

DEFENCE CONSTRUCTION CANADA
CONSTRUCTION DE DÉFENSE CANADA

CAN/ULC S1001-11 Integrated Systems Testing of Fire Protection and Life Safety Systems and Fire Protection Commissioning

Presentation To:
Manitoba Building Officials Association
- Annual Fall Seminar



Winnipeg, Manitoba
19 October 2016



PRESENTED BY

Bill Fremis

Technical Specialist - Fire Protection Engineering
Defence Construction Canada

Working Group Chair
ULC S1001-11 Integrated Systems Testing of
Fire Protection and Life Safety Systems

PRESENTATION OVERVIEW

- BACKGROUND
- SCOPE
- CAN/ULC S1001 HIGHLIGHTS
- CAN/ULC S1001 QUALIFICATIONS
- CAN/ULC S1001 PROCESS
- CAN/ULC S1001 TESTING REQUIREMENTS
- CAN/ULC S1001 DOCUMENTATION
- CAN/ULC S1001 BUILDING LIFE-CYCLE TESTING
- NEXT PROJECTS FOR ULC COMMISSIONING SUBCOMMITTEE

WHY COMMISSIONING?

- Requirement included as a Technical Change to the 2010 NBCC & NFCC
 - 2010 NBCC Article 3.2.4.6
 - 2010 NFCC Article 2.1.3.8

Where life safety and fire protection systems are installed to comply with the provisions of the NBC or the NFC, the commissioning of these integrated systems must be performed as a whole to ensure the proper operation and inter-relationship between the systems.

WHAT IS COMMISSIONING?

- Subcommittee had various discussions as to what “commissioning” is
- Two different processes identified:
 - Commissioning - Owners Process
 - Integrated Systems Testing - Code Requirement

Intent of the NBC / NFC were reviewed with NRC to align the ULC S1001 Standard with Building and Fire Codes

COMMISSIONING VS INTEGRATED SYSTEMS TESTING - DIFFERENCE IN PROCESSES

- Commissioning

A process of documentation, adjustment, testing, verification and training, performed specifically to ensure that the finished facility operates in accordance with the Owner's documented project requirements and the construction documents

- Integrated Systems Testing

A methodology for verifying and documenting that all interconnections between systems provided for fire protection and life safety are installed and operating in conformance with their design criteria

COMMISSIONING

■ Highlights

- Owner Driven and Quality Focused
 - Ensures Owners get what they paid for
- Process from Pre-Design to Turn-Over
 - Develop and Document Owner's Project Requirements
 - Develop Commissioning Scope and Plan
 - Review of Design Documents
 - Construction Checklists and Submittals
 - Review Construction and Testing
 - Training and Closeout Documents and Activities

COMMISSIONING

■ Highlights

- Documentation of Design Changes and Resolutions, Verifications, and Acceptance Testing
- Owner gets more out of their investment
 - Better Operating Systems
 - Properly Maintained Systems
 - Properly Training Building Staff
- Fire Commissioning is the fire protection and life safety component of Building Commissioning

INTEGRATED SYSTEMS TESTING

■ Highlights

- Code Driven Process – Required by Building & Fire Codes
- Minimum testing required to prove integrations
 - System A works with System B
- Testing of the integrations between systems in situ
- One input per integration activated to confirm corresponding outputs
- Documentation of the testing

INTEGRATED SYSTEMS TESTING

- Address “gaps” in existing Standards
 - Systems typically tested and verified independently
 - No requirements previously existed to test systems together
 - Example - Door Hold-Open Devices
 - ❖ Fire alarm relays tested and doors confirmed as operating
 - ❖ Testing by separate contractors
 - ❖ Integrated Systems Testing requires a coordinated test
 - Example - Fire Pumps
 - ❖ Fire pump installed and tested to confirm relays work
 - ❖ Fire alarm verification to confirm inputs
 - ❖ Integrated Systems Testing requires a coordinated test

