CAN/ULC-S1001, INTEGRATED SYSTEMS TEST OF FIRE PROTECTION AND LIFE SAFETY SYSTEMS

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Why Commissioning?

• 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 – *Owner Driven Process*
  – Integrated Systems Testing – *Code Requirement*

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

- Owner Driven and Quality Focused
  - Ensures Owners get what they paid for

- From Pre-Design to Turn-Over
  - Develop 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:
    • Owner Requirements,
    • 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 Full Building Commissioning
INTEGRATED SYSTEMS TESTING

• Highlights
  – Code Driven – required by NBC & NFC
  – Minimum testing to prove integrations
  – Testing of integrations with systems in situ
  – One input device per integration activated to confirm the corresponding outputs
  – Documentation

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INTEGRATED SYSTEMS TESTING

• Address “gaps” in existing Standards
  – Systems typically tested and verified independently
  – Examples:
    • Door Hold-Open Devices
      – Fire alarm relays tested
      – Doors confirmed as operating
      – Integrated Systems Testing requires a coordinated test
    • 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 is not

- Replacement for the review and acceptance of systems by Responsible Design Professionals
- Review of system design or installation
- Replacement or duplication of existing inspection, testing, and verification requirements
• Integrated Systems Testing vs. Commissioning
CAN/ULC-S1001-11

INTEGRATED SYSTEMS TESTING OF FIRE PROTECTION AND LIFE SAFETY SYSTEMS
INTEGRATED SYSTEMS TESTING OF FIRE PROTECTION AND LIFE SAFETY SYSTEMS
ULC S1001 Major Sections

- Integrated Systems Testing Requirements
  - Qualifications
  - Integrated Testing Process
  - Integrated Testing Requirements
  - Documentation
  - Periodic Integrated Systems Testing
  - Retro Integrated Systems Testing
  - Integrated Systems Testing for Modifications
• Methodology for verifying and documenting 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, A/V Systems, Lighting Control, etc.

• Not intended to verify individual system installations
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
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
 QUALIFICATIONS

• Integrated Testing Coordinator
  – 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

• Design Professionals to provide documentation detailing each interconnection

• Additional Information from Design Professionals
  – Building Floor Plans
  – Fire Protection / Life Safety System Design Documents
    • Drawings and Specifications
    • Sequencing Descriptions and Coordination Between Systems
    • Riser Diagrams
  – Operating and Testing Instructions
  – Alternative Solutions
  – Miscellaneous Information
PROCESS — PLANNING PHASE

• Preparation of the Integrated Testing Plan
  – Functional Objectives of System Integrations
  – Sequences of Operation
    • Normal Operation
    • Fire Condition
  – Test Protocols and Procedures for Integrated Testing
  – Occupant Notification Procedures
  – Alternative Measures

• Appendix B Guidelines
PROCESS – PLANNING PHASE

• Integrated Testing Plan
  – Consider safety of personnel
  – Consider safe operation of systems
  – Consider Phased Occupancy, as applicable
  – Approved by the Design Professionals
  – Reviewed by the AHJs, where required
  – Revised when changes to systems are made
PROCESS – PLANNING PHASE

• Partial Occupancy
  – ITP developed for entire building
  – Identify tests conducted for each occupancy phase
  – Systems in each area to be occupied are tested
  – Retesting not required, unless systems impacted by ongoing construction
    • Changes in physical installation of system or integration
    • Changes to control software
Prior to implementing the ITP the ITC to receive:

- Written confirmation from Design Professionals that
  - acceptance testing conducted
  - systems ready for integrated testing
- Written confirmation from Installing Contractors that
  - systems installed in accordance with design
  - systems ready for integrated testing
- Verification documentation from Verifying Parties
  - Fire Alarm Verification, Installation Test Reports, Contractor Material and Test Certificates, TAB Reports, etc.
PROCESS – IMPLEMENTATION PHASE

• Prior to implementing the ITP the ITC to receive:
  – Inspection Certificates from Local Authorities
    • Electrical Inspection
    • Elevator Inspection
    • As appropriate to the jurisdiction
  – Confirmation that occupant notification procedures and alternate measures are implemented

• Prior to testing, provide sufficient notification to AHJs, where required
PROCESS – IMPLEMENTATION PHASE

• Implementation of Test Protocols
  – As per the ITP
  – Design Professionals, Installing Contractor, and Verifying Party participation

