Interfacing Elevators with Fire Alarm and Sprinklers

IEEE

Atlanta Chapter

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Brian K Fabel, PE




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Agenda

- Today's Codes
  - NFPA, ASME, IBC/IFC
- Conflicts/Issues
- Tomorrow's Codes?




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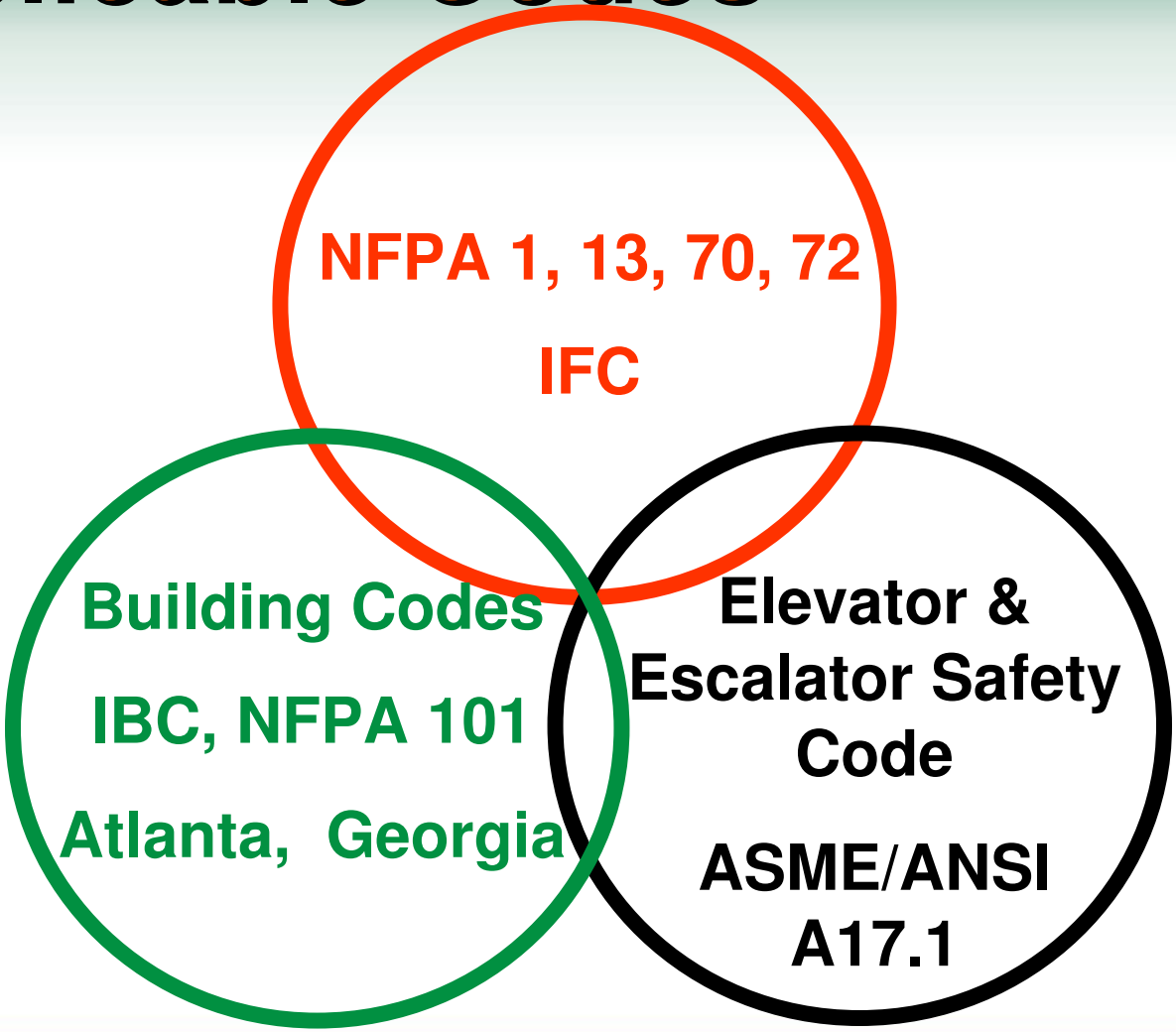
Applicable Codes



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Problem!

Can’t find all the requirements in one place!

Must use Codes together!




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Bigger Problem!

Codes are out of Synch!

- **ASME A17.1**
  - 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 13 & 72**
  - 1996
  - 1999
  - 2002
  - 2007




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ASME A17.1

- **Safety Code for Elevators and Escalators**
  - **Provides Operational Sequences for:**
    - **Phase 1 - Emergency Recall Operation**
    - **Power Shutdown – "Shunt Trip" Operation**




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ASME A17.1

Phase 1 - 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




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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




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ASME A17.1

- Added in 2004
- Section 2.27 - Emergency Operation and Signaling Devices
  - 2.27.3.2 – Phase 1 Emergency recall operation by fire alarm initiating devices




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ASME A17.1 - 2004

- Section 2.8 – Equipment in Hoistways, Machinery Spaces, Machine Room, Control Spaces and Control Rooms
  - 2.8.2.3.2
    - Shunt Trip/Power Disconnect Requirement




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International Building Code- 2003

- Chapter 30 Elevators and Conveying Systems
- Section 3003 – Emergency Operations
- Section 3006 – Machine Rooms




International Fire Code- 2002

- Section 607 –
  Elevator Recall and Maintenance
- 607.1 Required.

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NFPA 1 - 2002

- Chapter 13
  Fire Protection Systems
- 13.7 Detection Alarm
  & Communication Systems

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NFPA 72 -2002

- Chapter 6 – Protected Premises
- 6.15 Protected Premises Fire Safety Functions
  - 6.15.3 - Elevator Recall for Fire Fighters Service
  - 6.15.4 – Elevator Shutdown




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- Chapter 8 – Installation Requirements

- 8.14 – Special Situations

  8.14.5 – Elevator Hoistway and Machine Rooms




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Code of Ordinances, Atlanta

- ARTICLE C. ELECTRICITY*
- Sec. 8-2102. Elevator code; adopted by reference.

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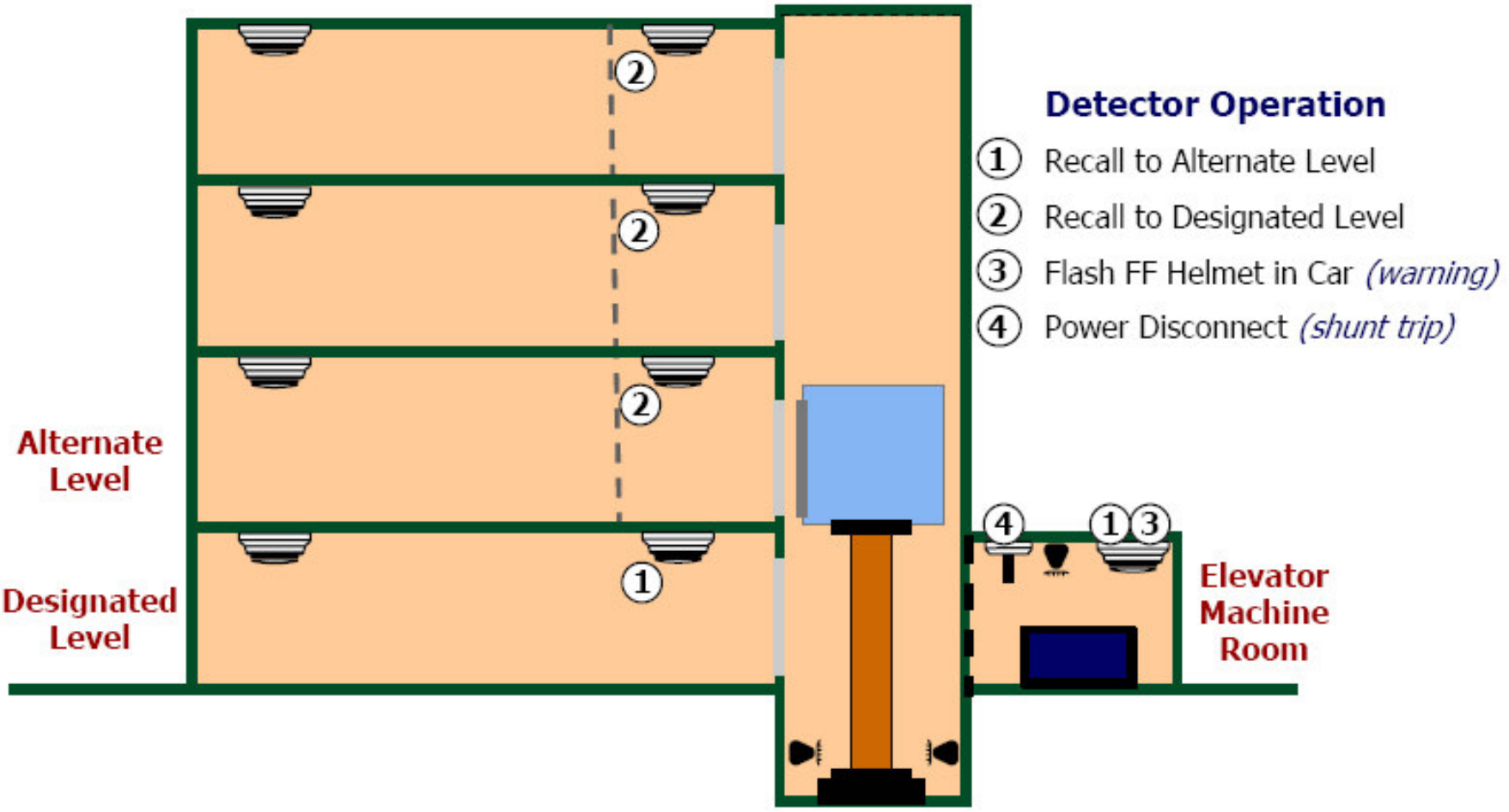
Simplified Hydraulic Elevator System



