SUPPLEMENT 2

Interfacing Fire Alarm Systems and Elevator Controls

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Editor's Note: *The relationship between fire alarm systems and elevator control systems, and how these systems interface with each other, has had a long history, one that is still evolving. This supplement summarizes the historical development of these relationships and provides insight into the requirements for firefighters' recall and elevator shutdown.*

HISTORICAL PERSPECTIVE OF FIREFIGHTERS' RECALL AND ELEVATOR SHUTDOWN

Background

Safe operation of elevators has always been paramount to the elevator industry. In the late 1960s and early 1970s, attention was drawn to the impact of fire on elevator safety. Thought was given to human behavioral actions as well as the electrical and mechanical aspects. In a high-rise building fire, for instance, passengers overcrowding an elevator in their panic to leave the building might disable an elevator, or the elevator might actually be called to the fire floor by the actuation of a call button that has shorted or by one that reacts to heat. People unaware of the fire condition on an upper floor might continue to use the elevators to access the building. It was generally agreed that because of the various unsafe conditions faced by building occupants using elevators during a fire, it was important to prevent those occupants and visitors of the building from using elevators during a fire. It was believed that the safer option was for everyone physically capable of using the stairs to exit the building to do so. This strategy would also make elevators available to firefighters for staging their equipment on floors closer to the fire floor and for evacuating those individuals incapable of self-rescue.

Conflicting Codes

Many individuals who must deal with the coordination of building codes and standards understand that it is difficult to keep the building, elevator, sprinkler, and fire alarm codes in step with each other — initially because of a general lack of coordination between the various code committees. Today, there is a concerted effort for cooperation with the code-making bodies and the fire services. Still, it

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is easy to get out of sync because of the differences in code cycles and the edition dates of the various codes that jurisdictions adopt. For instance, *NFPA 72®*, *National Fire Alarm Code®*, has operated on a 3-year cycle (e.g., 1996, 1999, 2002, 2007; the exception being from 2002 to 2007), whereas ASME A17.1, *Safety Code for Elevators and Escalators*, has operated on a multiple-year code cycle with published yearly addenda or supplements that can be adopted by jurisdictions (e.g., 2000, 2002[a], 2003[b], 2004, 2005[a], 2005[S]). ASME A17.1, 2004 edition, is the 17th edition of the *Safety Code for Elevators and Escalators*; its current supplement was issued on August 12, 2005, and is referenced as ASME A17.1[S], 2005 supplement, which was effective as of February 12, 2006.

Firefighters' Recall Introduced

In 1973, ASME A17.1b, *Supplement to the 1971 Elevator Code*, introduced a new rule (Rule 211.3) that contained, among other things, a requirement for ''Firefighters' Recall.'' The new rule applied to all automatic non-designated attendant elevators that traveled 25 ft above or below the designated level. Elevators having to comply with ASME A17.1 were now required to be ''recalled'' to a specific ''designated'' floor upon actuation of either a ''3-position, key switch'' (manual recall), or by smoke detectors located in elevator lobbies (automatic recall). The designated floor was usually the ground floor because that was usually the location where first-arriving firefighters entered the building to evaluate the situation. Firefighters were to be the only individuals to have access to the keys for the 3-position key switch. They would use this feature to capture and gain control over the elevator(s) for their use in fire fighting and assisting those not capable of evacuating on their own.

During this time period, smoke detectors were not nearly as reliable and stable as they are today and the industry was plagued with unnecessary smoke detector actuations and recalled elevators. In the 1970s, smoking was not frowned upon or prohibited in buildings as is the common practice today. Ashtrays were often placed right under or in close proximity to the elevator lobby smoke detectors. Passengers would take their last puff and deposit their smoking material in the ashtray prior to boarding the elevator — that last puff often led to trash in the ashtray igniting and a quick ride down to the designated level!

ASME A17.1, 1981 edition, introduced recall of elevators to an ''alternate'' level. This requirement called for a smoke detector in the main lobby to cause recall to an alternate level (other than the designated floor). Also introduced was a new requirement for smoke detectors in the elevator machine room to recall the elevators to the ''designated'' floor.

ASME A17.1, 1984 edition, produced the requirement that *only* the elevator lobby and the elevator machine room smoke detectors were to be used to automatically recall elevators.