• Correct and Retest Failed Integrations

• Return systems to normal conditions

• Document tests and provide report to:
  – Owner
  – AHJ, where required
  – Site
• Integrated Systems Testing Requirements
  – Project specific testing procedures
  – Performance Based
    • Procedures to demonstrate proper operation of integrated systems based on design criteria
  – Minimum level of testing detailed
    • Additional Testing may be required based on installation
PROCESS – IMPLEMENTATION PHASE

• Failures are related to integrations only:
  – Input / Output Correlation does not occur as detailed in the sequence of operation
  – Failed devices are noted for follow-up by the design professional
Integrated Systems Testing Requirements

- Functional operation of input devices
- Simulated operation permitted
  - for non-restorable devices
  - where tests could harm persons or damage systems

Acceptance of other documented testing at the discretion of the ITC

For systems not detailed, testing procedures to be developed with design professionals
TESTING REQUIREMENTS

• Systems Considered
  – Fire Alarm Systems
  – Mass Notification Systems
  – Elevators
  – Emergency Generators
  – A/V and Lighting Control
  – Notification Systems
  – Sprinkler Systems
  – Standpipe Systems
  – Fire Pumps
  – Water Supplies
  – Water Supply Control Valves
  – 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 related to the system complexity

Example - Smoke Exhaust Systems
  – 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
  – For complicated digital interfaces
    • each software command string considered an integration
SAMPLE TEST REQUIREMENTS

- Fire Pumps
- Emergency Generators
- Sprinkler Systems
- Fire Alarm Systems
- Elevators
- Hold Open Devices
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.
• Each monitored condition created to show the correct integration is provided

  Fire Pump manually started and “Fire Pump Running” annunciation confirmed at the Fire Alarm

  Fire Pump trouble condition created and “Fire Pump Trouble” annunciation confirmed at the Fire Alarm
• Testing of each interconnection, as provided
  – Generator Running
  – Generator Trouble
  – Excessive Temperature
  – Low Temperature
  – Damper Monitoring
  – Etc.

• Each monitored condition created to show the correct integration is provided
EMERGENCY GENERATORS

• Additional Generator Start-Up Test
  – Full load test
  – All systems running at full design capacity
  – Simulated loss of normal power
  – All systems confirmed as operating under emergency power
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 Coordinator’s discretion
  – Process to not duplicate existing test and verification requirements
FIRE ALARM SYSTEMS

• Most common system considered during development of ULC-S1001
• Testing of each integration 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
ELEVATORS

- Test of Integrations with other systems
- Same approach for integrations to fire alarm system or standalone fire detectors
- Input / Output Correlations
  - Recall to primary recall level
  - Recall to alternate recall level
  - In-Car Indicator
- One initiating device activated per output correlation
HOLD OPEN DEVICES

• Test of Integrations with other systems
• Confirm each door has returned to the closed and latched position
• Extent of Testing
  – Common interconnection for release tested through activation of one initiating device
  – Where release controlled through local initiating device, testing of each local initiating device required
DOCUMENTATION

• Integrated Testing Forms
  – Developed by the ITC based on the ITP
  – Forms to include:
    • Test Protocol and Procedure
    • Space to document observed results
  – Signed upon completion
    • Integrated Testing Coordinator
    • Test Participants, as appropriate for their systems
  – Initial and Re-Tests Documented
    • Re-Test Forms clearly indicated
DOCUMENTATION

• Integrated 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 use throughout the building’s life
    • Life Cycle Testing
    • Modifications

  – Form that can be easily maintained and updated
LIFE CYCLE TESTING

- On-Going Integrated Systems Testing
  - Periodic Testing
  - Retro-Testing of Existing Systems
  - Re-Testing after Modifications

- Implementation 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
  – 1 Year Confirmation Test
  – 5 Year Periodic 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
  – 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
• Guidelines for Integrated Testing Plans
  – Introduction
  – Sequence of Operation
  – Test Protocols and Procedures
  – Notifications
  – Personnel Safety
  – Phased Occupancies
  – Pre-Testing Documentation
  – Testing Forms
  – Ongoing Integrated Systems Testing
Overview of Integrated Testing Plans
- Unique testing plan required for each building
- No prescribed format, however certain information expected to be included
- Intended to be a living document
  - Initial Tests
  - Life Cycle Testing
  - Benchmarking of results
  - Reference of system interconnections
- Complexity of the Integrated Testing Plan is commensurate with the complexity of the building
APPENDIX B

