



Louisiana Automatic Fire Alarm Association, Inc.

Interfacing Fire Alarm, Sprinkler and Elevator Systems

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Agenda:

- *Elevator Recall and Power Shut-down*
- *Historical Perspective*
- *Where we are today, code-wise*
- *Look at specific code sections*
- *Discuss some of the issues*
- *Where we appear to be headed*

ASME A17.1

Safety Code for Elevators and Escalators

Provides requirements for operational sequences for:

- *Phase 1 - Emergency Recall Operation*
- *Power Shutdown - "Shunt Trip" Operation*

ASME A17.1

Phase I - Emergency Recall Operation

The operation of an elevator wherein it is automatically or manually recalled to a specific landing and removed from normal service because of activation of firefighters' service

ASME A17.1

Power Shutdown (shunt trip)

Mainline elevator power is disconnected from the elevator to eliminate potential problems as a result of sprinkler actuation in the hoistway or elevator machine room

Elevator Recall: Historical Perspective

- *1973 ASME A17.1b (supplement to the 1971 Code)*
- *Purpose:*
 - *Prevent people from using elevators*
 - *Responding Firefighters to Account for Elevators*
 - *Stage Equipment (Hose lines, air tanks, etc.)*
 - *Evacuate Occupants with Mobility Restrictions*
 - *Prevent Car from being called to the Fire Floor*

Elevator Recall: Historical Perspective

- *Identified Designated Level*
- *Both Manual and Automatic Recall*
 - *Key Switch (only by firefighters)*
 - *Smoke Detectors in Lobbies*
- *Travel of 25' above or below designated level*
- *1981 introduced the "Alternate" Level*

Elevator Recall: Historical Perspective

- *1984 introduced "only" lobby and machine room detectors were to initiate recall*
- *A17.1 referred users to NFPA 72E, Automatic Fire Detectors*
- *NFPA first mentions A17.1 requirements in 1987 edition of NFPA 72A, Installation, Maintenance and use of Local Protective Signaling Systems – "Elevator Recall for Firefighters' Service"*

Elevator Recall: Historical Perspective

- *Two "elevator zone circuits" were required to be terminated at the associated elevator controller*
- *In 1989, A17.1 required smoke detectors in hoistways ... only when hoistways had sprinklers*
- *First detector actuated determines the recall floor*
- *A17.1b, 1992 Supplement drops the 25 ft. criterion ... now applies to all automatic elevators regardless of travel distance*

Elevator Recall: Historical Perspective

- *1993 edition of NFPA 72, National Fire Alarm Code addressed cases where there was no required building fire alarm system ... "Elevator Recall and Supervisory Panel"*
- *1996 edition of NFPA 72 introduced "other" fire detection as being permissible if environment was not appropriate for a smoke detector.*

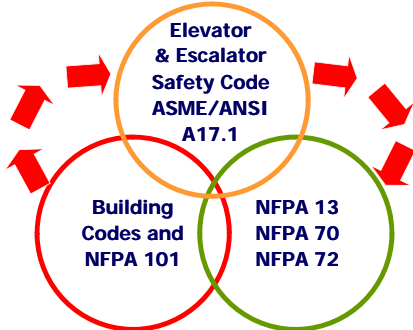
Elevator Recall: Historical Perspective

- *A "third" control circuit was added to provide a warning of fire in the hoistway or elevator machine room*
- *The 2000 A17.1 was "harmonized" with the Canadian B44 Elevator Safety Standard*
- *NFPA 72 [2002] and A17.1 [2004] now both address new technology elevators ... machine room-less elevators*

Shunt Trip: (Historical Perspective)

- *First introduced in ASME A17.1 - 1984*
- *Purpose:*
 - *Remove Main-line Power prior to sprinkler activation*
 - *Prevent Elevator from Moving/Operating dangerously*
- *Note: the requirement does not include circuits for ventilation, in-car lights and communication, pit receptacles and lights, etc.*

Applicable Codes



"Out of Sync" Codes

ASME A17.1

- 3 – 4 Year Cycle with Yearly Addenda
- A17.1 - 1996
- A17.1a - 1997
- A17.1b - 1998
- A17.1c - 1999
- A17.1d - 2000
- A17.1a - 2002
- A17.1b - 2003
- A17.1 - 2004

NFPA 72 and NFPA 13

- 3 Year Cycle
- 1996, 1999, 2002, 2007 etc.