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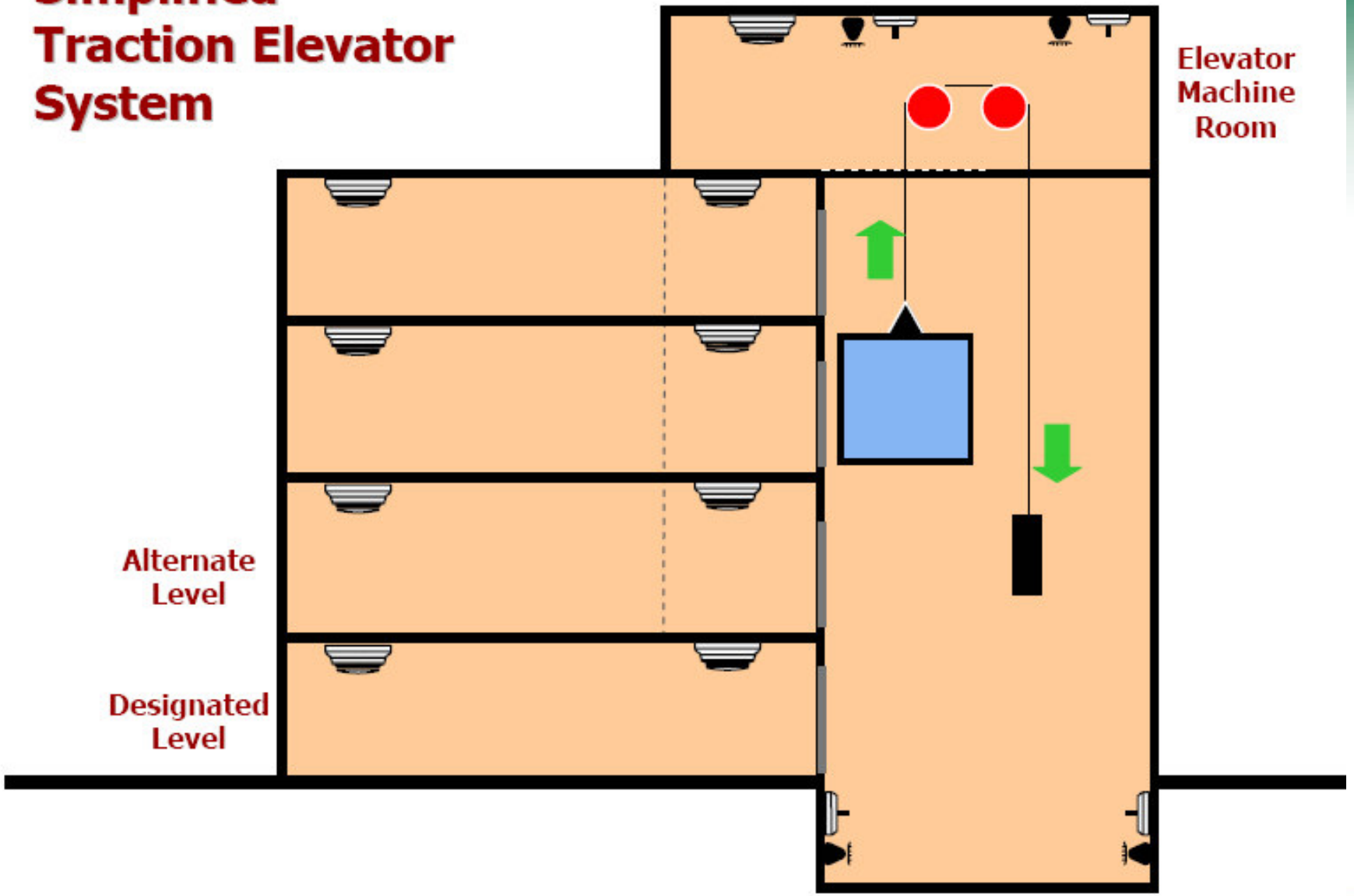
Simplified Traction Elevator System



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ASME A17.1 – 2004

- **2.27.3.2.1 – In Jurisdiction not enforcing the NBCC, fire alarm initiating devices used to initiate Phase 1 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.**




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International Building Code- 2003

- Chapter 30 Elevators and Conveying Systems
- Section 3003 – Emergency Operations
- 3003.2 – Fire Fighter's emergency operation. Elevators **shall be** provided with Phase I emergency recall operation …in accordance with **ASME A17.1**.




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International Building Code- 2003

- Chapter 30 Elevators and Conveying Systems
- Section 3006 – Machine Rooms
- 3006.5 –Shunt Trip. Where elevator hoistways or elevator machine rooms containing elevator control equipment are protected with automatic sprinklers, a means installed in accordance with NFPA 72, Section 3-8.15, Elevator Shutdown, *(now 6.15.4)* shall be provided to disconnect automatically the main line power supply to the affected elevator prior to the application of water. This means shall be self-resetting. The activation of sprinklers outside the hoistway or machine room shall not disconnect the main line power supply.

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International Fire Code- 2002

- Section 607 – Elevator Recall and Maintenance
- 607.1 Required. Existing elevators with a travel distance of 25 feet or more above or below the main floor or other level of a building and intended to serve the needs of emergency personnel for fire-fighting or rescue purposes shall be provided with emergency operation in accordance with ASME A17.3. New elevators shall be provided with Phase I emergency recall operation and Phase II emergency in-car operation in accordance with ASME A17.1.




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Code of Ordinances, Atlanta

- **ARTICLE C. ELECTRICITY***
- **Sec. 8-2102. Elevator code; adopted by reference.**
- CHAPTER IADMINISTRATIONSECTION 101 TITLE AND SCOPE, 101.2 The provisions of this code shall apply to the construction, installation, alteration, repair, location, use, and maintenance of all new and existing elevators, escalators, manlifts, personnel hoists, and related equipment unless specifically exempted by statute or ordinance within the corporate limits of the City of Atlanta, Georgia.The scope of this code does not apply to Georgia laws regulating and licensing carnival rides (see title 34 of the Official Code of Georgia Annotated).This code is **hereby declared to be remedial**; other codes and ordinances affecting the construction installation, alteration, repair, location, use, and maintenance of elevators, escalators, manlifts, personnel hoists, and related equipment are as follows:
  - (j) *Georgia Fire Safety Law:* For regulations governing means of egress and safety to life requirements, see the Georgia Fire Safety Law and the rules of the Georgia Safety Fire Commissioner pertaining thereto, Bureau of Buildings, Building Inspection Division.

NFPA 1 - 2002

- 13.7 Detection Alarm & Communication Systems
- 13.7.1.4.9.2.1* Elevator lobby, hoistway, and associated machine room smoke detectors used solely for elevator recall, and heat detectors used solely for elevator power shutdown, shall not be required to activate the building evacuation alarm if the power supply and installation wiring to such detectors are monitored by the building fire alarm system, and if the activation of such detectors initiates a supervisory signal at a constantly attended location.