During this time, smoke detectors had no specific installation requirements other than ASME A17.1 referencing that smoke detectors be installed in accordance with NFPA 72E, *Automatic Fire Detectors*, Chapter 4. Smoke detection technology was still in its relatively early stages, so the building owners continued to experience difficulties with instances of elevators returning (being recalled) as a result of unwarranted smoke detector actuation. These events were responsible for a groundswell reaction from building owners to disconnect the recall function, and it also led to installation of systems with questionable reliability. Various configurations of smoke detectors were being installed using different wiring methods and even intermixing of single station smoke alarms and system smoke detectors. Coordination between electrical contractors and elevator contractors didn't happen on a regular basis, and installation guidance was sorely lacking.

NFPA's Involvement

NFPA's first mention of smoke detectors used for firefighters' recall appeared in the 1987 edition of NFPA 72A, *Installation, Maintenance and Use of Local Protective Signaling Systems*. The section was titled ''Elevator Recall for Firefighters' Service,'' and it required that smoke detectors located in elevator lobbies and elevator machine rooms used to initiate firefighters' service recall be connected to the building fire alarm system. And, unless otherwise permitted by the authority having jurisdiction, only those detectors could be used to recall the elevators. The feeling was that as long as the elevators were not in danger from fire (as determined by elevator lobby and machine room smoke detectors), they could continue to operate for use of building occupants. And, of course, the other reason was that there would be less risk of incurring nuisance alarms that would be disruptive to building occupants and bad public relations for the building owner.

The actuated detector, in addition to initiating recall, was required to initiate an alarm condition on the fire alarm system and annunciate the zone from which the alarm originated.

Both acceptance testing and periodic testing were performed in accordance with requirements in NFPA 72E, 1987 edition, and NFPA 72H, *Testing Procedures for Local, Auxiliary, Remote Station, and Proprietary Protective Signaling Systems*, 1988 edition.

NFPA 72A, 1987 edition, also required that for each group of elevators within the building, two elevator zone circuits be terminated at the elevator controller. The operation had to be in accordance with ANSI/ASME A17.1 Rules 211.3–211.8. Essentially, the smoke detector in the designated lobby of recall would actuate the first circuit, and the smoke detectors in the remaining lobbies and elevator machine room would actuate the second circuit. The reason for the two circuits was to be able to differentiate the signal coming from the smoke detector at the designated elevator landing from all the other smoke detectors at the other elevator lobbies and elevator machine room. If that detector at the designated level actuated, it would be indicative of fire conditions in that area, so the elevators would then be recalled to an ‘‘alternate’’ level. The ‘‘alternate’’ level would be determined at the discretion of the authority having jurisdiction (usually the local fire department).

Smoke detectors for elevator recall were also required to initiate an alarm even with all other initiating devices on the circuit in an alarm state. The reason for this requirement was to ensure the reliability of the recall operation because some fire alarm initiating device circuits could not support having all devices in alarm at one time and still guarantee the smoke detector used for elevator recall would operate.

Two examples (drawings) were placed in the appendix of NFPA 72A recommending wiring configuration for the smoke detectors for a new installation as well as for an elevator retrofit situation. The standards at this time did not require electrical supervision of these control circuits.

In 1989, ASME A17.1b addressed smoke detectors in hoistways. Smoke detectors were allowed to be installed in any hoistway, but they were required to be installed in hoistways that were sprinklered. The hoistway smoke detectors, when actuated, were to cause recall to the designated level. Also, the elevators must react only to the first recall signal. In other words, if the detector at the designated level actuated and then shortly after the third floor elevator lobby detector actuated, the car would be recalled to the alternate floor of recall and not the designated level because the detector at the designated level was the first to actuate. This requirement was added because it was believed that the first detector to operate would have a high probability of sensing a fire in its vicinity, whereas there would be a fair chance of the smoke migrating to other locations and tripping the detectors and giving conflicting instructions to the elevator controllers.

In 1990, NFPA consolidated some of the signaling standards (NFPA 72A, *Installation, Maintenance, and Use of Local Protective Signaling Systems*, 1987 edition; NFPA 72B, *Auxiliary Protective Signaling Systems for Fire Alarm Service*, 1986 edition; NFPA 72C, *Remote Station Protective Signaling Systems*, 1986 edition; NFPA 72D, *Proprietary Protective Signaling Systems*, 1986 edition; and NFPA 72F, *Installation, Maintenance and Use of Emergency Voice/Alarm Communication Systems*, 1985 edition), into a single publication, *NFPA 72*, *Installation, Maintenance, and Use of Protective Signaling Systems*, 1990 edition. There were no changes made to the paragraphs relating to elevators in NFPA 72A, 1987 edition.