ASME A17.1 - 2004

Section 2.27 Emergency Operation and Signaling Devices

2.27.3.2 Phase I Emergency Recall Operation by Fire Alarm Initiating Devices

Note: Section 2.27 applies to Electric Elevators and section 3.27 applies to Hydraulic Elevators ... section 3.27 says refer to 2.27.

ASME A17.1 - 2004

Section 2.8 Equipment in Hoistways, Machinery Spaces, Machine Rooms, Control Spaces and Control Rooms

2.8.2.3.2

(Shunt Trip / Power Disconnect requirement)

NFPA 72 - 2007

Chapter 6 – Protected Premises

6.16 Protected Premises Fire Safety Functions.

6.16.3 Elevator Recall for Fire Fighters' Service

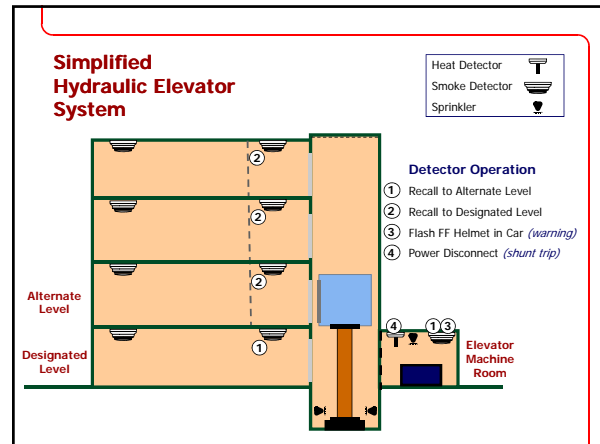
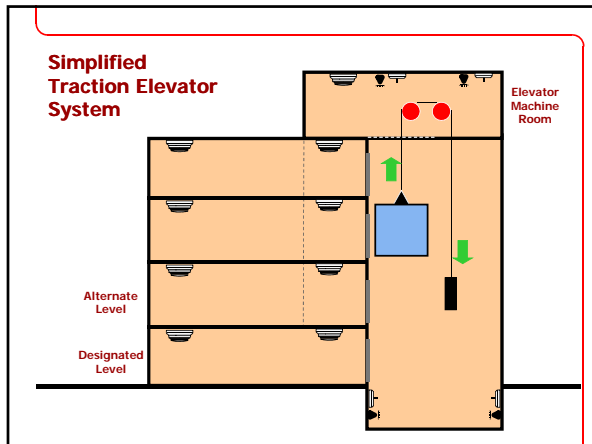
6.16.4 Elevator Shutdown

NFPA 13 - 2007

Chapter 8 – Installation Requirements

8.15 Special Situations

8.15.5 Elevator Hoistway and Machine Rooms



ASME A17.1 - 2004

2.27.3.2.1 In jurisdictions not enforcing the NBCC, fire alarm initiating devices used to initiate Phase I Emergency Recall Operation shall be installed in conformance with the requirements of NFPA 72, and shall be located

- (a) at each floor served by the elevator;
- (b) in the associated elevator machine room; and
- (c) in the elevator hoistway, when sprinklers are located in those hoistways.

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.7 If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be permitted.