NFPA 1 - 2002

- 13.7 Detection Alarm & Communication Systems
- 13.7.1.4.9.5.6 Visible signals **shall not** be required in elevator cars.
- 13.7.1.4.9.6.6 The general evacuation signal **shall not** be required to operate in elevator cars.

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NFPA 72 - 2002

- 6.15.3 Elevator Recall
- 6.15.3.1 System-type smoke detectors or other automatic fire detection as permitted by 6.15.3.7 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.




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- 6.15.3 Elevator Recall
- 6.15.3.7 – If ambient conditions prohibit installation of automatic smoke detection, other automatic fire detection shall be permitted.




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NFPA 72 -2002

- 5.7.1.8 Special Conditions
- 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 0ºC (32 ºF)
  - (2) Temperature above 38ºC (100 ºF)
  - (3) Relative Humidity above 93 percent
  - (4) Air velocity greater than 1.5 m/sec (300 ft/min)




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- 6.15.3 Elevator Recall
- 6.15.3.6 – Smoke detectors **shall not be installed** in unsprinklered elevator hoistways **unless** they are installed to activate the elevator hoistway smoke relief equipment




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- 6.15.3 – Elevator Recall
- 6.15.3.2* - In facilities **without a building fire alarm system**, these smoke detectors…shall be connected to a dedicated fire alarm system control unit that shall be designated as **"elevator recall control and supervisory panel"** permanently identified on the control unit and on the record drawings.




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- 6.15.3 Elevator Recall
- 6.15.3.3 – 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.




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- 6.15.3 Elevator Recall
- 6.15.3.5* - 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.




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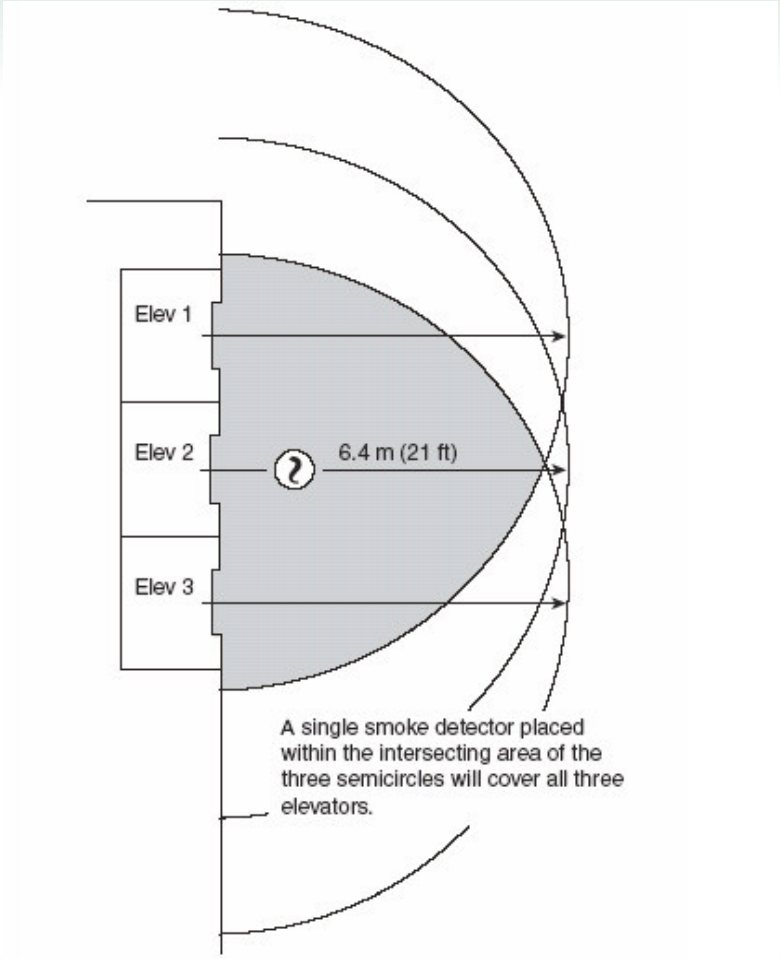
Smoke Detector Location



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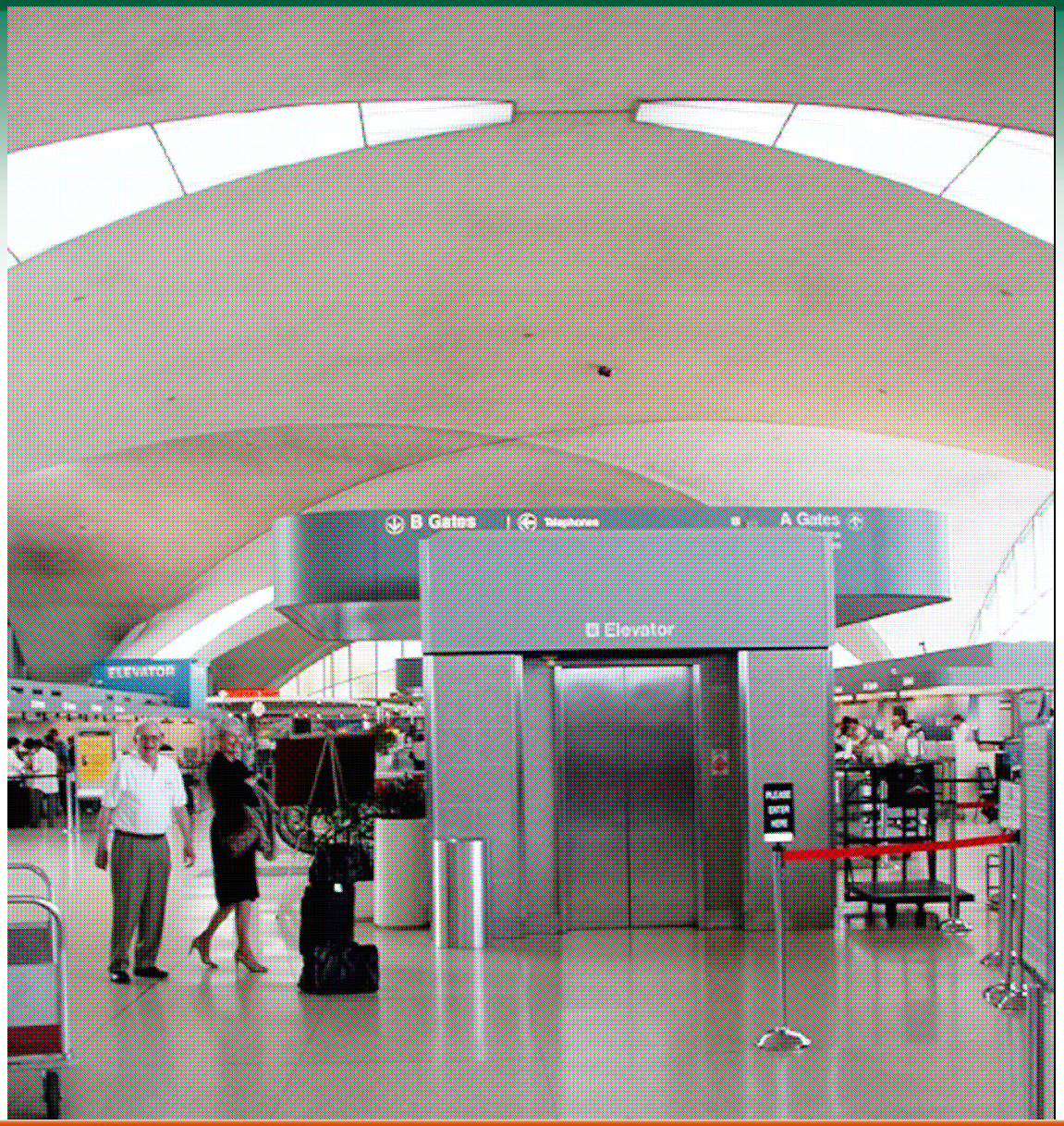




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- 6.15.3 Elevator Recall
- 6.15.3.9 – Actuation from elevator hoistway and elevator machine room smoke detectors…shall cause separate and distinct visible annunciation at the control unit and required annunciators to alert fire fighters and other emergency personnel that the elevators are no longer safe to use.




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ASME A17.1 - 2004

- 2.27.3.2 Phase 1 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.




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ASME A17.1 - 2004

- 2.27.3.2 Phase 1 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 the 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.




