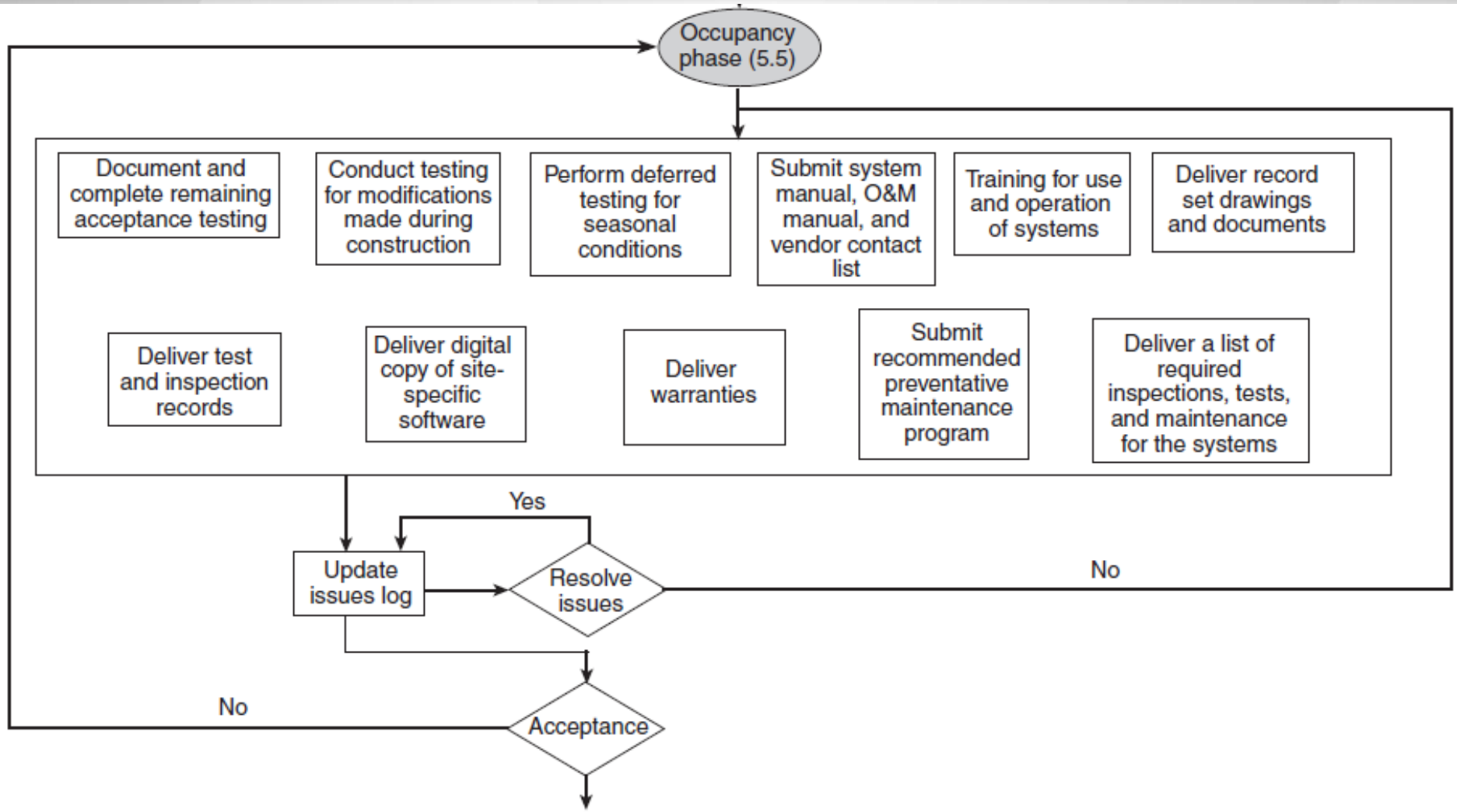
Design Phase



Construction Phase



Occupancy Phase



Commissioning Team

- Owner
- Commissioning Authority
- Fire Commissioning Agent (FCxA)
- Installation Contractor(s)
- Manufacturer's Representatives
- Registered Design Professionals (RDPs)
- Construction Manager/General Contractor
- Owner's Technical Support Personnel
- Facility Manager or Operations Personnel
- Insurance Representative
- Third-Party Testing Entity
- AHJ – Authority Having Jurisdiction
- ITa – Integrated Testing Agent

Who Is The FCxA?