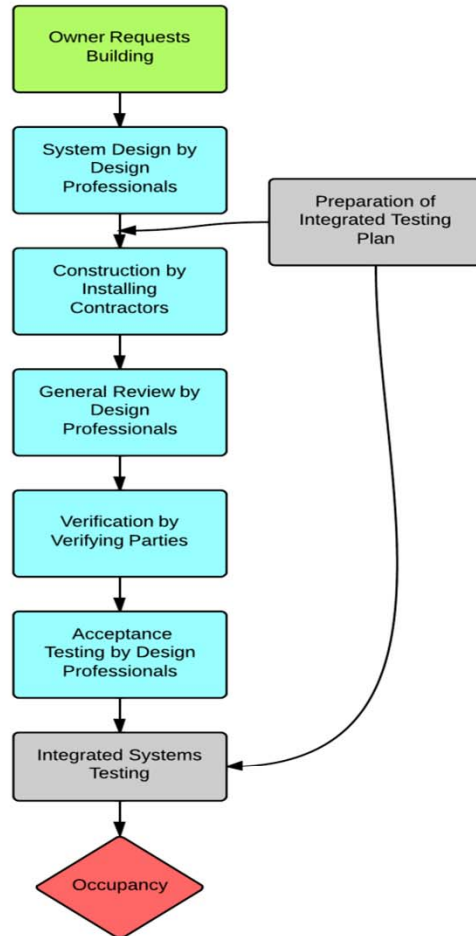
INTEGRATED SYSTEMS TESTING

- Integrated Systems Testing is not
 - Replacement of system review and acceptance by Design Professionals
 - Review of system designs or installations (only system integrations)
 - Duplication or Replacement of existing inspection, testing, and verification requirements

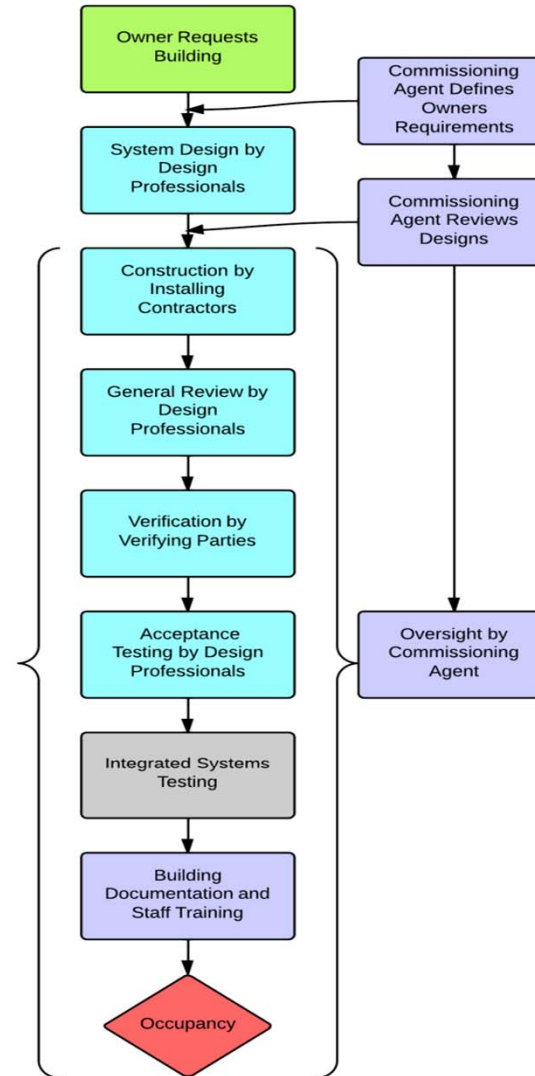
COMPARISON OF THE INTEGRATED SYSTEMS TESTING PROCESS VS. A SAMPLE COMMISSIONING PROCESS

CTION CANADA
DÉFENSE CANADA

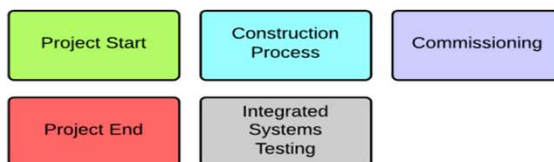
INTEGRATED SYSTEMS TESTING PROCESS



SAMPLE COMMISSIONING PROCESS



LEGEND



CAN/ULC S1001-11

Integrated Systems Testing of Fire Protection and Life Safety Systems

ULC-S1001 CODE ADOPTION

- Reference Standard Status
 - Code Changes submitted to the NRC
 - Inclusion in the 2015 National Building and Fire Codes of Canada
 - Reviewed by Reference Standards Working Group
 - Recommendations to the Standing Committees