The ASME A17.1, 1990 edition, added a requirement for all elevator cars to be provided with an illuminated visual and audible signal system (firefighter's helmet symbol). The light would illuminate during recall to alert passengers that the car is returning nonstop to the designated level. In reality, unless passengers were taught or otherwise shown what the light meant, it was doubtful as to the value this feature provided the average elevator passenger. Exhibit S2.1 shows an illustration of the firefighter's helmet symbol. Later, this visual symbol will be discussed in another application.

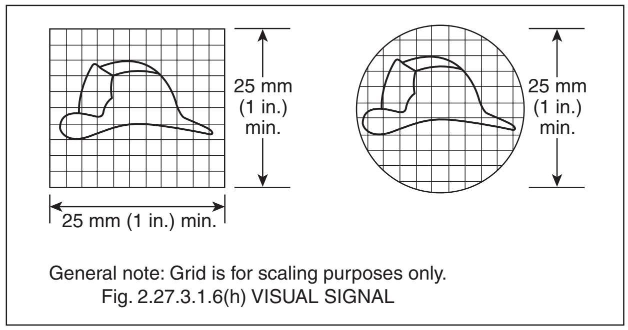

EXHIBIT S2.1 *Firefighter's Helmet Symbol. (Reprinted from ASME A17.1a, 2005, by permission of the American Society of Mechanical Engineers. All rights reserved.)*

The 25 ft travel criterion was dropped from ASME A17.1b, 1992 supplement, so the Firefighters' Service Recall then applied to all automatic non-designated attendant elevators regardless of the travel distance.

ASME A17.1 [1993] (14th Edition)

In 1993 liaisons between the NFPA 72 Technical Committee on Protected Premises Fire Alarm Systems and the ASME A17.1 Emergency Operations Committee were established and were effectively communicating to coordinate their code activities. Requirements were more complex, and it was essential this communication and cooperation continue. More specific application details were surfacing, such as the requirement that smoke detectors in the hoistway might be installed below the lowest recall level and when actuated, those detectors would now cause the elevator car to be sent to the upper level of recall. Reasoning for that change was to keep the car away from the fire.

NFPA 72 Changes [1993]

In 1993 NFPA further consolidated the signaling standards to form what is now *NFPA 72, National Fire Alarm Code.* Reference to hoistway smoke detectors was added in this edition to correlate with ASME A17.1, 1990 edition. The result required hoistway detectors to cause recall of elevators to the designated level.

The 1993 edition of *NFPA 72* also, for the first time, addressed elevator recall in buildings that were not required to have a fire alarm system. Those buildings having elevators and no building fire alarm systems and having to comply with ANSI/ASME A17.1 must now have an ''Elevator Recall and Supervisory Panel.'' This panel is essentially a fire alarm control unit (now defined as a ''dedicated function fire alarm control unit'') specifically used to provide signals to the elevator controller to initiate elevator recall, but not notify the occupants of the building or the fire department. Additionally, this control unit was used to initiate removal of elevator main line power prior to sprinkler operation should the building have sprinklers in the elevator machine room or hoistway. The main reason for this requirement was to ensure these critical elevator recall systems were installed with the reliability of building fire alarm systems, which included the supervision (monitoring for the integrity) of circuit wiring and secondary power meeting the requirements of *NFPA 72*.

Also in the 1993 edition, the term *fire safety control functions* was introduced. The section on fire safety control functions addressed those components and interfaces that are meant to increase the level of life safety and property protection in buildings. The following are examples of such fire safety control functions: door holding, door releasing, door unlocking, elevator recall, shunt trip, fan control, smoke hatches, and stairway ventilation. The section on fire safety control functions reinforced the requirement that the circuits from the fire alarm system to the elevator controller(s) had to be monitored for integrity.

A section on shutdown of main elevator power was also added in the 1993 edition of *NFPA 72* primarily as a result of the ASME 17.1 requirements that now addressed the concerns of sprinklers in elevator machine rooms and hoistways. These sprinkler requirements were driven by national building codes. This subject is discussed in greater detail later under the topic ''Main Line Power Disconnect — Shunt Trip.''

ASME A17.1b [1995]

ASME A17.1b, 1995 supplement, included a new requirement addressing the condition (as with many hydraulic elevators) where the elevator machine room is on the designated level. Smoke detectors in the elevator machine room, when actuated, will send the car to the alternate level. Again, the reasoning was to use the recall level furthest from the fire condition.

