Don’t Get Caught Up (or Down)"

Fire Protection and Life Safety Requirements for Elevator Systems

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Topics

• Basic intro to elevator types
• 2015 International Building Code (IBC) and International Fire Code (IFC)
  o General construction requirements, function, etc.
  o Specifics of Fire Service Access Elevators (FSAE) and Occupant Evacuation Elevators (OEE)
• National Fire Protection Association (NFPA) requirements
  o NFPA 13 and NFPA 72
• Touch upon ASME A17.1-2013 (by reference)
Alternate Compliance - Important Exclusions/Additions

- Unified Facilities Criteria (UFC)
  - 3-600-01, Section 6-30
  - Breakdown by elevator type, etc.

- GSA PBS P-100 Facilities Standards for the Public Buildings Service, Section 7.10

Not Included

- General safety requirements
  - Lights, ladders, safety interlocks for maintenance, etc.
- Convenience requirements
  - Sump pumps, maintenance outlets, etc.
- Pressurization/Venting
  - Presentation on its own
- Construction Elevators
- Full-on Commissioning
  - Loading requirements, etc.
Elevator Types

Typical Elevator Types

- Direct Plunger
- Hole-less Hydraulic
  - Machine Room or Machine Room-less
- External Machine Room Traction Elevator
- Machine Room-less Traction Elevator
  - Geared and Non-Geared

Understanding operational concepts will help you understand code requirements.
Elevators are Simple

Direct Plunger Elevator

- Hydraulically-based
  - Limited to casing
- Piston and bore casing below
- Limited equipment above car
- Hydraulic machine room
  - Controller and reservoir
- Limited Travel (<60 ft)
Hole-less Hydraulic Elevator

- Hydraulically-based
  - Shaft and Mechanical Room
- Limited equipment above car
- Pistons in shaft
- Hydraulic machine room
  - Controller and reservoir
- Limited Travel (<30 ft)
  - Single Stage, 2-Stage, 3-Stage, etc. for greater travel

Machine Room Traction Elevator

- Strictly mechanical
- Direct drive or pulley drive from adjacent room
  - With counterweight
- Most common for high-rise
  - Gearless models up to 825 ft
**Machine Room-less Traction Elevator**

- Strictly mechanical
  - In shaft or on car
- Noncombustible components
  - Cable vs. belt?
- Direct drive
- Most common for mid/high-rise
  - 100-300 ft

**Machine Rooms**

- Vary in size and hazard based on type
- Typically adjacent to shaft
  - IBC expects this
  - These days, not many penetrations
Controller (Traction or Hydraulic)

Hydraulic Components

...About 40 gal of hydraulic oil (ISO 46, FP = 594°F)
IBC 3005.4 - Changed

Elevator machine rooms, control rooms, control spaces and machinery spaces outside of but attached to a hoistway that have openings into the hoistway shall be enclosed with fire barriers constructed in accordance with Section 707 or horizontal assemblies constructed in accordance with Section 711, or both. The fire-resistance rating shall be not less than the required rating of the hoistway enclosure served by the machinery.

Just Askin’…

Even when connected to the shaft…

Is there a distinct hazard?
Code Bases

Starts with 2015 IBC/IFC and referenced standards therein:

- ASME A17.1, 2013
- NFPA 13, 2013
- NFPA 72, 2013

Not a whole lot has changed in the sub-standards. Substantial requirements in the IBC/IFC.

International Building Code (IBC) and International Fire Code (IFC) “General” Requirements
**Hoistway Enclosures**

- Built as “shafts” using fire barrier construction
  - 1 hr for < 4 stories
  - 2 hr for 4 or more stories
  - Additional requirements for impact resistance, etc.
- Maximum of 4 cars per shaft when they all serve the same building area (IBC 3002.2)
- Elevators shall not be in a common enclosure with a stairway (IBC 3002.7)
- No plumbing or mechanical systems (IBC 3002.9)

**Shaft Construction Needs Detail**

- Continuity per IBC 707.5
  - Foundation to roof – or – supported on rated construction
  - Shaft wall liner and CMU construction common
- Rated openings
  - Elevator door ratings are a given
- Pressure induced loads
Elevator Cab Size

- Where elevators are provided in buildings four or more stories above, or four or more stories below, grade plane, not fewer than one elevator shall be provided for fire department emergency access to all floors.

- The elevator car shall be of such a size and arrangement to accommodate an ambulance stretcher 24 inches by 84 inches with not less than 5-inch radius corners, in the horizontal, open position.