ULC-S1001 CODE ADOPTION

- Standing Committees
 - Proposed Change reviewed by Standing Committees
 - Use and Egress
 - Fire Protection
 - Housing and Small Buildings
 - Proposed changes accepted by all three standing committees

NATIONAL BUILDING CODE

- 2015 Edition Changes
 - New Subsection 3.2.9 Integrated Fire Protection and Life Safety Systems
 - Removes 2010 NBC Article 3.2.4.6
 - New Sentence 3.2.9.1.(1) Requirements
 - Testing of integrations between fire protection and life safety systems, and systems with fire protection and life safety functions
 - Systems and integrations to be tested as a whole
 - ULC-S1001 Reference Standard for Integrated Testing

NATIONAL BUILDING CODE

- Appendix Note A-3.2.9.1.(1)
 - Testing of Integrated Systems
 - Owners must ensure fire protection and life safety systems are functioning in accordance with their design, including interconnections with other building systems
 - CAN/ULC-S1001 provides the methodology for verifying and documenting that interconnections between building systems satisfy the intent of their design

NATIONAL FIRE CODE

- 2015 Edition Changes
 - Construction requirements in Article 2.1.3.7
 - Sentence 2.1.3.7(1) references the NBC for installation of system integrations
 - New Section 6.8 on testing and maintenance of integrations
 - Sentence 6.8.1.1(1) indicates integrations between fire protection and life safety systems to be tested and maintained in conformance with ULC-S1001

NATIONAL
STANDARD
OF CANADA

CAN/ULC-S1001-11

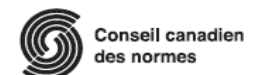
INTEGRATED SYSTEMS TESTING OF FIRE PROTECTION AND
LIFE SAFETY SYSTEMS



NORME
NATIONALE
DU CANADA

CAN/ULC-S1001-11

ESSAIS INTÉGRÉS DE SYSTÈMES DE PROTECTION
INCENDIE ET DE SÉCURITÉ DES PERSONNES



ULC S1001 MAJOR SECTIONS

- Integrated Systems Testing Requirements
 - Scope
 - Qualifications
 - Process
 - Testing Requirements
 - Documentation
 - Periodic Integrated Systems Testing
 - Retro Integrated Systems Testing
 - Integrated Systems Testing for Modifications

SCOPE

■ Methodology

- Verify and document that interconnections between systems are installed and operating in conformance with their design
- Fire Protection and Life Safety Systems
 - Fire Alarm, Sprinklers, Emergency Generators, etc.
- Systems with Fire Protection and Life Safety Functions
 - Elevators, Audio/Visual Systems, Lighting Controls, etc.
- Not intended to verify individual system installations

SCOPE

- Interconnection

- *“The link between two or more integrated fire protection and life safety systems which has an associated input/output correlation. The link between two or more integrated fire protection and life safety systems may or may not be a physical connection.”*
- Interconnections may include electrical, optical, or wireless transmissions, or data transfer protocols.

QUALIFICATIONS

- Integrated Testing Participants
 - Persons identified in the Integrated Testing Plan
 - Design Professionals
 - Installing Contractors
 - Verifying Parties
 - Knowledge and experience in the design, installation, and operation of their relevant systems
 - Regulations may exist for licensing and/or certification of these individuals (future discussion)

QUALIFICATIONS

- Integrated Testing Coordinator
 - Maybe a person, firm, or corporation
 - Knowledge and experience with design, installation, and operation of integrated systems,
 - Knowledge and understanding of:
 - Codes and Standards regulating design
 - System operation under normal and fire conditions
 - Methods of validation
 - Licenses and Certifications?
 - Standard can't dictate professional qualifications
 - To be part of the adoption in Regulations
 - Could also be in Owner's contractual requirements

PROCESS

■ Planning Phase

➤ *Information gathering from Design Professionals*

- Interconnection Details
- Fire Protection / Life Safety System Design Documents
 - Drawings and Specifications
 - Sequencing descriptions and coordination between systems
 - Mechanical & Electrical Riser Diagrams
- Operating and Testing Instructions
- Alternative Solutions
- Miscellaneous Information Required