NFPA 72 Changes [1996]

In the 1996 edition of *NFPA 72*, smoke detectors in hoistways were prohibited unless the top of the hoistway had a sprinkler. If the top of the hoistway was sprinklered, then ASME A17.1b, 1995 supplement, required a smoke detector to be installed to initiate recall prior to having the main line power shut down.

The reason for not wanting smoke detectors in hoistways is obvious. The adverse environmental conditions of most elevator hoistways, with dirt and contaminants and varying air velocities caused by elevator piston action, initiated many unwarranted or ''nuisance'' recalls. Because smoke detectors in hoistways were (and still are) difficult to service and to perform periodic testing on, smoke detectors were often sadly neglected, allowing them to become dirty, overly sensitive, and prone to causing nuisance recalls.

Another section added to the 1996 edition of *NFPA 72* allowed other appropriate automatic fire detection to be used in place of smoke detectors in those situations where the environment was unsuitable for smoke detectors, such as unheated elevator lobbies commonly found in northern climates.

A ''third'' control circuit was added to the existing ''designated'' floor of recall and ''alternate'' floor of recall circuits. This third circuit was to operate when a hoistway or machine room smoke detector actuated. It was to annunciate separately at the fire alarm control unit and other required annunciators. The purpose was to alert firefighters and other emergency personnel of a potential problem that might cause unsafe elevator operation and, indeed, they may soon lose elevator power.

At this time there was confusion in the industry because ASME A17.1 had not yet introduced the third circuit as an elevator requirement. In the works was a proposal to ASME A17.1 that would cause the firefighter's helmet symbol in the elevator car to flash to indicate impending danger if firefighters were to continue to use the car under ''Phase II — Emergency In-car Operation.'' Under ''Phase II,'' the elevator is controlled by firefighters by way of a special key that permits firefighters to override other safety controls. The firefighters can then use the elevator for staging their equipment and for evacuating people.

ASME A17.1a [1997]

Some fairly substantial changes were made in terminology in the 1997 supplement of ASME A17.1. The title of section ‘‘211.3b Smoke Detectors’’ was changed to ‘‘211.3b Phase 1 Fire Alarm Activation.’’ Also, the term *fire alarm initiating devices* replaced the previously used term *smoke detectors*. This change was intended to recognize that smoke detectors may not be the most appropriate choice of detection to initiate elevator recall when environmental conditions exceed those for which the smoke detector is suitable.

ASME A17.1b [1998]

A new paragraph was added to the 1998 supplement of ASME A17.1 requiring that the actuation of a fire alarm initiating device in the elevator machine room or in the hoistway cause the visual signal (firefighter’s helmet) in the affected elevator car to flash. This addition provided the change needed for correlation with the ‘‘third circuit’’ requirement added in the 1996 edition of *NFPA 72*.

NFPA 72 Changes [1999]

There were no substantive changes related to elevator recall in the 1999 edition of *NFPA 72*. See changes to power disconnect requirements later in the section on ‘‘Elevator Shutdown and Sprinklers.’’

ASME A17.1 [2000] (16th Edition)

The 2000 edition of ASME A17.1 was harmonized with the Canadian CAN/CSA B44 Elevator Safety Standard. In addition, the entire code was reformatted and renumbered using a decimal numbering system.

Some heading changes were made, for instance, ‘‘Firefighters’ Service – Automatic Elevators’’ was changed to ‘‘Firefighters’ Emergency Operation – Automatic Elevators.’’ And, ‘‘Phase I Fire Alarm Activation’’ was changed to ‘‘Phase I Emergency Recall Operation by Fire Alarm Initiating Devices.’’ But, the content did not change essentially. Some rewording and paragraph modifications were made to accommodate the differences that still exist between the United States and Canada. Where differences exist between ASME A17.1 and CAN/CSA B44, there is wording such as *‘‘In jurisdictions not enforcing the NBCC . . .’’*. The NBCC refers to the National Building Code of Canada, so used in that context, that particular code requirement would apply to the United States.

NFPA 72 Changes [2002]

Several correlation changes occurred in the 2002 edition of *NFPA 72*. Wording was added to include consideration for new elevator technology that alters the way we have traditionally thought of elevators. Various elevator components and equipment (drive motors, controllers, braking mechanisms, etc.) were customarily installed in spaces called machine rooms. Recent elevator technology has led to what is now referred to as ‘‘machine room-less’’ elevator systems. Some elevators today have the equipment in other spaces, such as mounted on the elevator car itself. So, now, when referring to locations where smoke detectors are installed for the purpose of initiating recall (elevator lobbies, elevator hoistways, and elevator machine rooms), additional reference is made to elevator machine rooms ‘‘including machine space, control room, and control space.’’