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ASME A17.1

- **2.27.3 Firefighters' Emergency Operation – Automatic Elevators**

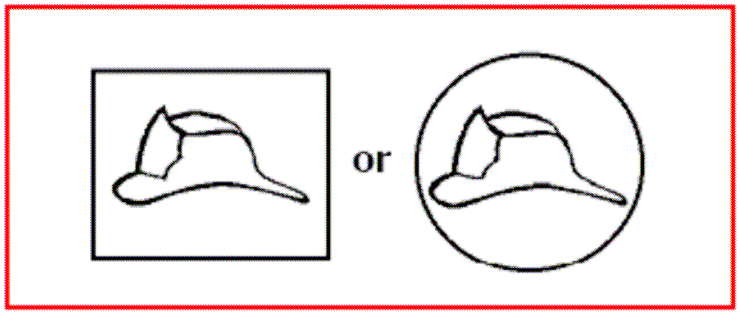

FIG. 2.27.3.1.6(h)

Visual Signal




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NFPA 72 - 2002

- 6.15.3 Elevator Recall
- 6.15.3.10* - For each group of elevators within a building, a minimum of three separate elevator control circuits shall be terminated at the designated elevator controller within the group's elevator machine room(s)… the smoke detectors…shall actuate the elevator control circuits as follows:




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- 6.15.3 Elevator Recall
- 6.15.3.10* cont'd…

(1) The smoke detector located in the designated elevator recall lobby shall actuate the first elevator control circuit. In addition, if the elevator is equipped with front and rear doors, or if the elevator machine room is located at the designated level, the required detectors shall actuate the first elevator control circuit. The detectors in both lobbies at the designated level shall actuate the first elevator control circuit.




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- 6.15.3 Elevator Recall
- 6.15.3.10* cont'd…

(2) The detectors in the remaining elevator lobbies shall actuate the second elevator control circuit.

(3) The detectors in elevator hoistways and the elevator machine room(s) shall actuate the third elevator control circuit.




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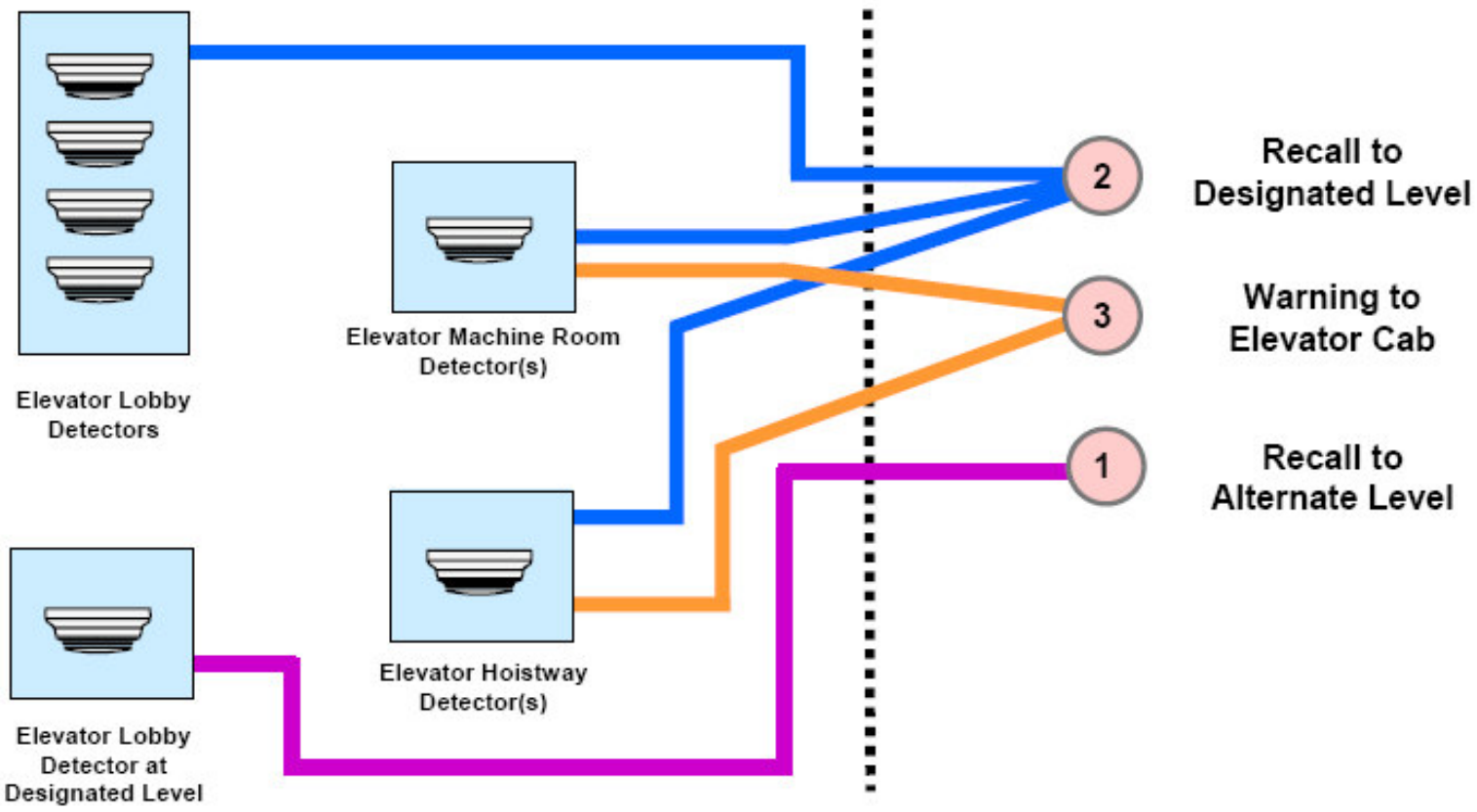
Pictorial Representation of Signals from Fire Alarm System to Elevator Controller



Activation of smoke detector(s) causes signal(s) to elevator controller

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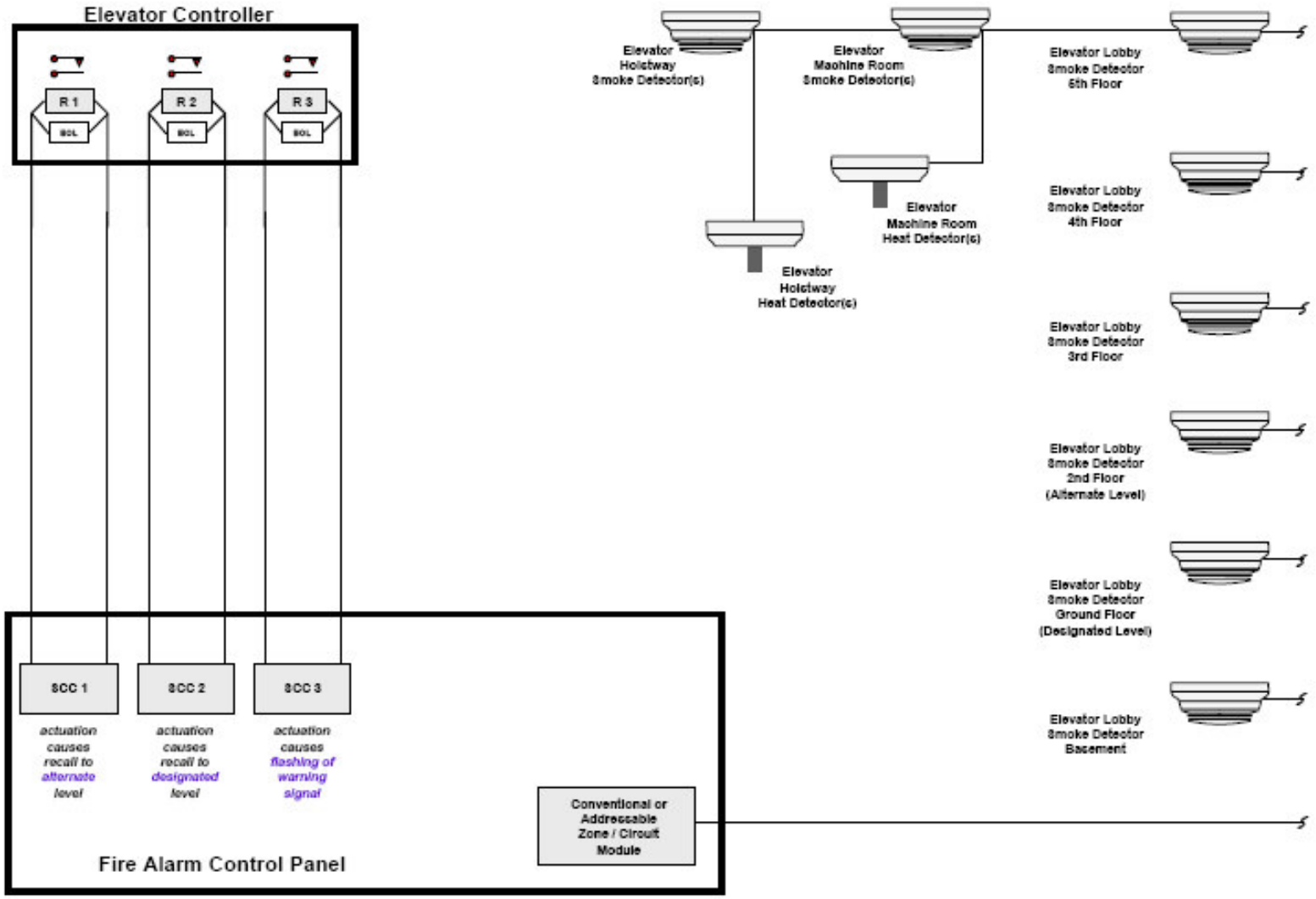
Fire Alarm System / Elevator Controller Relationship



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- 6.15 Protected Premises Fire Safety Functions
- 6.15.2.2 – 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**.
- 6.15.2.3 – The relay or other appliance shall function within the voltage and current limitations of the fire alarm control unit.