PROCESS

- Planning Phase
 - Preparation of the Integrated Testing Plan
 - Functional Objectives of System Integrations
 - Sequences of Operation
 - Test Protocols and Procedures for Integrated Testing
 - Occupant Notification Procedures
 - Alternative Safety Measures
 - Phased Occupancy (if applicable)
 - Approved by the Design Professionals and Reviewed by the AHJ's (where required)
 - Guidance in Appendix B of Standard

PROCESS

- Pre-Implementation
 - Prior to implementing the Integrated Testing Plan
 - Receive Design Professionals confirmation of acceptance testing complete and systems ready for integrated testing
 - Receive Installing Contractors confirmation that systems installed in accordance with design and ready for integrated testing
 - Receive Verification Documents
 - Fire Alarm Verification, Installation Test Reports, Contractor Material and Test Certificates, TAB Reports, etc.
 - Receive Inspection Certificates
 - Electrical Inspection, Elevator Inspection, etc.

PROCESS

- Implementation Phase
 - Sufficient notification to AHJ's (where required)
 - Implement occupant notification and alternate measures
 - Perform Integrated Testing Protocols
 - Document Testing in Integrated Testing Forms
 - Correct and Re-test Failed Integrations
 - Input/Output correlation not per the sequence of operation
 - Failed devices noted for follow-up by Design Professional
 - Return systems to normal conditions
 - Prepare Integrated Testing Report

TESTING REQUIREMENTS

- Project Specific Testing
 - Project and system specific testing procedures
 - Performance Based
 - Demonstrate proper operation of integrated systems
 - Minimum level of testing detailed in ULC S1001
 - Additional Testing may be required based on installation
 - Functional operation of input devices
 - Simulated operation permitted for non-restorable devices or tests that could harm persons or damage systems
 - Acceptance of documented testing at Integrated Testing Coordinator's discretion

TESTING REQUIREMENTS

■ Systems Considered

- Fire Alarm System
- Mass Notification Systems
- Elevators
- Emergency Generators
- A/V and Lighting Control Systems
- Notification Systems
- Sprinkler Systems
- Standpipe Systems
- Fire Pumps
- Water Supplies
- Water Supply Control Valve
- Freeze Protection Systems
- Fixed Fire Suppression Systems
- Cooking Suppression Systems
- Hold-Open Devices
- Electromagnetic Locks
- Smoke Control Systems
- Hazardous Protection Monitoring
- Smoke Alarms

TESTING REQUIREMENTS

- Testing effort is related to the complexity of the system
 - Example - Smoke Exhaust System
 - Various input/output correlation tests
 - Fan and damper control and status monitoring
 - Door opening forces
 - Control interfaces (Firefighter's Smoke Control Station, BMS)
 - For simple analog interconnections,
 - one input activated to initiate sequence
 - operation of fans, dampers, etc. confirmed to test integrations
 - Complicated digital interfaces
 - each software command string considered an integration

SAMPLE TEST REQUIREMENTS - FIRE PUMPS

- Fire Pumps
 - Testing of each interconnection, as provided
 - Fire Pump Running,
 - Trouble,
 - Phase Reversal,
 - Loss of Phase,
 - Connected to an Alternate Source,
 - Controller Main Switch in Off or Manual Position,
 - etc.

SAMPLE TEST REQUIREMENTS - FIRE PUMPS

■ Fire Pumps

- Each monitored connection is created on the Fire Pump to show that the correct integration is provided
 - Fire Pump manually started and “Fire Pump Running” annunciation confirmed at the Fire Alarm System
 - Fire Pump trouble condition created and ‘Fire Pump Trouble” annunciation confirmed at the Fire Alarm System

SAMPLE TEST REQUIREMENTS - EMERGENCY GENERATORS

- Emergency Generators
 - Similar to Fire Pumps
 - Testing of each interconnection, as provided
 - Generator Running, Trouble, Excessive Temperature, Low Temperature, Damper Monitoring, etc.
 - Each monitored condition is created on the Emergency Generator to show the correct integration is provided