Where *NFPA 72*, 1999 edition, addressed three separate circuits per each group of elevators within a building for the purpose of interfacing the fire alarm system with the elevator system, *NFPA 72*, 2002 edition, addressed the potential of having more than three circuits. Wording was changed from ‘‘three separate elevator control circuits’’ to ‘‘a minimum of three separate elevator control circuits.’’ The reason for that change was that in some instances, two (or more) separate hoistways could share the same common elevator machine room. An ASME A17.1 requirement is to provide a danger signal to elevator cars (by flashing the firefighter helmet symbol) if there is fire in an elevator hoistway or an elevator machine room. The reasoning behind the change was that if the fire was in one hoistway, the signal should not be given to the elevator car in the other hoistway where there may be no immediate danger. Of course, if the fire occurred in the common machine room, the signal would be sent to the cars in both hoistways.

Annex material was added to advise against installing smoke detectors in outdoor locations or locations that are exposed to weather, such as unenclosed elevator lobbies in open parking structures, because those environments can exceed the parameters of detector listing and further could result in unwanted alarms and unnecessary recall of elevators. If a smoke detector has undergone testing and subsequent listing as acceptable for the anticipated environment, then, of course, that device would be appropriate for installation in that case.

ASME A17.1a [2002] Supplement

There were no changes in requirements to the emergency recall operation in this first addendum to the 2000 edition of ASME A17.1.

ASME A17.1b [2003] Supplement

There were no substantive changes in requirements for emergency recall, but wording was modified to reaffirm the intent of where fire alarm initiating devices used for the purpose of initiating emergency recall were to be installed. The fire alarm initiating devices were required to be installed in conformance with *NFPA 72* and located as follows: (1) at each floor served by the elevator; (2) in the associated elevator machine room; and (3) in the elevator hoistway, when sprinklers are located in those hoistways.

ASME A17.1 [2004] 17th Edition

No new requirements were introduced to the existing emergency recall requirements.

ASME A17.1a [2005] Supplement

No new requirements were introduced to the existing emergency recall requirements.

ASME A17.1S [2005] "Special" Supplement

This release is a ''special'' supplement that was published as a result of an ad hoc committee tasked with addressing the issues associated with the advancement of new technologies being used in today's design and construction of elevator equipment. The committee looked at the various safety aspects of the new equipment and its installation, and recommendations were put forth in proposals that addressed equipment located in traditional hoistways and machine rooms as well as what is now termed ''machinery spaces, control spaces'' that may be found either inside or outside the hoistway.

No new requirements were introduced to the existing emergency recall requirements.

NFPA 72 Changes [2007]

A significant rewrite of some of the paragraphs of the Elevator Recall for Firefighters' Service section was made with the intent of improving clarity, readability, and continuity.

The section is now arranged with general requirements leading in to three distinct sections specific to the output signals from the fire alarm system to the elevator control system, namely, Designated Level Recall, Alternate Level Recall, and Visual Warning.

ELEVATOR SHUTDOWN AND SPRINKLERS

Since its inception, the requirement in ASME A17.1 for shutdown of elevator main line power has been the cause for confusion in the industry and also has been very controversial. The following paragraphs try to provide some background and insight on the subject.

Main Line Power Disconnect — "Shunt Trip"

Main line power disconnect, commonly referred to as ''shunt trip,'' was first required by ASME A17.1, 1984 edition. The reference to ''shunt trip'' is used because it is that method that is predominantly used to disconnect the elevator main line power.

When the term *main line power* is used here, it does not mean ''complete'' or ''total'' power. It means the power that drives the elevator itself. Those circuits that would not be shut down would include the following:

- Branch circuits for car lighting, receptacle(s), ventilation, heating, and air conditioning
- Branch circuit for machine room/machinery space lighting and receptacle(s)
- Branch circuit for hoistway pit lighting and receptacle(s)

Because of the potential danger from water shorting and bridging electrical components and because it is considered hazardous to have water on the elevator brake (braking system) of traction elevators, especially when the car is in motion, the requirement to disconnect the elevator main line power prior to the release of water from the sprinkler system was included in ASME 17.1, 1984 edition.