NFPA 72 - 2007

5.7 Smoke-Sensing Fire Detectors

5.7.1.8* Unless specifically designed and listed for the expected conditions, smoke detectors shall not be installed if any of the following ambient conditions exist:

- (1) Temperature below 32°F
- (2) Temperature above 100°F
- (3) Relative humidity above 93 percent
- (4) Air velocity greater than 300 ft/min

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.1 System-type smoke detectors or other automatic fire detection as permitted by 6.16.3.7 located in elevator lobbies, elevator hoistways, and elevator machine rooms including machine space, control room, and control space used to initiate fire fighters' service recall, shall be connected to the building fire alarm system.

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.6 Smoke detectors shall not be installed in unsprinklered elevator hoistways unless they are installed to activate the elevator hoistway smoke relief equipment.

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.2* In facilities without a building fire alarm system, these smoke detectors ... shall be connected to a dedicated function fire alarm system control unit that shall be designated as "elevator recall control and supervisory control unit," permanently identified on the dedicated function fire alarm control unit and on the record drawings.

NFPA 72 - 2007

6.16.3 Elevator Recall

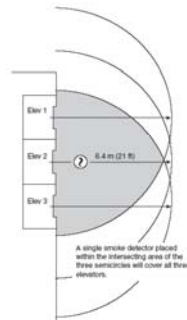
6.16.3.3 Unless otherwise required by the authority having jurisdiction, only the elevator lobby, elevator hoistway, and the elevator machine room smoke detectors ... shall be used to recall elevators for firefighters' service.

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.5* A lobby smoke detector shall be located on the ceiling within 21 ft. of the centerline of each elevator door within the elevator bank under control of the detector.

Smoke Detector Location



NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.5* A lobby smoke detector shall be located on the ceiling within 21 ft. of the centerline of each elevator door within the elevator bank under control of the detector.

Exception: For lobby ceiling configurations exceeding 15 ft. in height or that are other than flat and smooth, detector locations shall be determined in accordance with Chapter 5.

NFPA 72, 2009 ROP

72-187 Log #529 SIG-IDS Final Action: **Accept**
(5.7.3.1.4 and A.5.7.3.1.4 (New))

5.7.3.1.4 If the intent is to initiate action when smoke/fire threatens a specific object or space, the detector shall be permitted to be installed in close proximity to that object or space.

NFPA 72, 2009 ROP

72-187 Log #529 SIG-IDS Final Action: **Accept**
(5.7.3.1.4 and A.5.7.3.1.4 (New))

A.5.7.3.1.4 There are some applications that do not require full area protection, but do require detection to initiate action when specific objects or spaces are threatened by smoke or fire such as at elevator landings that have ceilings in excess of 15 ft. and for protection of fire alarm control units. In high ceiling areas, to achieve the desired initiation such as for elevator recall and protection of FACUs, detection should be placed on the wall above and within 6 ft. from the top of the elevator door(s) or FACU.

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.9 Actuation from elevator hoistway and elevator machine room smoke detectors ... shall cause separate and distinct visible annunciation at the building fire alarm control unit ... and required annunciators to alert fire fighters and other emergency personnel that the elevators are no longer safe to use.

ASME A17.1 - 2004

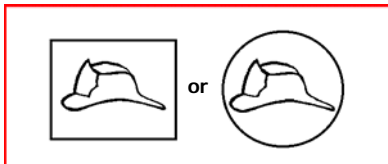
2.27.3.2 Phase I Emergency Recall Operation by Fire Alarm Initiating Devices

2.27.3.2.6 When activated, a fire alarm initiating device in the machine room shall cause the visual signal to illuminate intermittently only in car(s) with equipment in that machine room. When activated, a fire alarm initiating device in the hoistway shall cause the visual signal to illuminate intermittently only in car(s) with equipment in that hoistway.

ASME A17.1 - 2004

2.27.3 Firefighters' Emergency Operation - Automatic Elevators

FIG. 2.27.3.1.6(h)
Visual Signal



"When flashing, exit elevator"

NFPA 72 - 2007

6.16.3 Elevator Recall

6.16.3.12.3 Visual Warning. For each elevator or group of elevators, an output(s) shall be provided for the elevator visual warning signal in response to the following:

- (1) Activation of the elevator machine room initiating devices ...
- (2) Activation of the elevator hoistway initiating devices ...