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- 6.15 Protected Premises Fire Safety Functions
- 6.15.2.4 – 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.




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Addressable Control Relays




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Addressable Control Relays




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NFPA 72 - 2002

- 6.15.3 Elevator Recall
- A.6.15.3.10 – It will be necessary sometimes to provide more than three (3) signals to the elevator controller. A17.1 requires differentiation between separate hoistways that share a common elevator machine room.




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NFPA 72 - 2002

- 6.15.3 Elevator Recall
- A.6.15.3.10 – It will be necessary sometimes to provide more than three (3) signals to the elevator controller. A17.1 requires differentiation between separate hoistways that share a common elevator machine room. For instance, in a situation where there is more than one single hoistway sharing the same elevator machine room, a separate signal must be derived from each hoistway.

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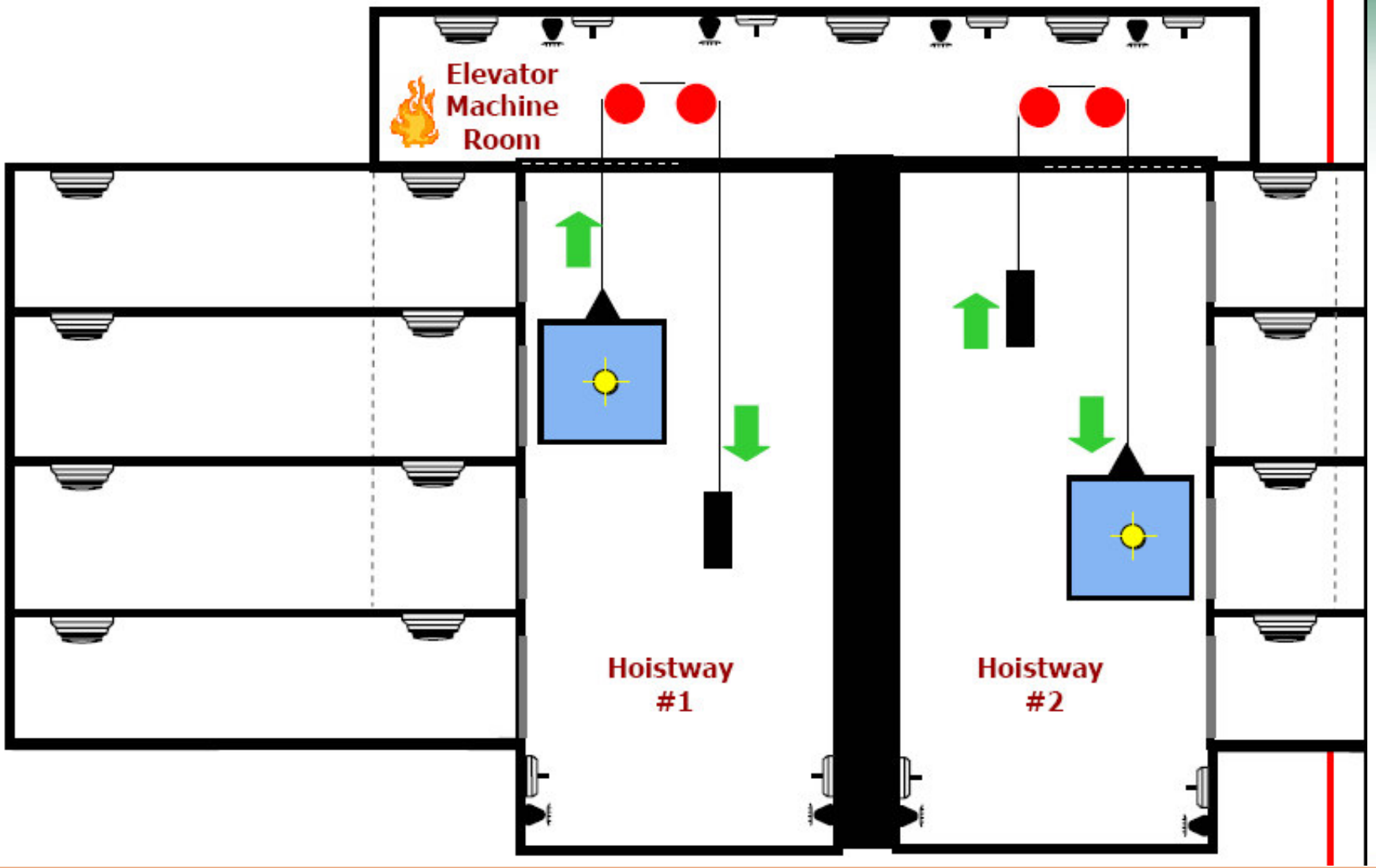
One Elevator Machine Room and Two Separate Hoistways



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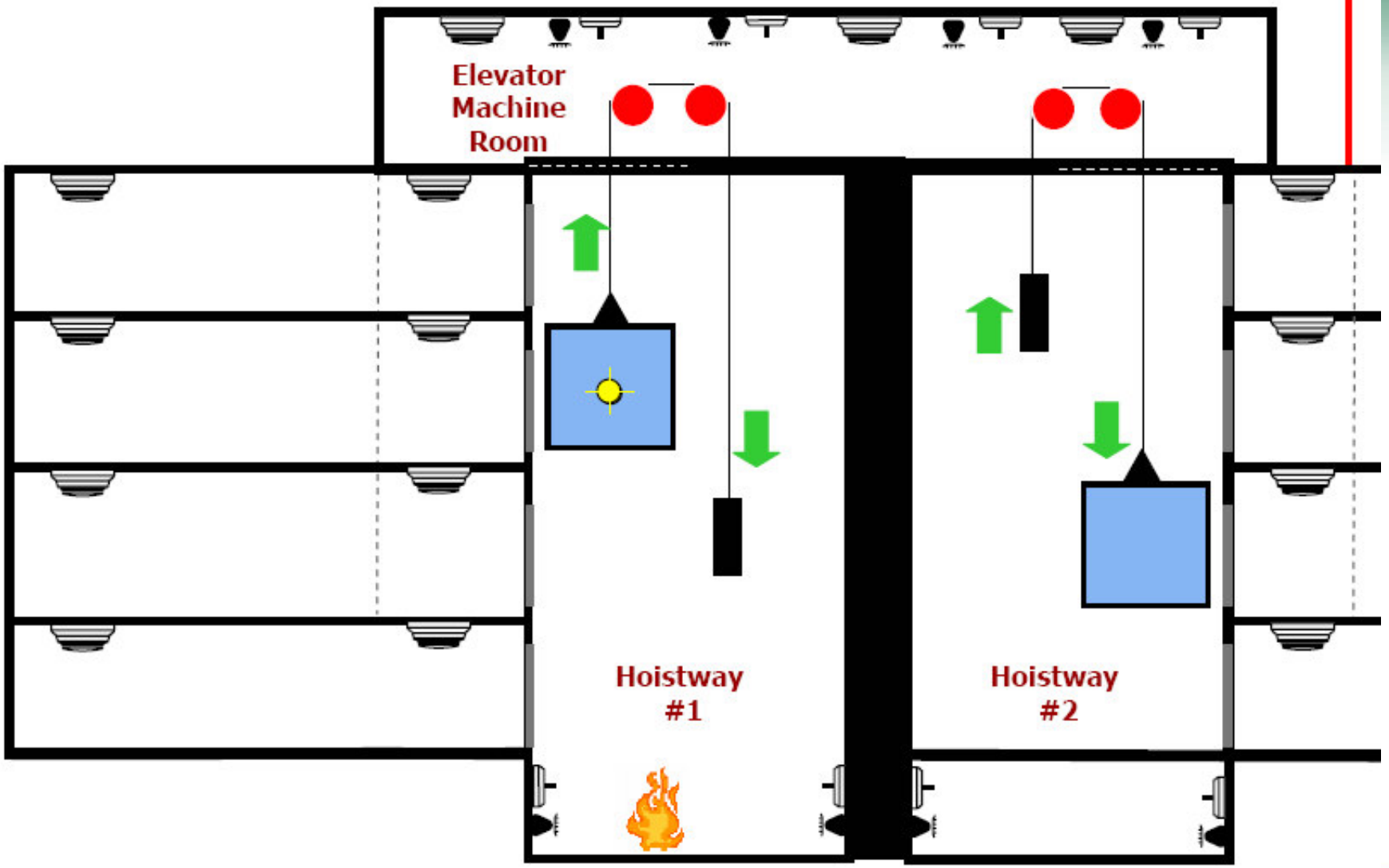
One Elevator Machine Room and Two Separate Hoistways