The concept was to remove main line power from the elevator to stop the car and prevent it from moving prior to a sprinkler releasing water that could get onto elevator electrical components or the elevator brake. There was a concern that ''shorting'' of control and safety circuits could result in dangerous situations such as uncontrollable motion and running of the elevator with doors open, and so on. On traction elevators there is the additional concern of getting water on the brake while the car is moving, which could result in uncontrolled braking and failure to stop safely.

The original theory for elevator shutdown was to use a heat detector as the means to actuate shunt trip. The following sequence was intended:

1. A smoke detector used for elevator recall would sense smoke and initiate recall.
2. The elevators would be recalled immediately (with or without passengers) to the floor of recall and doors open.
3. Heat buildup causes heat detector to actuate, which initiates main line power shutdown.
4. Power is removed from elevator and the car cannot be used until power is manually restored.
5. Further heat buildup causes sprinkler to fuse, releasing water to control fire.

In ASME A17.1a, 1994 supplement, the wording changed to ''upon or prior to the application of water from sprinklers.'' Effectively, the rewording now allowed sprinkler waterflow switches to initiate main line power disconnect in addition to the previously used heat detectors. Built-in delays were not allowed in the waterflow switch (such as the retard mechanism furnished with many flow switches that could be set to provide as much as a 90 second delay in initiating a signal). The reason flow switches are provided with built-in delays is to prevent false tripping from ''water hammer'' caused by changes in pressure in the water supply. At this time, the heat detector appeared to be the most widely used as well as preferred option because waterflow switches (without retard mechanisms) were prone to causing unwanted and unwarranted recall of elevators. Today, the use of more reliable check valves has minimized this problem.

Power Disconnect Initiated from the Fire Alarm System

Confusion existed for years over a couple of code sections, one on a sentence in earlier editions of the *National Electrical Code®,* Article 620 (Elevators), under the section covering ''Disconnecting Means and Control.'' It stated that ''nor shall circuit breakers be opened automatically by a fire alarm system.'' Some interpreted this as a requirement that the heat detector used to actuate shunt trip could not be associated with or connected to the fire alarm system. In fact, what was intended was that the elevator power should not be shut down when the fire alarm system was activated by just any fire alarm initiating device in the building. Many were not aware of the programming capabilities that fire alarm systems have that allow for matrixing of various inputs and outputs. So, for years, a separate circuit, not connected to the fire alarm system, was commonly used to accomplish elevator main line power disconnect. Unfortunately, much of the time the circuit conductors were not monitored for integrity (supervised). This oversight meant that a broken wire or open circuit could go undetected until testing revealed the problem and also meant the circuit could be out of commission when needed in an emergency. These instances emphasize the need for critical circuits to be monitored for integrity, as is the case with fire alarm initiating device circuits.

In the 1993 edition of NFPA 70, *National Electrical Code,* the troublesome reference to the fire alarm system was removed to avoid the confusion. The requirements regarding the means to achieve elevator shutdown were also more clearly defined in *NFPA 72* [1993]. If heat detectors were used to shut down elevator power prior to sprinkler operation, the heat detector was required to have a lower temperature rating and higher sensitivity when compared to the sprinkler. Obviously, in order to accomplish the desired sequence, the heat detector must actuate earlier than the sprinkler under the fire condition. If the sequence somehow occurred in reverse order, water could be released on live electrical components as well as on the braking mechanism, which is exactly the condition that is trying to be avoided.

Heat detectors also had to be installed within 2 ft of each sprinkler head in the elevator machine room and hoistway. This spacing was to ensure the heat detector sampled, as nearly as practicable, the temperature that the sprinkler was sensing.

The second area for confusion was a requirement in NFPA 72A, 1987 edition, *Installation, Maintenance and Use of Local Protective Signaling Systems,* under the section for ''Installation and Design'' that stated ''The performance of automatic control functions shall not interfere with power for lighting or for operating elevators.'' This requirement remains in *NFPA 72*, 2007 edition, as paragraph 6.16.2.1. Elevator main line power shutdown is a fire safety control function, and the operation is intentionally designed as such. This operation does not interfere with operating power for the elevators; it instead controls the power shutdown.

NFPA 72 Elevator Shutdown (1999)

A weak link in the reliability of ''shunt trip'' was recognized and addressed by *NFPA 72*, 1999 edition. It was often found during periodic testing of the shunt trip feature that the power needed to trip the shunt trip breaker was not available. This lack of power was usually because a circuit breaker that supplies the needed power was in the off position. The requirement for supervising that power was established in *NFPA 72*, 1999 edition. Absence of the power required a supervisory signal to be indicated at the fire alarm control unit and required annunciators. An example of a typical method of providing the elevator power shunt trip supervisory signal was included in the Appendix.