SAMPLE TEST REQUIREMENTS - EMERGENCY GENERATORS

- Emergency Generators
 - Additional required Generator Start-Up Test
 - Full load test - All systems running at full design capacity
 - Simulated loss of normal power - automatic generator start-up
 - Systems confirmed as operating under emergency power

SAMPLE TEST REQUIREMENTS - SPRINKLER SYSTEMS

- Sprinkler Systems
 - Testing of Each Interconnection
 - Typically alarm and supervisory device monitoring
 - Test method appropriate for the integration
 - ❖ Flow water to test an integration to a flow switch
 - ❖ Turn valve to test an integration to a supervised valve
 - CAN/ULC-S537 Verification acceptable, at Integrated Testing Coordinators discretion
 - Process to not duplicate existing test and verification requirements

SAMPLE TEST REQUIREMENTS - FIRE ALARM SYSTEMS

- Fire Alarm Systems
 - Most common system considered during development
 - Testing of Integrations with other systems
 - Based on design sequence of operation
 - Input / Output correlations
 - Example - Fire Signal Receiving Centre Integration
 - ❖ Receipt of alarm signal
 - ❖ Receipt of supervisory signal
 - ❖ Receipt of trouble signal
 - ❖ Disconnect provides specific trouble at system and trouble signal at signal receiving centre

DOCUMENTATION

- Integrated Testing Forms
 - Developed by the Integrated Testing Coordinator
 - Test Protocol and Procedure
 - Space to document observed results
 - Signed upon completion
 - Integrated Testing Coordinator
 - Test Participants, as appropriate
 - Initial and Re-Tests Documented
 - Re-Test Forms clearly indicated

DOCUMENTATION

- Integrated Systems Testing Report
 - Final Integrated Testing Report consists of the:
 - Integrated Testing Plan
 - Documentation collected during Implementation Phase
 - Integrated Testing Forms for Initial Test
 - Integrated Testing Forms for Re-Tests
 - Intended for future use throughout the building's life cycle
 - Life Cycle Testing
 - Modifications
 - Format that can be easily maintained and updated

LIFE CYCLE TESTING

- On-Going Integrated Systems Testing
 - On-Going Testing or Testing of Existing Systems
 - Re-Testing after system modifications
 - Implementation to be by Governing Bodies
 - Building and Fire Codes
 - Other Legislation
 - Contract Requirements

LIFE CYCLE TESTING

- Periodic Integrated Systems Testing
 - Routine Integrated Systems Testing throughout the building's life cycle
 - Ensure system integrations are maintained
 - Frequency
 - 1 Year Confirmation Test
 - 5 Year Periodic Testing
 - Documentation of Testing

LIFE CYCLE TESTING

- Retro Integrated Systems Testing
 - Integrated Systems Testing for Existing Buildings
 - Confirmation that systems are properly integrated
 - Similar process as new construction
 - Lack of design information may require detailed review
 - Repeated every five years
- Integrated Systems Testing for Modifications
 - Amended Integrated Systems Testing
 - Implement testing for effected systems

APPENDIX A - GENERAL INFORMATION

- Informative Information
 - Aligned with the Standard Numbering (e.g., A1.1)
 - Provides background from the Working Group on the intent of requirements
 - Examples of procedures and approaches that can be considered
 - Examples of existing tests and reports
 - Examples of Fire Protection and Life Safety Systems

APPENDIX B - GUIDELINES FOR INTEGRATED TESTING PLANS

- Introduction
 - Building or Facility Information
 - System Integrations and Functional Objectives
- Sequence of Operation
 - List of each integrated test outcome
 - Cause and Effect Matrix
- Test Protocols and Procedures
 - Test Methodology and Step-by-Step Instructions
 - Record initiating device activated and confirm each output
 - Test Scenarios

APPENDIX B - GUIDELINES FOR INTEGRATED TESTING PLANS

➤ Notifications

- Coordination of test participants
- Notification of Testing

➤ Personnel Safety

- Occupant Notification of Emergencies
- Safety Protocols
 - Dealing with Unexpected Results - Back Out Protocols
- Emergency Procedures

➤ Phased Occupancies

- Systems required to be functional for occupancy to be subjected to testing prior to occupancy