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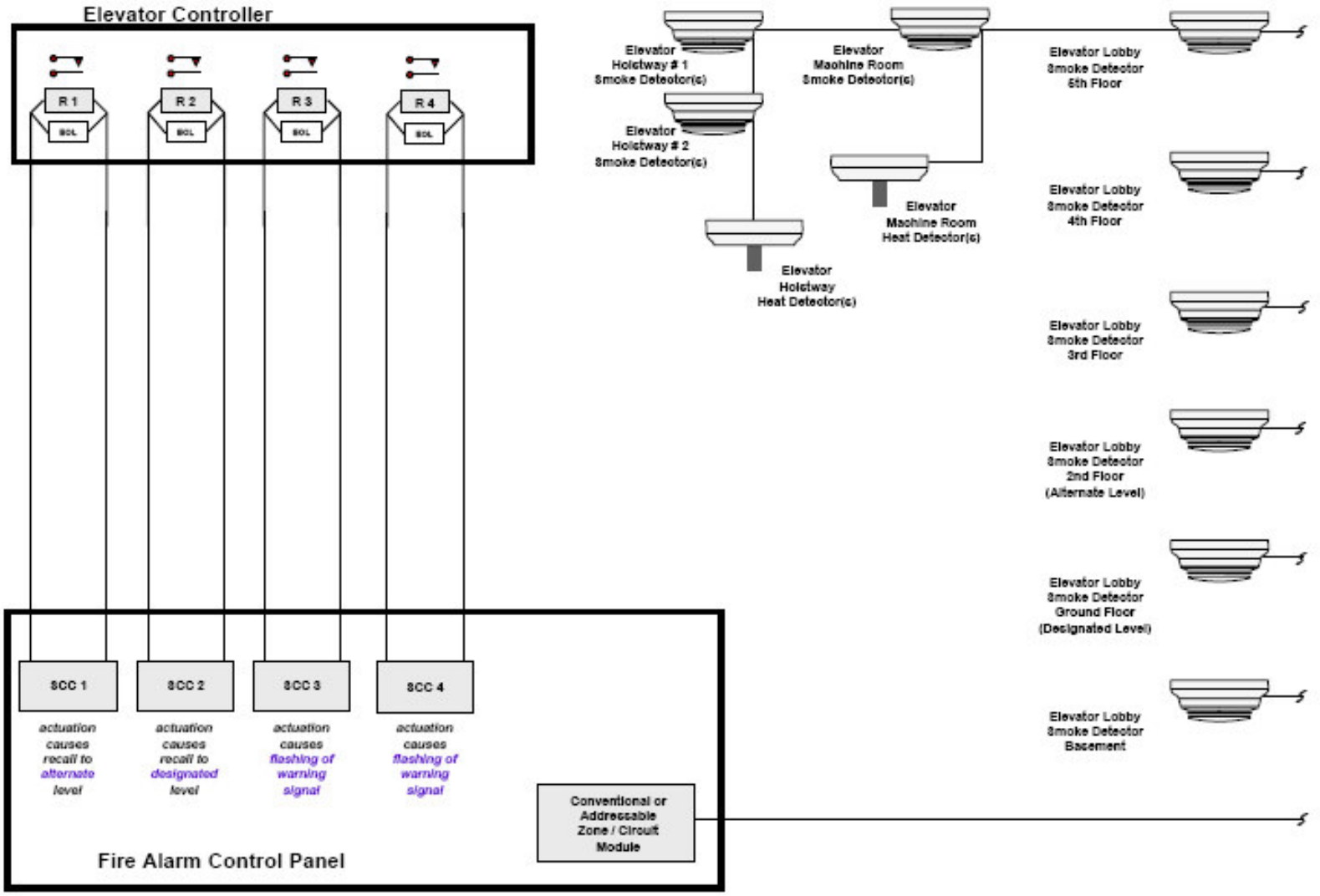
Fire Alarm System / Elevator Controller Relationship



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NFPA 13 - 2002

- 8.14.5 Elevator Hoistway and Machine Rooms
- 8.14.5.4* - Upright or pendent spray sprinklers shall be installed at the top of elevator hoistways.
- 8.14.5.5 – The sprinkler required a the top of the elevator hoistway by 8.14.5.4 shall not be required where the hoistway for passenger elevators is noncombustible and the car enclosure matierials meet the requirements of ASME A17.1.




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NFPA 13 - 2002

- 8.14.5 Elevator Hoistway and Machine Rooms
- 8.14.5.1* - Sidewall spray sprinklers shall be installed at the bottom of each elevator hoistway not more than 2 ft above the floor of the pit.
- 8.14.5.2 – The sprinkler required at the bottom of the elevator hoistway by 8.14.5.1 shall not be required for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids.




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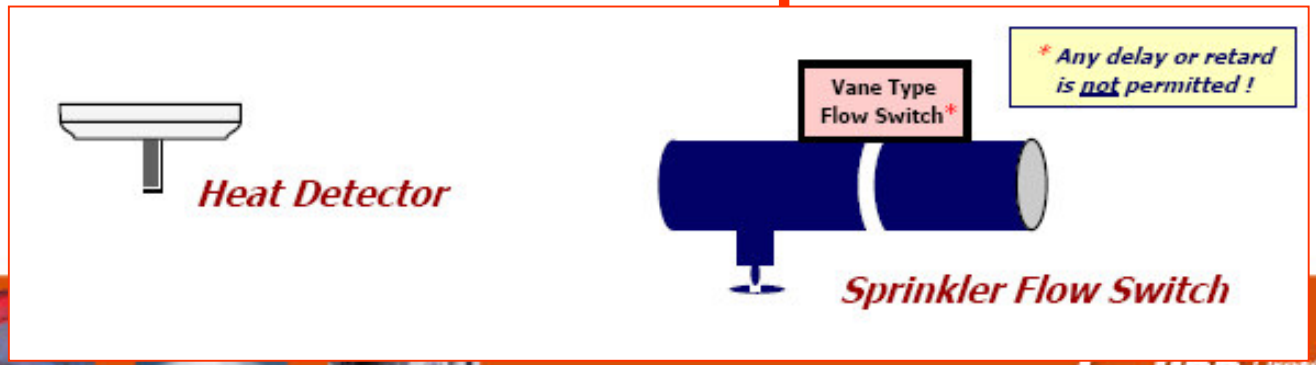
ASME A17.1 - 2004

- 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.



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NFPA 72 - 2002

- 6.15.4 Elevator Shutdown
- 6.15.4.3* - 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.




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NFPA 72 - 2002

- 6.15.4 Elevator Shutdown
- 6.15.4.1* - 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.




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Recommendation-

- Use 165ºF, ordinary temperature rated sprinkler head
- Use 135 ºF , thermistor-type heat detector

Or maintain similar relationship on ambient temperatures

Note: Sprinklers in elevator machine rooms and hoistways must be of ordinary or intermediate temperature rating. (NFPA 13 (2002), 8.14.5.3)




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NFPA 72 - 2002

- 6.15.4 Elevator Shutdown
- 6.15.4.2 – If heat detectors are used to shutdown 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.




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NFPA 72 - 2002

- 6.15.4 Elevator Shutdown
- 6.15.4.2 – If heat detectors are used to shutdown 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 scenarios.