NFPA 72 Elevator Shutdown (2002)

In *NFPA 72*, 2002 edition, it was made clear that the initiating devices (heat detectors and flow switches) used to initiate main line power disconnect (shunt trip) are required to be monitored for integrity by the fire alarm control unit. As mentioned previously, if the initiating devices were not connected to the fire alarm system, a broken wire, for instance, could disable the circuit and go unnoticed until found during periodic testing. This requirement increases the operational reliability of the circuit and helps to ensure the shunt trip feature will operate properly when called on in an emergency.

ASME A17.1a [2005] Supplement

In this supplement, wording was added to require that heat detectors and sprinkler flow switches used to initiate power removal comply with the requirements of *NFPA 72*.

ASME A17.1S [2005] "Special" Supplement

This special supplement included significant rewrites of certain chapters. Unfortunately, when a large modification is made to a code, there is the potential for something "slipping through the cracks" or the undoing of some previously coordinated efforts. The following issue may be cause for some confusion until it is addressed in a future edition.

Previous editions of ASME A17.1 exempt the power removal requirements for sprinklers in the pit if the installation complies with the NFPA 13 requirement for installation of sprinklers at or less than 24 in. from the bottom of the pit. The new wording is in more of a performance language and makes the decision very subjective. A comparison of the wording follows:

Wording prior to A17.1S [2005]

". . . 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 sprinklers located in the machine room or in the hoistway more than 24 inches above the pit floor."

Wording of A17.1S [2005]

". . . 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." Note: there is no longer mention of sprinklers installed 24 inches or less from the bottom of the pit.

Sprinklers and Fire Alarm Initiating Devices in Hoistways

A review of the requirements of ASME A17.1, *Safety Code for Elevators and Escalators*; *NFPA 72, National Fire Alarm Code*; and NFPA 13, *Standard for the Installation of Sprinkler Systems*, considered collectively, would suggest that there may be no need to install fire alarm initiating devices for the purpose of initiating main line power disconnect (shunt trip) in hoistways of passenger elevators. If the hoistway of a passenger elevator is noncombustible and the car enclosure materials meet the requirements of ASME A17.1 (which should be the case with all new elevator installations), then NFPA 13 does not require sprinklers at the top of the hoistway. Thus, with respect to requirements for the top of the hoistway, if the sprinkler is not needed, then the corresponding requirement for the smoke detector that would be used for recall goes away as well as the corresponding requirement for the heat detector used for power disconnect. Further, if the noncombustible elevator hoistway does not contain combustible hydraulic fluids, NFPA 13 does not require sprinklers at the bottom of the hoistway (discussed further below). If no sprinklers are installed anywhere in the hoistway (including the elevator pit) then there is no requirement for initiating devices to be installed anywhere in the hoistway for either recall or shutdown. It is important to recognize that this applies to passenger elevators only and not to freight elevators. So, for freight elevators, the sprinkler at the top of the hoistway is still required and, therefore, so is the smoke detector (or other automatic initiating device), as well as the heat detector used for power disconnect.

NFPA 13 requires sidewall spray sprinklers to be installed at the bottom of each elevator hoistway not more than 0.61 m (2 ft) above the floor of the pit. However, there is an exemption for the sprinkler requirement for enclosed, noncombustible elevator shafts that do not contain combustible hydraulic fluids. Realistically, this exemption is rarely observed and more than likely, sprinklers will be installed in elevator pits. In addition, the ASME A17.1 2000 and 2004 codes and supplements ASME A17.1a [1997] through ASME A17.1a [2005] indicate that main line power disconnect is not required if those sprinklers are installed no more than 0.61 m (2 ft) from the floor of the pit. However, this prescriptive exemption has been replaced in ASME A17.1S [2005] Special Supplement with subjective language and not the clear exemption that earlier editions provided. (Refer to previous section ASME A17.1S [2005] "Special" Supplement for additional details.) It is therefore extremely important to know what edition of ASME A17.1 is in force.

In any event, current requirements for elevator recall initiated from the pit allow initiation from either a sprinkler waterflow device or from an automatic fire detection initiating device (usually a heat detector).