- Fire Commissioning Agent
- Why “Agent” and not “Authority”?
- Ringleader for fire protection & life safety commissioning process
- Significant responsibilities - See A.5.2.2.1 of NFPA 3
- The FCxA should be knowledgeable and experienced in the proper application of commissioning recommendations of NFPA 3 and general industry practices.
- 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 integrated system testing.

Registered Design Professional (RDP)

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

Facilities Management Personnel

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

Facilities Management

(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.

Authority Having Jurisdiction (AHJ)

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

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

Integrated Testing Agent (ITa)

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.

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

What's In the Cx Plan?

- Cx Scope and Overview of the Project
- General Project Information
- FCx Team Roles & Responsibilities
- Communication Plan and Protocol
- Cx Process Tasks and Activities
- Cx Schedule
- Cx Process Documentation and Deliverables
- Testing Procedures
- Recommended Owner Training
- Integrated Testing Frequency

Recommended Testing Prerequisites

- Written Certification of Compliance
- Set of PE Approved Shop Drawings
- Set of As-Built drawings
- Points List and Address Labels
- Written/Documented Testing Plan
- Pre-test forms verifying system was functionally tested
- Circuit Installation & Integrity Testing
  - (Megger, Loop Resistance & Stray Voltage)
- Notification of Off-Site Monitoring

NFPA 72 Inspection and Testing

- All new systems shall be inspected and tested in accordance with the requirements of Chapter 14
- Inspection - The visual inspection shall be made to ensure there are no changes that affect equipment performance
- Inspection performed as outlined in Table 14.4.3.1
- Testing Methods are clearly documented in Table 14.4.3.2

Test Methods

Control equipment

a. Functions
b. Fuses
c. Interfaced Equipment
d. Lamps and LEDs
e. Primary power supply

Test Methods

Secondary Power - Batteries (general test)

a. Visual inspection
b. Battery replacement
c. Charger test
d. Discharge test
e. Load voltage test
f. Are batteries dated?

Power Supply Testing

Confirm that the location of the circuit disconnecting means is permanently identified at the FACP and that the main system power supply is secured, clearly marked FIRE ALARM (in red).

Test Methods

Fire alarm control unit trouble signals

a. Audible and visual
b. Disconnect switches
c. Ground-fault monitoring circuit
d. Transmission of signals to off-premises location

Test Methods

Remote Annunciators

The correct operation and identification of annunciators shall be verified. If provided, the correct operation of annunciator under a fault condition shall be verified.

Test Methods

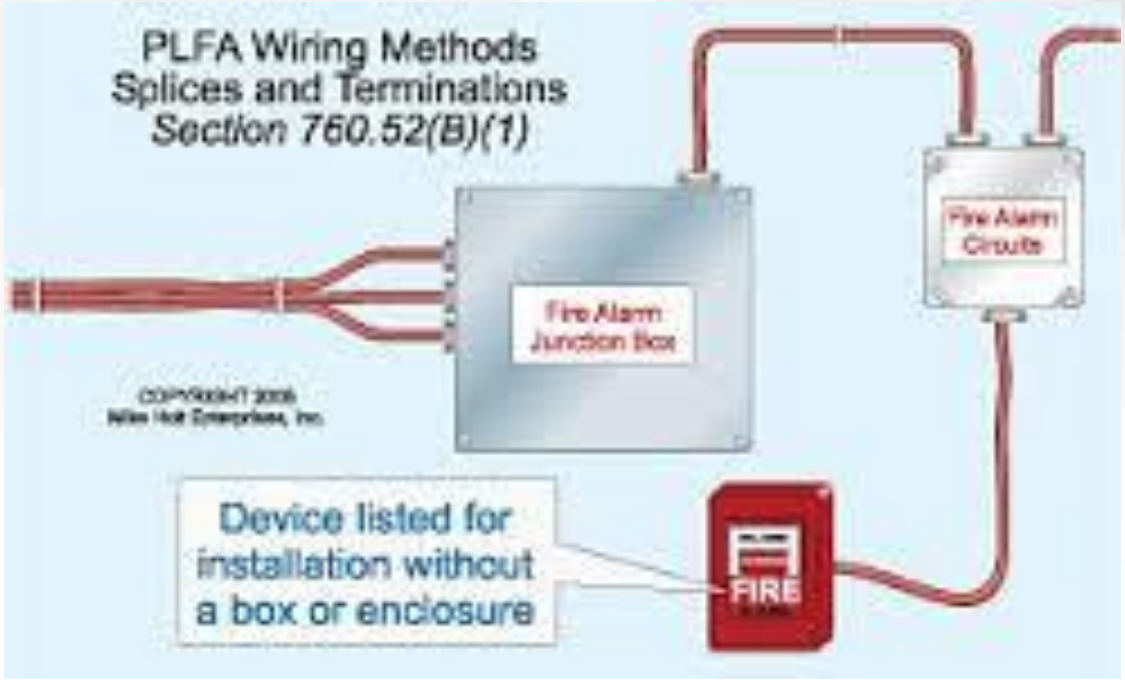
Conductors – metallic

a. Stray voltage
b. Ground faults
c. Short-circuit faults
d. Loop resistance
e. Circuit Integrity
f. Supervision