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NFPA 72 - 2002

- 6.15.4 Elevator Shutdown
- 6.15.4.5 – The initiating devices described in 6.15.4.2 (WFS) and 6.15.4.3 (HD) **shall be monitored for integrity by the control unit** required in Section 6.15.3.




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Background-

- Water from sprinklers in the hoistway and elevator machine room presents a hazard to safe elevator operation:
  - "Shorts" on circuit conductors
    - Uncontrolled elevator operation
  - Wet brakes (traction elevators)
    - Uncontrolled stopping




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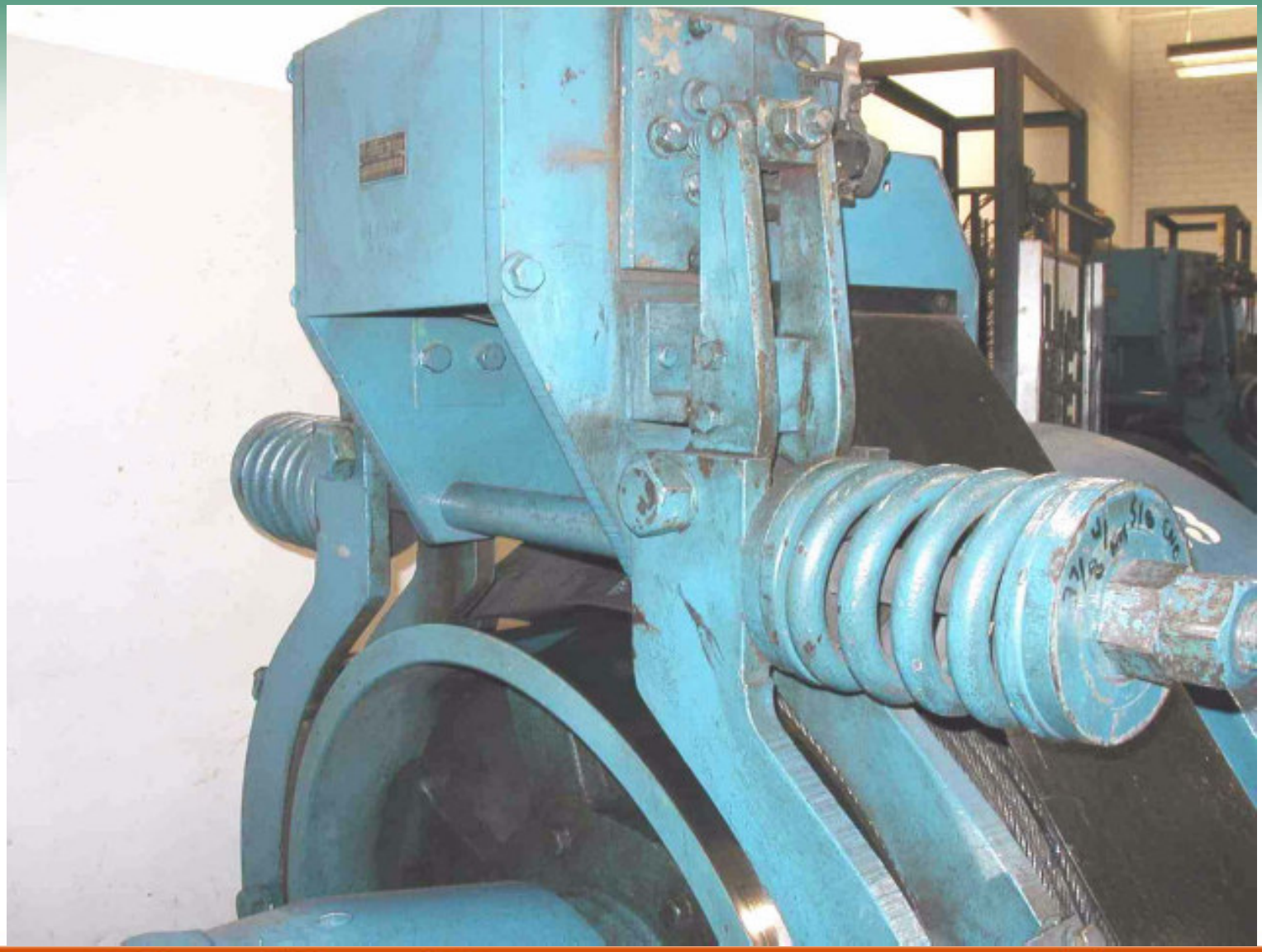




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Shunt Trip Operation (theoretical)

Smoke detector activates, causing elevator recall

Elevators arrive at the recall floor and open doors

Heat buildup causes heat detector to activate

Shunt trip operates, removing power from elevator

Sprinkler operates




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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!




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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




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Sprinkler/Power Shutdown Concerns

- **A17.1 Task Group Recommendations:**
  - **Exemption of sprinklers in elevator machine rooms**
  - **If sprinklers are installed in elevator machine rooms, 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" strategy**
  - **Stop at next floor**




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NFPA 72 - 2002

- 6.15.4 Elevator Shutdown
- A.6.15.4.4 – 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**.




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- 6.15.4 Elevator Shutdown
- A.6.15.4.4 – 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.




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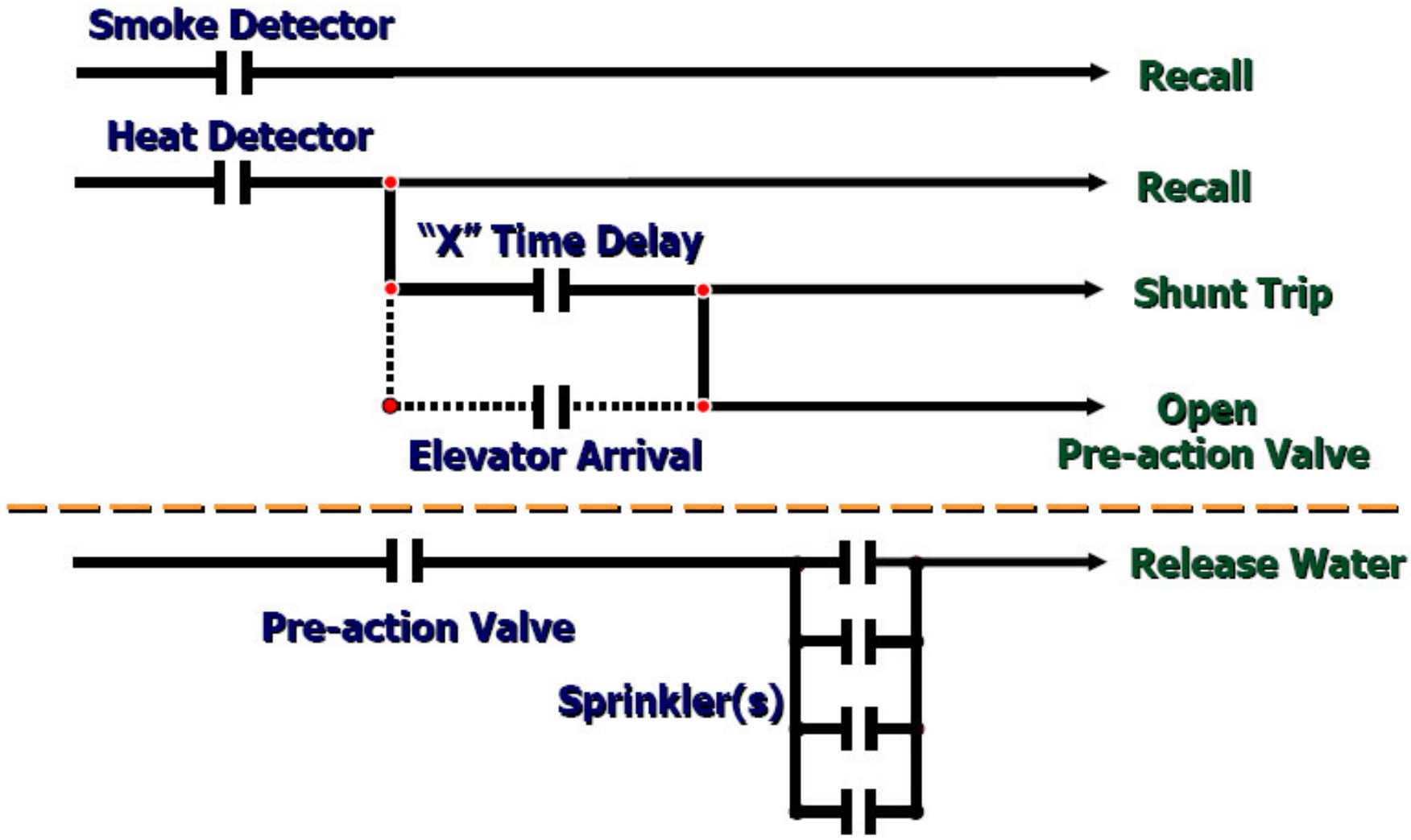
Shunt Trip Operation - Delay Strategy