Maintaining a high degree of reliability for the fire alarm system is fundamental to the purpose of the *National Fire Alarm Code*. For that reason, paragraph 6.16.3.7 of the 2007 edition permits the use of other automatic fire detection devices where ambient conditions prevent the reliable use of smoke detectors. Elevator hoistways are often locations where ambient conditions exceed those for which the smoke detectors have been tested and listed. When automatic fire detection devices are needed within a hoistway, the selection of the devices must consider system reliability as well as the performance needed to provide the intended system operation.

In summary, when sprinklers are installed in an elevator hoistway (either at the top or bottom), appropriate automatic fire detection devices are required to provide elevator recall. (See 6.16.3.12.1 and 6.13.3.12.2 of the Code.) If any of these installed sprinklers are located more than 0.61 m (2 ft) from the floor of the pit (ASME A17.1a [2005] and earlier), or where elevator equipment is located or its enclosure is configured such that application of water from sprinklers (in any location) could cause unsafe elevator operation (ASME A17.1S [2005]), appropriate automatic fire detection devices are required to provide power shutdown. Requirements for elevator shutdown are addressed separately from those for elevator recall, and ASME A17.1 prohibits the use of smoke detectors for the purpose of power shutdown. It is worthwhile to note that main line elevator power shutdown is always required when sprinklers are installed in the elevator machine room.

Workshop on Emergency Use of Elevators

In March 2004, a workshop co-sponsored by ASME, NFPA, NIST, ICC, IAFF, US Access Board, and others was held in Atlanta, Georgia, to consider the challenges of evacuation of high-rise buildings in fire and other emergencies. It was a three-day conference with over 120 life safety professionals attending from various communities concerned with high-rise safety and egress. There were two distinct focus points, one on the use of elevators by firefighters and one on the use of elevators for occupants during emergencies. The participants were split up into breakout groups to develop recommendations as to how elevators in high-rise buildings could be put to better use during emergencies. The goal was to develop proposals that could be submitted to various code-writing organizations for consideration. A steering committee made up of all the sponsoring organizations reviewed the breakout groups' recommendations and formulated plans for the next steps to be taken and also to identify the appropriate standards-making bodies to which to direct the proposals. Some of the consistently repeating themes were as follows:

- The culture change since 9-11 and the reluctance of occupants to stay in place and await further instructions
- Elevators not meant to be a substitute for stairs
- Evacuation of people with mobility impairments
- Water entering hoistways
- Lack of firefighter confidence in using elevators
- Entrapment caused by activation of shunt trip
- Re-educating people to use elevators for egress after years of ''don't use the elevators — use the stairs'' instructions

There were also repeating recommendations from the breakout groups such as mandatory adoption of ASME A17.3 everywhere; ensuring the reliability of Phase I and Phase II operation; better training of firefighters on elevator operation; enforcing the building emergency plan; sprinklering all buildings; the need for ''real-time'' communication to building occupants/emergency responders; and the use of compartmented and pressurized lobbies/vestibules.

Consistent themes relative to the needed process included utilizing a risk/hazard analysis, involving firefighters in the decision making, and involving the appropriate committees (A17.1, B44, model building and fire codes, and NFPA Codes and standards).

The two active task groups resulting from the workshop efforts (Task Group on the Use of Elevators by Firefighters and Task Group on the Use of Elevators for Occupant Egress) are performing comprehensive risk/hazard analyses of various emergency scenarios plus the residual hazards and the mitigation of the hazards. The task groups have estimated completion sometime late 2007 to early 2008. The groups will then put forth their conclusions and outline their recommendations. The task groups, made up of various industry components (research, fire service, architect and engineering, codes and standards makers, disability interests, and other industry members), have embarked on a journey that will command a Herculean effort.

These efforts will most certainly culminate in a significant impact on the interface and interaction between sprinkler, fire alarm, and elevator systems.

CONCLUSION

A historical perspective has been given here to help provide a better understanding of both the actual code evolution and some of the thought processes that went into the interface requirements for elevator and fire alarm systems. During the past decade it became very evident that the issues faced in addressing these challenges were ones that were not ''black or white.'' There were, and continue to be, many varying shades of gray. One thing, though, is very clear. There is now a spirit of willingness and cooperation between industry, code enforcement, and the fire service to continue to work together to find the best solutions to achieve the highest level of safety and reliability for the passengers and emergency personnel who use elevators. With more focus on improving building evacuation time by rethinking and improving the egress process, with performance-based design approaches, and with new technologies providing more options, that cooperation will need to continue as we face even more difficult and challenging decisions ahead.

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