NFPA 72 - 2007

6.16.3.12.1 Designated Level Recall. For each elevator or group of elevators, an output shall be provided to signal elevator recall to the designated level in response to the following:

- (1) Activation of smoke detectors ... located at any lobby served by the elevator(s) other than the lobby at the designated level.

NFPA 72 - 2007

6.16.3.12.1 Designated Level Recall. *Cont'd.*

(2) Activation of smoke detectors ... located at any elevator machine room serving the elevator(s) except where the machine room is located at the designated level.

(3) Activation of smoke detectors ... located in the elevator hoistway serving the elevator when sprinklers are located in the elevator hoistway unless otherwise specified in 6.16.3.12.2(3).

NFPA 72 - 2007

6.16.3.12.2 Alternate Level Recall. For each elevator or group of elevators, an output shall be provided to signal elevator recall to the alternate level in response to the following:

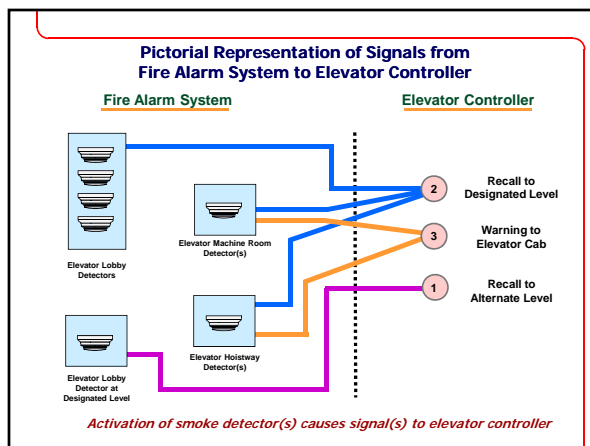
- (1) Activation of smoke detectors ... located at the designated lobby served by the elevator(s).

NFPA 72 - 2007

6.16.3.12.2 Alternate Level Recall. *Cont'd.*

(2) Activation of smoke detectors ... located in the elevator machine room serving the elevator(s) if the machine room is located at the designated level.

(3) Activation of initiating devices identified in 6.16.3.12.1(3) if they are installed at or below the lowest level of recall in the elevator hoistway and the alternate level is located above the designated level.



NFPA 72 - 2007

6.16 Protected Premises Fire Safety Functions

6.16.2.2 A listed relay or other listed appliance connected to the fire alarm system used to initiate control of protected premises fire safety functions shall be located within 3 ft of the controlled circuit or appliance.

6.16.2.3 The relay or other appliance shall function within the voltage and current limitations of the fire alarm control unit.

NFPA 72 - 2007

6.16 Protected Premises Fire Safety Functions

6.16.2.4 The installation wiring between the fire alarm control unit and the relay or other appliance shall be monitored for integrity.

Exception: Relays or appliances that operate on loss of power shall be considered self-monitoring for integrity.

NFPA 13 - 2007

8.15.5 Elevator Hoistway and Machine Rooms

8.15.5.4* Upright, pendent, or sidewall spray sprinklers shall be installed at the top of elevator hoistways.

8.15.5.5 The sprinkler required at the top of the elevator hoistway by 8.15.5.4 shall not be required where the hoistway for passenger elevators is noncombustible and the car enclosure materials meet the requirements of ASME A17.1 ...

NFPA 13 - 2007

8.15.5 Elevator Hoistway and Machine Rooms

8.15.5.1* Sidewall spray sprinklers shall be installed at the bottom of each elevator hoistway not more than 2 ft above the floor of the pit.

8.15.5.2 The sprinkler required at the bottom of the elevator hoistway by 8.15.5.1 shall not be required for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids.