Also required as part of full FSAE and OEE
Power and Emergency Operations

- Standby power is optional, but where provided:
  - Automatic transfer (within 60 seconds)
  - Manual transfer means is also required
- Phase I Emergency Recall (Automatic)
  - NFPA 72, etc.
- Phase II (Manual) Key Operated in Cab
  - Standardized Key

International Building Code (IBC) and International Fire Code (IFC) “Special” Requirements
**Fire Service Access Elevators (FSAE)**

Where required by Section 403.6.1, every floor of the building shall be served by fire service access elevators complying with Sections 3007.1 through 3007.9.

- Occupied floors greater than 120 ft FD vehicle access
- At least 2
- 3,500-lb. capacity
- Sized for stretcher

**FSAE Requirements**

- Fire Service Access Lobby
  - Formed by 1-hr smoke barriers with smoke/draft doors
    - Ultra-high-rises get impact resistant construction
  - Direct access to stairway
  - > 150 sf with a dimension not less than 8 ft
- Standby power and **protection** of power
  - Power the equipment, lights, ventilation
  - Cables outside the hoistway or machine room need protection commensurate with the shaft rating (3007.8.1)
- Monitored in the Fire Command Center
**FSAE Requirements (cont.)**

- **Protection Against Water**
  - Mechanical Rooms are NOT sprinklered
    - NO Shunt trip
  - An *approved* method to prevent water from infiltrating into the hoistway enclosure from the operation of the *automatic sprinkler system* outside the enclosed fire service access elevator lobby shall be provided
- **Standpipe Connection**
  - Class I in stair with common access between the stair and elevator lobby

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**Occupant Evacuation Elevators (OEE)**

- Concept developed through ASME Hazard analysis
- Any building could utilize this concept if in compliance with IBC Section 3008
- Primarily as an alternative to 3rd stair requirement in High rise provisions (Building height > 420 feet) – not mandatory
**OEE Initiation Requirements**

- Assign call priority prior to Phase I recall
- Automatic detection on floors
  - Smoke/heat, water flow
  - Also manual initiation from Command Room (not manual pull stations)
  - NOT active if Level of Exit Discharge is in alarm
- Establish evacuation zones
  - Alarm floor and 2 floors above/floor below
  - Multiple alarm floors provision (increased alarm group) with priority to highest floor
  - Travel between priority floor(s) and discharge level in “express” mode

**OEE Lobby Requirements**

- 1 hr smoke barriers
- Direct access to co-located egress stair
- Size
  - 3 sf per person, at least 25% of occupant load of floor
  - One wheelchair space (30 x 48 inches) for each 50 occupants of floor or portion thereof
- Protection against water infiltration
- Standby power and protection of power
- Two way communication in lobby
- Occupant notification (minimum 1 device)
Comparison of Features

<table>
<thead>
<tr>
<th>Element of Lobby</th>
<th>Fire Service Access Elevator (3007)</th>
<th>Occupant Evacuation Elevators (3008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobby Size</td>
<td>150-sq ft minimum with 8-foot minimum dimension</td>
<td>3 square feet per person for 25% of occupants and 30-inch by 48-inch wheelchair for each 50 occupants</td>
</tr>
<tr>
<td>Lobby Enclosure</td>
<td>Not required at street floor</td>
<td>Not required at level(s) of exit discharge</td>
</tr>
<tr>
<td>Door</td>
<td>3/4-hour door tested without bottom seal</td>
<td>Automatic closing 3/4-hour door with a vision panel</td>
</tr>
<tr>
<td>Wall</td>
<td>1-hour smoke barrier</td>
<td>1-hour smoke barrier</td>
</tr>
<tr>
<td>Access</td>
<td>Direct access to exit enclosure</td>
<td>Direct access to exit enclosure</td>
</tr>
</tbody>
</table>

Hoistway Venting

- Deleted requirements in 2015
- Conflicts with hoistway pressurization
- Intent conflicts with need for traditional elevator lobbies
**Integrated Elevator Controls**

- Requires a LOT of coordinating between GC, FA, AS, and Elevator contractors
- Basic NFPA requirements
  - Functions include recall and shunt, and could include alternate power testing (battery lowering)
- Often conflicting requirements and interpretations
  - ASME A17.1 vs. UFC vs. P-100
NFPA 13 Sprinkler Design Questions

- Elevator Technology (Hydraulic or Traction)
  - Sprinkler required at bottom of pit (± 2ft AFF) – not for traction elevators (8.15.5.2)
  - Traction elevators comprised of belts require sprinkler protection at top and bottom of shaft with exception provided for low flame spread (8.15.5.7)