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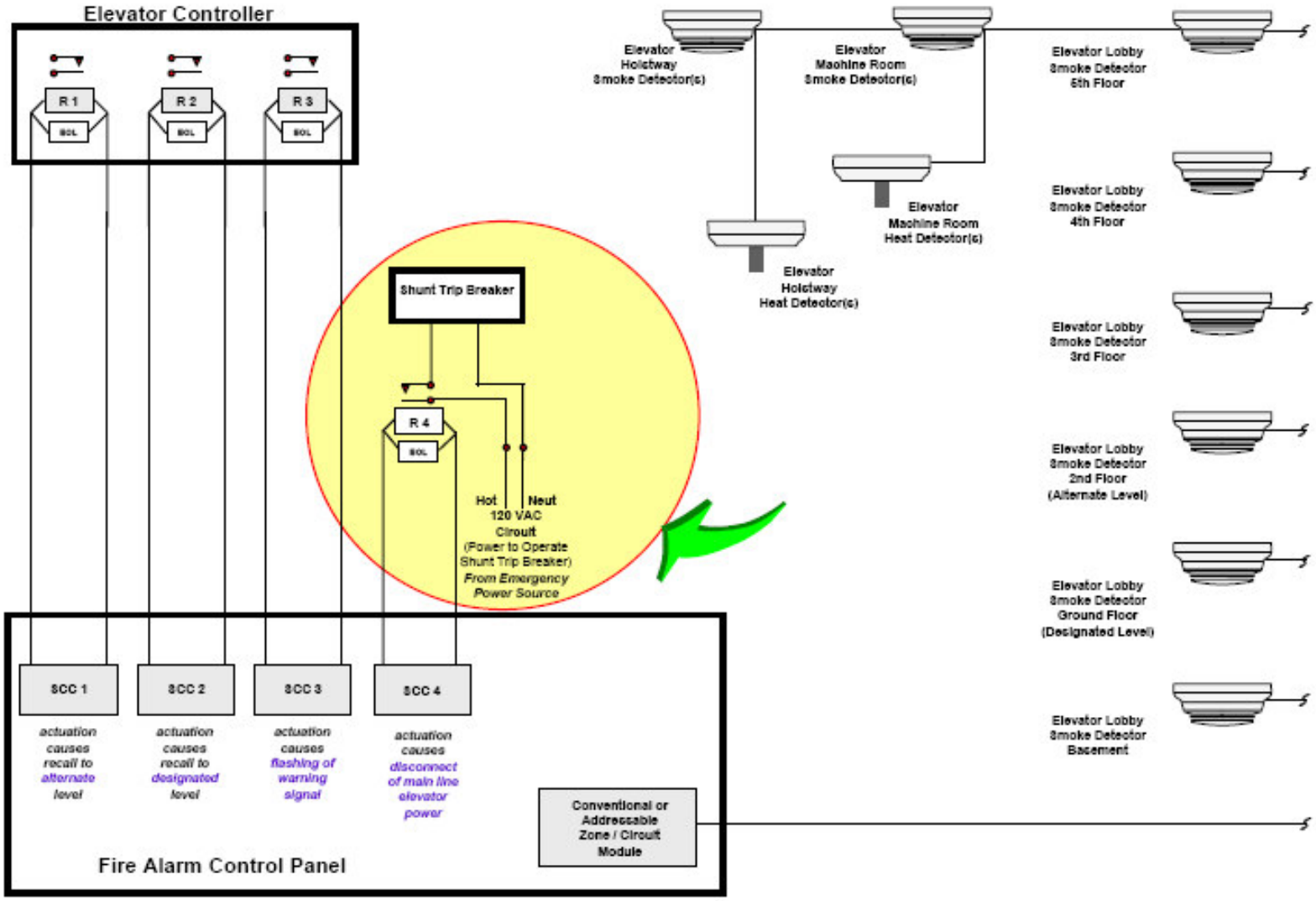
Fire Alarm System / Elevator Controller Relationship



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- 6.15.4 Elevator Shutdown
- 6.15.4.4* - Control circuits to shut down elevator power **shall be monitored for presence of operating voltage**. The loss of voltage to the control circuit for disconnecting means **shall cause a supervisory signal** to be indicated at the control unit and required remote annunciators.




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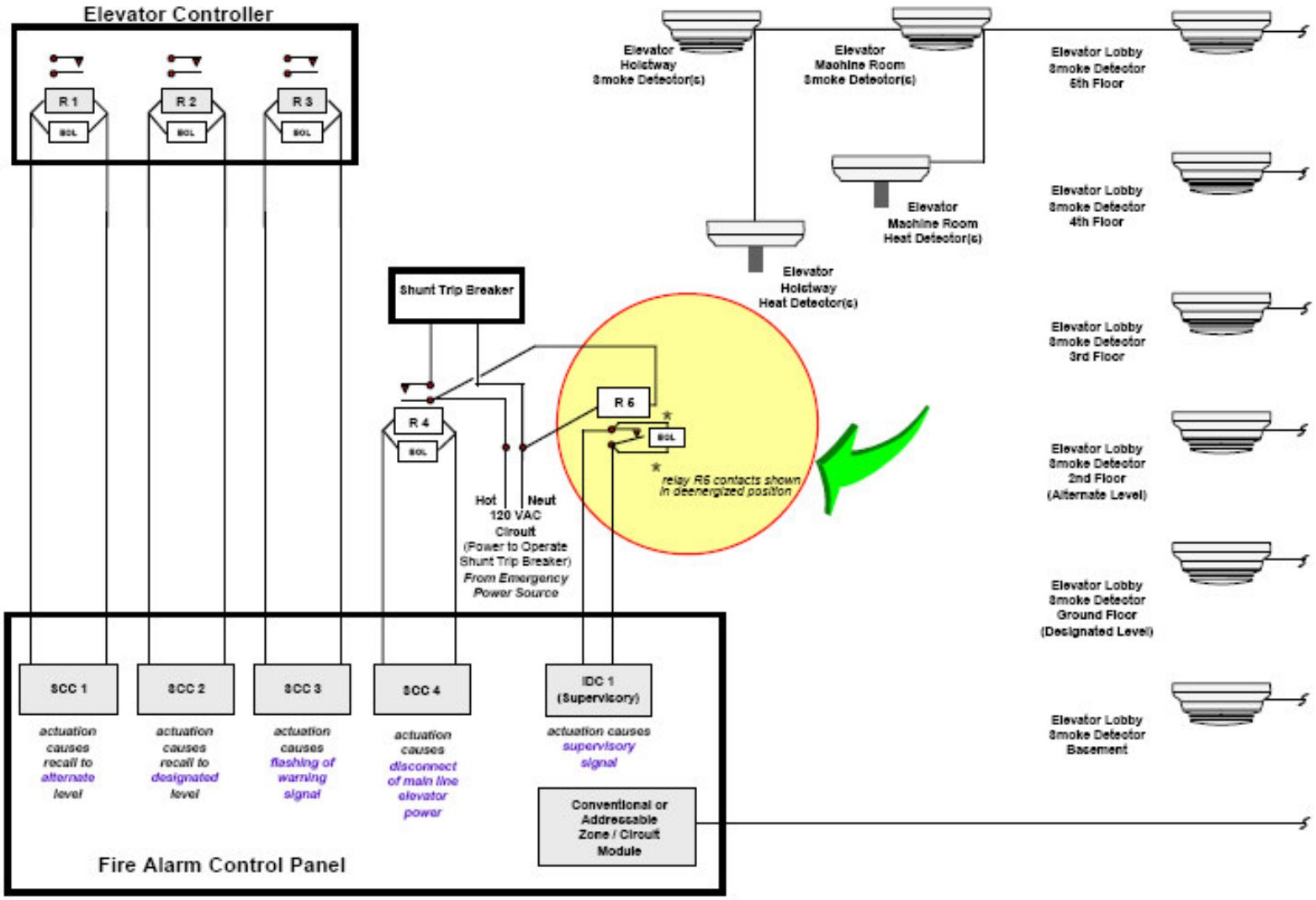
Fire Alarm System / Elevator Controller Relationship



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THANK YOU!

?QUESTIONS?




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