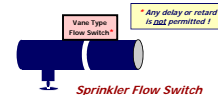
ASME A17.1 - 2004

2.8 Equipment in Hoistways and Machine Rooms

2.8.2.3.2 ... means shall be provided to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water from the sprinklers located in the machine room or in the hoistway more than 24 in. above the pit floor.



Heat Detector



Sprinkler Flow Switch

**Any delay or retard is not permitted!*

NFPA 72 - 2007

6.16.4 Elevator Shutdown

6.16.4.3* If pressure or waterflow switches are used to shut down elevator power immediately upon or prior to the discharge of water from sprinklers, the use of devices with time-delay switches or time-delay capability shall not be permitted.

NFPA 72 - 2007

6.16.4 Elevator Shutdown

6.16.4.1* Where heat detectors are used to shut down elevator power prior to sprinkler operation, the detector shall have both a lower temperature rating and a higher sensitivity as compared to the sprinkler.

Recommendation: *[Example]*

- Use **165 ° F**, ordinary temperature rated sprinkler.
- Use **135 ° F**, thermistor-based heat detector.

Or maintain a similar relationship based on ambient temperatures

Note: Sprinklers in elevator machine rooms and hoistways must be of ordinary or intermediate temperature rating. (NFPA 13 [2007], 8.15.5.3)

NFPA 72 - 2007

6.16.4 Elevator Shutdown

6.16.4.2 If heat detectors are used to shut down elevator power prior to sprinkler operation, they shall be placed within 2 ft of each sprinkler head and be installed in accordance with the requirements of Chapter 5.

Alternatively, engineering methods, such as specified in Annex B, shall be permitted to be used to select and place heat detectors to ensure response prior to any sprinkler head operation under a variety of fire growth rate scenarios.

NFPA 72 - 2007

6.16.4 Elevator Shutdown

6.16.4.5 The initiating devices described in 6.16.4.2 (*HD*) and 6.16.4.3 (*WFS*) shall be monitored for integrity by the control unit required in Section 6.16.3.1 and 6.16.3.2.

Background:

Water from sprinklers in the hoistway and elevator machine room presents a hazard to safe elevator operation:

- *"Shorts" on circuit conductors*
 - *Uncontrolled and dangerous elevator operation*
- *Wet brakes (traction elevators)*
 - *Uncontrolled stopping*

Shunt Trip Operation – (theoretical)

- *Smoke detector actuates, causing elevator recall*
- *Elevators arrive at the recall floor and open doors*
- *Heat buildup causes heat detector to actuate*
- *Shunt trip operates, removing power from the elevator*
- *Sprinkler operates*

Concern:

Potential of passengers becoming entrapped in the elevator if a heat detector or waterflow switch actuates (to cause "shunt trip") prior to the completion of the recall function!

Sprinkler/Power Shutdown Concerns:

- A17.1 Task Group addressed "Shunt Trip" and Sprinklers
- Risk Analysis was performed
- Concern of "over-temperature" of elevator controller
 - Equipment stops
 - Equipment runs erratically / uncontrollably
- Concern water from sprinklers may cause:
 - Brake Failure
 - Shorting out of an electrical safety or control circuit

Sprinkler/Power Shutdown Concerns:

- **A17.1 Task Group Recommendations:**
 - Exempt sprinklers from being installed in elevator machine rooms and the top of the hoistway
 - If sprinklers are installed in elevator machine rooms and/or the top of the hoistway, then the delay of the release of water from sprinklers will be required so recall can be completed first.
 - the "delay strategy"

Sprinkler/Power Shutdown Concerns:

- **A17.1 Task Group Recommendations:**
 - Exempt sprinklers from being installed in elevator machine rooms and the top of the hoistway
 - If sprinklers are installed in elevator machine rooms and/or at the top of the hoistway, then the delay of the release of water from sprinklers will be required so recall can be completed first.
 - the "delay strategy"
- **Consideration of "Earthquake Mode" as a strategy**
 - Stop at next floor