Test Methods

Conductors – nonmetallic

a. Circuit integrity
b. Fiber optics
c. Supervision



Test Methods

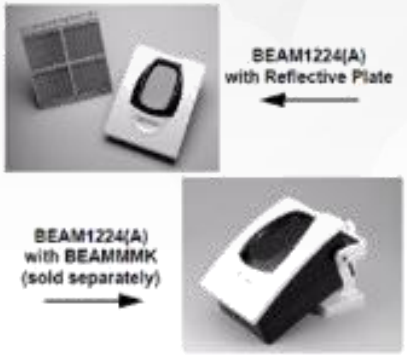
Initiating devices

a. Electromechanical releasing device
b. Fire extinguisher or suppression system alarm switch
c. Fire-gas and other detectors
d. Heat detectors
e. Manual fire alarm boxes
f. Radiant energy fire detectors

Test Methods

Initiating devices

g. Smoke detectors
h. Carbon monoxide detectors/carbon monoxide alarms for the purposes of fire detection
i. Initiating devices, supervisory
j. Mechanical, electrosonic, or pressure-type waterflow device
k. Multi-sensor fire detector or multi-criteria fire detector or combination fire detector



Test Methods

Alarm notification appliances

a. Audible and/or Intelligible
b. Audible textual notification appliances
c. Visible

Functional Testing of Notification Appliances

Initiate a general fire alarm and verify:

- FACP tone device sounds
- Notification appliances operate in all areas
- Associated alarm indicator flashes

Functional Testing of Notification Appliances

Verify intelligibility of the voice or mass notification system in each ADS (Acoustically Distinguishable Space).

Not required to use a meter.

Test Methods

Special hazard equipment

a. Abort switches (all types)
b. Cross-zone detection circuit
c. Matrix-type circuit
d. Release solenoid circuit
e. Squibb release circuit
f. Verified, sequential, or counting zone circuit
g. All above devices or circuits or combinations thereof

Test Methods

Supervising station alarm systems— transmission equipment

a. All equipment
b. Digital alarm communicator transmitter (DACT)
c. Digital alarm radio transmitter (DART)
d. McCulloh transmitter
e. Radio alarm transmitter (RAT)
f. Performance-based technologies

Test Methods

Supervising station alarm systems— receiving equipment

a. All equipment
b. Digital alarm communicator receiver (DACR)
c. Digital alarm radio receiver (DARR)
d. McCulloh systems
e. Radio alarm supervising station receiver (RASSR) and radio alarm repeater station receiver (RARSR)
f. Private Microwave radio systems
g. Performance-based technologies

Test Methods

Emergency communications equipment

a. Amplifier/tone generators
b. Call-in signal silence
c. Off-hook indicator (ring down)
d. Phone jacks
e. Phone sets
f. System performance

Test Methods

Emergency control functions

Emergency control functions (i.e., fan control, smoke damper operation, elevator recall, elevator power shutdown, door holder release, shutter release, door unlocking, etc.) shall be tested by operating or simulating alarm signals. Testing frequency for emergency control functions shall be the same as the frequency required for the initiating device that activates the emergency control function.

Completion Documentation (Chapter 7)

- Written Narrative & Statement of Compliance?
- O&M Manuals
- As-Built Drawings (Plans and Riser Diagram)
- Written Sequence of Operation with I/O Matrix
- Inspection & Testing Documentation
- System IT Documentation & Record of Completion
- Copy of Site-Specific Software
- Documentation on Supervising Station
- Document Accessibility (in a cabinet)

Summary of Presentation

- Acceptance Testing?
- Commissioning?
- Integrated FP/LS System Testing?
- Why is it done
- Cx Team and the Cx Plan
- Typical FA Testing Performed
- Documentation Requirements

Now is your chance for Questions

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Thank You

Jack Poole, PE, FSFPE
Poole Fire Protection, Inc.
jpoole@poolefire.com
913-747-2050