APPENDIX B - GUIDELINES FOR INTEGRATED TESTING PLANS

- Pre-Testing Documentation
 - Design Professional / Installing Contractor Acceptance
 - Acceptable Verifications
- Testing Forms
 - Record all test and observed conditions
 - Track Deficiencies for review by Design Professionals
 - Re-testing of Deficiencies

ULC SUBCOMMITTEE ON COMMISSIONING

Current Projects

STANDARDS UPDATE

- Published

- CAN/ULC-S1001, Integrated Systems Testing for Fire Protection and Life Safety Systems

- In Development

- ULC-S1002, Guideline on the Fire Commissioning Process
- ULC-S1003, Acceptance Testing for Active Fire Protection and Life Safety Systems
- ULC-S1004, Acceptance Testing for Passive Fire Protection and Life Safety Systems

ULC S1002

- Fire Commissioning Process
 - All aspects of the construction process
 - Pre-design, design, installation, acceptance testing, closeout, training, etc.
 - New Construction, Retro, and Modifications
 - Review existing processes
 - CSA Z320, NFPA, NIBS, ISO, Public Works, etc.
 - Defining Fire Commissioning Team
 - Fire Commissioning Phases
 - Fire Commissioning Expectations
 - Align with ULC-S1001, ULC-S1003, and ULC-S1004

ULC-S1002 PRELIMINARY ITEMS

- Commissioning Process
 - Project Inception
 - Planning & Pre-Design
 - Detailed Design
 - Construction
 - Verification
 - Acceptance Testing
 - Occupancy and Close-Out

ULC-S1002 PRELIMINARY ITEMS

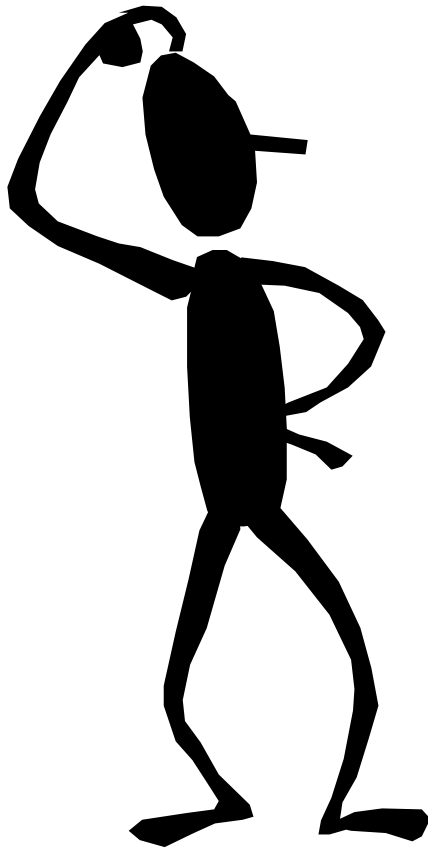
- Documentation Requirements
 - Owners Project Requirements
 - Commissioning Plans and Schedules
 - Commissioning Documents and Forms
 - Design Phase
 - Construction Rough-In Phase
 - Construction Finishing Phase
 - Acceptance Testing Phase
 - Closeout Phase

ULC-S1002 PRELIMINARY ITEMS

- Fire Commissioning Team
 - Owner & Facility Personnel
 - Fire Commissioning Team
 - Design Professionals / Contractors / Verifying Parties
 - Authorities Having Jurisdiction
- Fire Commissioning Phases
 - New Construction
 - Re-Commissioning
 - Retro-Commissioning

ULC-S1003 & ULC-S1004

- Recommended practices for design professionals to ensure systems properly installed and functioning
- Reviewing all aspects of the construction process
- Aligned with ULC-S1000 Series Standards
- Acceptance Testing requirements in development for both active and passive systems
- Extent of Testing requirements being developed based on system components, percentage of components to be tested, and permitted failure rates



Questions or Comments?

BILL FREMIS
DEFENCE CONSTRUCTION CANADA
819-939-4971
613-293-3975
Bill.Fremis@dcc-cdc.gc.ca
Bill.Fremis@forces.gc.ca

WORKING GROUP CHAIR,
INTEGRATED SYSTEMS TESTING OF
FIRE PROTECTION & LIFE SAFETY
SYSTEMS