NFPA 72 - 2007

6.16.4 Elevator Shutdown

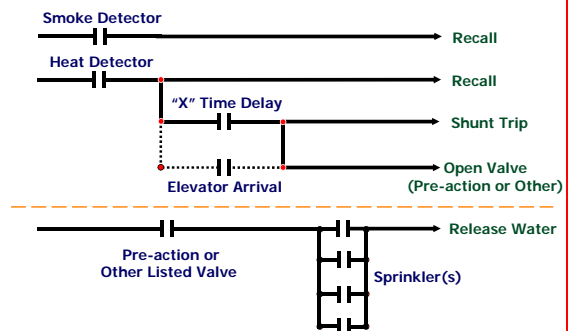
A.6.16.4.4 Upon activation of the heat detector used for elevator power shut down, there should be a delay in the activation of the power shunt trip.

NFPA 72 - 2007

6.16.4 Elevator Shutdown

A.6.16.4.4 Upon activation of the heat detector used for elevator power shut down, there should be a delay in the activation of the power shunt trip. This delay should be the time that it takes the elevator cab to travel from the top of the hoistway to the lowest recall level.

Shunt Trip Operation - Delay Strategy



Shunt Trip Operation - Delay Strategy

Either:

- Pre-Action Sprinkler System
- Fail-Safe Sprinkler Valve

Shunt Trip Operation - Delay Strategy

Sprinkler Valve

- Electrically operated
- 24 VDC from Fire Alarm System
- Normally energized
- Held closed – Fails open



Underwriters Laboratories (UL) UL429,
"Electrically Operated Valves"

NFPA 72 - 2007

6.16.4 Elevator Shutdown

6.16.4.4* Control circuits to shut down elevator power shall be monitored for presence of operating voltage. Loss of voltage to the control circuit for the disconnecting means shall cause a supervisory signal to be indicated at the control unit and required remote annunciators.

ASME A17.1 - 2004

2.8 Equipment in Hoistways and Machine Rooms

2.8.2.3.2 ... means shall be provided to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water from the sprinklers located in the machine room or in the hoistway **more than 24 in. above the pit floor.**

ASME A17.1S - 2005

2.8 Equipment in Hoistways, Machinery Spaces, Machine Rooms, Control Spaces and Control Rooms

2.8.3.3.2 In jurisdictions not enforcing the NBCC, where elevator equipment is located or its enclosure is configured such that application of water from sprinklers could cause unsafe elevator operation, means shall be provided to automatically disconnect the main line power supply to the affected elevator upon or prior to the application of water.

- **A17.1 - 2007 Edition (has been released)**
- **NFPA 72 - 2010 Edition (now in process)**
- **Elevator Use in Fires and Other Emergencies**
 - For Occupants
 - For Firefighters
 - Risk Assessment almost finished
- **Conference 2009 in the works now!**

Elevator Use in Fires and other Emergencies

- *For Occupants*
- *For Firefighters*

Background:

- *Workshop on the Use of Elevators in Fires and other Emergencies (Atlanta – March 2-4, 2004)*
- *Emergency egress re-examined as a result of September 11, 2001 attack on the WTC*
- *Changed the way we look at high-rise buildings and evacuation strategies*

2004 Workshop:

- *Co-sponsored by ASME, NIST, ICC, NFPA, IAFF, and the US Access Board*
- *120 attendees representing a cross section of industry*
- *20 Fire service representatives – funded by NIST and FEMA*

Workshop Program:

- *3-day conference (address challenges posed by egress from tall buildings)*
- *Plenary sessions (selected papers presented)*
- *Breakout groups (brainstorming and development of recommendations on how elevators could be put to better use during emergencies)*

Workshop Program:

- ***Focus:***
 - *Use of Elevators by Firefighters*
 - *Use of Elevators by Occupants During Emergencies*
- ***Goal:*** *to develop proposals that can be submitted to various code writing organizations for consideration*