- Elevator Cab Materials
  - If “limited combustibility” – Omit sprinklers from shaft
  - Beware of existing elevators in retro-active sprinklered buildings

Need to also know base Code

Unsprinklered Machine Rooms

“New” in 2013 – Allowed When:

- Traction elevator machine rooms containing elevator equipment only
- Protected by smoke detectors, or other automatic fire detection
- Area is separated from the remainder of the building by fire rated construction
- No storage
- Exception is NOT for hydraulic elevators
  - So important, it looks like a repeat of Condition 1
**Key Parameters: Recall**

- Provided by lobby heat or smoke detection which initiates a recall to a safe floor
  - Designated primary and alternate
- Also provided by machine room detection and shaft detection – if present
- Selection of primary and alternate should be based on Engineering Judgment and must be documented in the I/O matrix
  - Recall on general alarm – not required

**NFPA 72 Recall**

- Typically smoke or heat depending on lobby environment
  - Parking Garages, *etc.*
  - Code allows water flow switch when dedicated (rare)
- Lobby smoke within 21 ft of the centerline of each elevator door in a bank
  - One detector can serve multiple openings
  - Spacing adjustments of Chapter 17 apply with ceilings over 15 ft tall
- 21.3.12: With approval, elevator recall detectors can be supervisory? – Possible
Additional Recall Device Locations

21.3.7 When sprinklers are installed in elevator pits, automatic fire detection shall be installed to initiate elevator recall in accordance with 2.27.3.2.1(c) of ANSI/ASME A17.1/CSA B44, Safety Code for Elevators and Escalators, and the following shall apply:

(1) Where sprinklers are located above the lowest level of recall, the fire detection device shall be located at the top of the hoistway.
(2) Where sprinklers are located in the bottom of the hoistway (the pit), fire detection device(s) shall be installed in the pit in accordance with Chapter 17.
(3) Outputs to the elevator controller(s) shall comply with 21.3.14.

Primary Recall

21.3.14.1 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, or other automatic fire detection as permitted by 21.3.9, located at any elevator lobby served by the elevator(s) other than the lobby at the designated level
(2) Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.9, located at any elevator machine room, elevator machinery space, elevator control space, or elevator control room serving the elevator(s), except where such rooms or spaces are located at the designated level
(3) Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.9, located in the elevator hoistway serving the elevator where sprinklers are located in the hoistway, unless otherwise specified in 21.3.14.2(3)
Alternate Recall

21.3.14.2 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, or automatic fire detection as permitted by 21.3.9, located at the designated level lobby served by the elevator(s)
2. Activation of smoke detectors, or other automatic fire detection as permitted by 21.3.9, located in the elevator machine room, elevator machinery space, elevator control space, or elevator control room serving the elevator(s) if such rooms or spaces are located at the designated level
3. Activation of the initiating devices identified in 21.3.14.1(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

Just Askin’

• 2-Story 1st Floor Lobby Recall

<table>
<thead>
<tr>
<th>Alternate Level</th>
<th>Primary Level</th>
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<tbody>
<tr>
<td>Alternate</td>
<td>Primary</td>
</tr>
</tbody>
</table>

Lobby
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• Hi-Rise and Low Rise Elevator Bank Recall

Primary

Alternate

Alternate

Primary

“Express” Zone

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• For hydraulic elevators where should it go?

NFPA 72, 21.3.14.2(3)
Alternate Recall to Avoid Fires in Pit

A.21.3.14.2(3) Where initiating devices are located in the elevator hoistway at or below the lowest level of recall, ANSI/ASME A17.1/CSA B44, Safety Code for Elevators and Escalators, requires that the elevator be sent to the upper recall level. Note that the lowest level of recall could be the designated level or alternate level as determined by the local authority for the particular installation. Also note that the elevator hoistway, as defined in ASME A17.1, includes the elevator pit.