• Introduction
  – Building or Facility Information
  – Overview of Installed Systems
  – System Integrations and Functional Objectives
  – Contact Information for
    • Owner
    • Design Professionals
    • Installing Contractors
    • Verifying Parties
    • Integrated Testing Coordinator
**Appendix B**

- **Sequence of Operation**
  - Comprehensive list of each integrated test outcome
  - Cause and Effect Matrix
  - Building Operational Modes
    - Normal
    - Fire Condition
    - Etc.
APPENDIX B

• Test Protocols and Procedures
  – Specific for each system
  – Test Methodology and Step-by-Step Instructions
  – Document initiating device used to initiate sequence and confirmation of each expected output
  – Test Scenarios
    • Coordinated scenarios to test input / output correlations
APPENDIX B

• Notifications
  – Schedule and Planning
    • Coordination of all parties involved
    • Clear communication methods

  – Notification of Testing
    • Posting Notices
    • Impairments
    • Fire Safety Plan
• Personnel Safety
  – Occupant Notification of Emergencies
    • Means of notifying occupants of an actual emergency
    • Fire Safety Plan, Standard Operating Procedures
    • Communication to Occupants

– Safety Protocols
  • Safety of integrated system testing participants
  • Health & Safety, PPE, WHMIS, Site Training, etc.
  • Unexpected results during system testing
  • Emergency procedures
• Personnel Safety
  – Special Hazards
    • Specific hazardous conditions, equipment, chemicals, etc.
    • Test Procedures to avoid/minimize exposure

  – Team Communications
    • Clear and concise means of communicating observations
    • Emergency procedures
APPENDIX B

• Phased Occupancies
  – Occupancy incorporated into the Integrated Testing Plan
  – Systems required to be functional for occupancy to be subjected to testing prior to occupancy

• Pre-Testing Documentation
  – Design Professional / Installing Contractor acceptance
  – Pre-Completed Testing
  – Building Pre-Check
• Testing Forms
  – Pre-testing coordination of roles and responsibilities
  – Record all test results and observed conditions
  – Review of deficiencies by Design Professionals, Installing Contractors, and Verifying Parties
  – Re-testing of deficiencies

• On Going Integrated Systems Testing
  – Plan developed with consideration to future testing
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CODE ADOPTION UPDATE
ULC-S1001 Code Adoption

- Reference Standard Status
  - Proposed Code Changes submitted to NRC
  - Reference to ULC-S1001 in the 2015 National Building and Fire Codes of Canada
  - Proposed Code Changes have been reviewed by the Reference Standards Working Group
  - Recommendations for Code Changes made to the Standing Committees
2015 NBC Tentative Changes

- New Subsection 3.2.9
- Remove 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
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.
• 2015 NFC Tentative Changes
  – Construction requirements in Article 2.1.3.8
  – New Section 6.8 on testing of integrations
  – Article 2.1.3.8
    • References the NBC for installation of system integrations
  – Section 6.8
    • Integrations between fire protection and life safety systems to be tested and maintained in confirmation with ULC-S1001
ULC-S1001 Code Adoption

- Proposed Changes reviewed by Standing Committees
  - Use and Egress
  - Fire Protection
  - Housing and Small Buildings
- Proposed changes accepted by all three standing committees
- Changes circulated for public comment
ULC SUBCOMMITTEE ON COMMISSIONING
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- Published Standards

- Standards In Development
  - ULC-S1002, Guideline on the Fire Commissioning Process
  - ULC-S1003, Acceptance Testing for Active Fire Protection and Life Safety Systems
• Fire Commissioning Process
  – All aspects of the construction process
    • Pre-design, design, installation, acceptance testing, closeout, training, etc.
  – New Construction, Retro, and Modifications
  – Reviewing existing processes
    • CSA Z320, NFPA, NIBS, ISO, Public Works, etc.
  – 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 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

- Technical aspects of acceptance testing
- Recommended practices for design professionals, including reasonable steps to ensure systems are properly installed and functioning
- Reviewing all aspects of the construction process
- To align with ULC-S1001 & ULC-S1002
ULC-S1003 & ULC-S1004 PRELIMINARY ITEMS

• Acceptance Testing requirements in development
• Active and Passive Systems
• Extent of testing requirements being developed
  – Based on system components
  – Percentage of component to be tested
  – Permitted failure rates
THANK YOU

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