Workshop :

- ***Steering Committee:*** *made up of representatives from each of the sponsoring organizations*
 - *Review breakout groups recommendations*
 - *Develop a prioritized list of issues*
 - *Conduct a hazard analysis of the issues*
 - *Draft code revisions for those issues*

Process:

- **ASME took lead on the hazard analysis**
- **2 Task groups**
- **Occupants** - to evaluate the use of elevators for egress in emergencies ... what can be done to decrease egress time
- **Firefighters** – to evaluate use of elevators by firefighters during fire operations ... what can be done to mitigate existing hazards

Workshop :

- **Consistent Themes - Concerns:**
- Culture change since 9-11 ... total evacuation
- Elevators are not a “substitute” for stairs
- Evacuation of mobility impaired people
- Lack of firefighter confidence in using elevators
- Elevator reliability issues
- Water entering hoistways

Workshop :

- **Consistent Themes - Concerns:**
- Rescue of passengers
- Shunt trip – entrapment
- Loss of elevator power from elsewhere in the building
- Retraining occupants to “use elevators” (in some buildings)
- Cost concerns
- Not enough information for occupants to make an informed decision

Workshop :

- **Consistent Themes - Recommendations:**
- Mandatory adoption of ASME A17.3 ... everywhere
- Ensure reliability of Phase I, Phase II operation
- Better training on elevator operation for firefighters
- Regular testing by qualified (certified?) personnel
- Building Emergency Action Plan enforcement

Workshop :

- **Consistent Themes - Recommendations:**
- Sprinkler all buildings
- Compartmented/pressurized lobbies/vestibules
- Area of Refuge / Rescue Assistance
- Better “real time” communications to occupants
- Better “real time” communications to firefighters
- Elevator technician respond to building emergencies

Workshop :

- **Consistent Themes - Process:**
- Utilize Hazard Analysis
- Involve firefighters in decisions
- Involve appropriate committees (A17-B44, Building codes, NFPA, etc.

Process:

- **Hazard Analysis** (*not a risk analysis*)
 - Develop scenarios
 - Identify hazards
 - Mitigate the hazard
 - Identify residual hazards
 - Mitigate the residual hazards

Process:

- **Situational Awareness Analysis**
 - Identify the task related questions that people need answered concerning the use of elevators during building emergencies so they can make decisions
 - Identify the types of information that people need to answer those questions
 - Identify residual hazards resulting from mistakes caused by poor situation awareness.
 - Cross-reference the findings in the SA analysis to the hazard analyses.
 - Identify corrective actions (hardware and protocols) for providing the information identified in step 2. Current and evolving technologies should be considered (e.g. email, telephone, chat-room, text messaging, website, etc).

Recommendations:

- **Robust fire service elevators**
- Provides greater protection allowing the elevator to continue to operate for the firefighters during their operations.
 - Protection from water
 - Protection from smoke and heat
 - Direct access to protected lobby and stairwell containing standpipe
 - Protection of primary and backup power supplies

Recommendations:

- **Emergency Evacuation Operation [EEO]**
- Scalable: EEO can be applied to one or more elevators in the building but is not necessarily required on all elevators. Allows elevators to be used for evacuation until they are recalled.
 - Routing of elevators
 - Cancel all pre-existing calls
 - Not accept car calls except for designated level
 - Respond only to hall calls at affected floors
 - As the fire grows to include more floors, the zone of affected floors would also increase

Recommendations:

- Provide protected elevator lobbies
- Dynamic signage at elevator lobbies
- Early warning detection
- 2-hour fire rating for elevator power feeders
- Remote control operation of elevators for firefighter use
(shuttle equipment, etc.)

Current Status:

- Nothing is cast in stone at this time, however, NFPA and ICC proceeding with process
- Still a "Work in Progress"
- Another symposium is being planned for 2009
- Analyses should be complete end of 2008
- Glacial speed ...

Stay tuned !