Firefighter Warning

• Activation of primary recall detectors
  o SOLID HAT
• Activation of the elevator machine room, elevator machinery space, elevator control space, or elevator control room initiating devices identified in 21.3.14.1(2) or 21.3.14.2(2)
  o FLASHING HAT
• Additional reqmts. for annunciation in Command Room (where provided) for FSAE and OEE
  o Typically handled by elevator control panel
Key Parameters: Shunt Trip

- In the presence of a sprinkler system, shunt trip kills power to critical equipment before sprinkler operation
  - Top of shaft and elevator machine rooms
  - Note machine room and machine room-less
- Mechanism to achieve shunt trip is heavily-debated (Temp Ratings, QR vs. SR, etc.)
  - Intent of Code (remove power before water)
  - Recognized approaches

Shunt Trip Approaches

Traditional
- Heat detection with an activation temperature less than the activation temperature of the sprinkler heads

Alternates (Allowed)
- Zero-Retard (Non-field-settable) Flow Switch

*Or just get rid of sprinklers?*
**NFPA 72 Shunt Trip Requirements**

- **Heat Detectors – Lower Temperature/Higher Sensitivity**
  - Usually see FA adjusted 135°F instead of SR heads
- **Heat detector must be within 24 in. of each sprinkler head**
  - Performance-based approach (not typical)
- **21.14.3 Also Allows flow switch with no time delay**
- **Shunt trip relay power must be monitored**
  - Transmit supervisory if impaired

*Excellent Flow Chart in ASME A17.1, 2.8.3.3.2*

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**NFPA 72 Requirements for FSAE**

Section 21.5, *The following conditions shall be continuously monitored and displayed:*

- Normal and emergency power availability
- Status of the elevator(s), including location within the hoistway, direction of travel, and whether they are occupied
  - Elevator management system should provide
- Temperature and presence of smoke in associated lobbies and machine room (if provided)
  - Temperature of lobby?
**NFPA 72 Requirements for OEE**

*All the requirements of Section 21.5, Plus:*

- Notify Fire Command when the elevator is called into Occupant Evacuation Mode
- Ability to start total evacuation or selective evacuation based on an alarm signal received from a specific floor or by Fire Command
  - Pass these signals through relays to elevator controller
- Special alarm floor evacuation messages
  - “USE” Elevator…
  - Safe Zone Messages – by Alarm Group

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**Unified Facilities Criteria (UFC) 3-600-01 “Fire Protection Engineering for Facilities**
UFC Elevator Requirements

- Broken-out by Elevator Type
  - Recall general construction features of each type and follow along
- Similar requirements for primary and alternate recall (function only – initiation may be different)
  - Heat/Smoke in Lobbies w/ key-operate Phase II
  - Fire hat illumination and flash
- Similar shunt requirement
  - Machine room and shaft
  - NO shunt in pit

UFC Deviations/Variations

- Navy and DLA projects get 2 hr rating on all heights
- Shunt trip function is activated by zero-retard (non-field-settable) flow switch
  - Potter VS-SP
  - Cannot discharge to Janitor closet
- Individual control valves are required for top of shaft and machine room
- Special protection based on machine room placement
- So far…No option for unsprinklered machine room
UFC Traction Elevators

UFC Machine Room-Less (Code is Behind)
UFC Hole-Less Hydraulic

GSA PBS P-100 “Facilities Standards for the Public Buildings Service” Section 7.10
**P-100 Key Features**

- Sprinklered Machine Rooms – unless GGSA Regional FPE allows unsprinklered
  - Some are being taken out...Region 07 deletes them
- Separate control valve/flow switch (similar to UFC), located outside the room
- Similar shunt trip requirements (sprinklered)
- Similar lobby construction requirements
- Similar FSAE and OEE requirements
  - OEE required (not optional design) for new construction >120 ft

**GSA Elevator Retro-Fit**
P-100 Key Features (cont.)

• For EVACS Systems, provide speaker in cab
  ○ Activates on manual/live broadcast messages only
• Head guards required on all heads in sprinkler machine room and elevator pits
  ○ Machine room head guards not typically enforced if > 7 ft AFF
• Portable fire extinguisher required in machine room, even if potentially excluded elsewhere in fully-sprinklered building

Summary

• Elevators are “simple”
  ○ Fit into basic types warranting prescriptive protection
• Know common construction requirements
  ○ Shaft ratings
  ○ Special lobby construction for FSAE/OEE
  ○ Not many other lobby requirements in sprinklered buildings
  ○ Machine room construction
  ○ Construction details for proprietary systems, including support structures
Summary (cont.)

• FSAE and OEE special functional requirements
• Sprinkler and fire alarm requirements have been fairly consistent
  o NFPA13 recognition of unsprinklered machine rooms
• If you are a designer:
  o Ask basic questions on configuration and programming
  o Know the potential conflicts in codes and establish hierarchy of compliance

Special Thanks to:

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Jim Poston, GSA Elevator Inspector

Questions/Discussion…