SPRINKLERS IN ELEVATOR HOISTWAYS AND MACHINE ROOMS

by Gordon A. Holland

Sprinklers are an extremely effective means of fighting a fire. Since they are permanently installed fixtures they are immediately available to extinguish the fire while it is small. Both fire damage and water damage should be kept to a minimum.

At present the A17.1 Elevator Code has only one Rule concerning sprinklers; i.e. Rule 102.2(c), which states:

> (c) Standard sprinkler protection conforming to the requirements of ANSI/NFPA 13 may be installed in these spaces, subject to the following.
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> (1) All risers and returns shall be located outside these spaces.
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> (2) Branch lines in the hoistway shall supply sprinklers at not more than one floor level.
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> (3) Shutoff valves shall be provided for each branch line in accessible locations outside these spaces.
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> (4) Means shall be provided to automatically disconnect the main line power supply to the affected elevator prior to the application of water.This means shall not 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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> (5) Smoke detectors shall not be used to activate sprinklers in these spaces or to disconnect the main line power.

This paper will consider the ramifications of having sprinklers installed in elevator hoistways and machine rooms. The advantages gained, and the problems caused by sprinklers in each area, will be discussed separately.

SPRINKLERS IN ELEVATOR PITS

The elevator pit is the most likely place for litter and debris to gather if good housekeeping is not practiced. It is also open to the hazard of lighted cigarette butts dropping from above. The pit is therefore an area that needs to be sprinklered. The introduction of water into the elevator pit is not a serious problem, since minimal wiring is present. Waterproof fittings and switches in the pit would be a reasonable solution.

SPRINKLERS IN ELEVATOR HOISTWAYS

The elevator cab and platform are virtually the only source of combustible material in the hoistway. Fires inside elevator cars are fortunately very rare, and spraying water on the outside of the car with a sprinkler head fixed somewhere in the hoistway is of doubtful value. It would seem prudent therefore to omit sprinklers in the upper area of the hoistway and rely on the hoistway smoke detector to institute Phase 1, thereby returning the car to the lobby. In the unlikely event that the car is actually on fire, the fire can be fought more efficiently there. Discharging sprinklers in open hoistways, other than pits, can also lead to elevator shutdown, or worse yet, to dangerous malfunction. Modern elevators commonly have microprocessor controls situated in diverse locations in and on the elevator car, rather than simple wiring and switches as was common in the past. Door operators, position sensor, leveling units, and car stations now include much of the elevator control logic. They are sensitive to both heat and water. Waterproofing of hoistway interlocks, hoistway switches, and the multitude of electrical devices and controls on the elevator car would be a severe economic hardship for the average passenger elevator. Waterproofing the car equipment would also add considerably to the car weight and would make maintenance and troubleshooting more difficult. The sprinklers are likely to cause more harm than good in this instance, and I would recommend they not be required or allowed.

The latest revision of the British Standard "Bs 5588 Part 5- Code of Practice for Firefighting Stairways and Lifts" states, in part, in 12.1 : "The provision of sprinkler heads within the firefighting shaft (elevator hoistway) is not desirable: given compliance with the recommendations of this code, the only potential for fire occurring within the lift well (elevator hoistway) would arise from combustibles within the car, which could not be reached by sprinkler discharge." I added (elevator hoistway) notes for clarity.

SPRINKLERS IN ELEVATOR MACHINE ROOMS

The A17.1 Code allows sprinklers in machine rooms, but requires that the main power supply to the affected elevators be disconnected prior to the application of water. The most common method of complying with this requirement is to supply a dry system, and to monitor the machine room ambient by a heat detector with a lower temperature rating than the sprinkler head. A likely scenario, in the event of a fire in the machine room, would be the actuation of the smoke detector, which would put all the cars associated with that machine room on Phase 1 and return them to the designated level. As the fire progressed, the temperature sensor would activate, which would operate a shunt-trip circuit breaker to disconnect the main power to the affected elevators, and simultaneously open the valve to flood the sprinkler system. If the temperature increased sufficiently, some or all of the sprinklers would activate.

There is no reasonable argument to suggest that sprinklers would be an ineffective means of extinguishing a machine room fire. But is it the ideal method? There are questions that need to be considered, such as:

(1) Is water the best medium to fight a fire in electrical equipment?

(2) Did the elevator machine room simply get caught in the sweeping requirement that " all areas shall be sprinklered", because no viable alternative has yet been suggested? Telephone equipment rooms, power distribution areas and computer rooms are often protected without resorting to sprinklers.

(3) Does the fire load of flammable material in the machine room justify the use of sprinklers, with the consequent loss of elevator service for days or weeks, while equipment is being dried-out, repaired, or replaced?

(4) Is there not a better way to get equivalent protection, without resorting to water, which might easily do more widespread damage than the fire itself?

CHANGES SUGGESTED BY LOCAL AUTHORITIES AND OTHERS

There have been many comments made, and changes suggested, concerning sprinklers. I would like to comment on some of them.

(1) "Only the elevator control in contact with the fire would have to be shut down, so the rest of the group would be available for firefighter service, or to transport handicapped personnel."

One of the key phrases in the Rule is "the affected elevators." With elevator control panels often grouped together, and with the close spacing of machines necessitated by the width of hoistways, and with the group supervisory logic controller electrically connected to each individual car controller, it becomes necessary to remove power from all the elevators in that machine room when the temperature sensor activates. Even if the fire was so localized that it only activated one sprinkler, it is likely that several machines, M.G. sets, or controllers would get soaked with water. Hence all elevators in that machine room would be shut down immediately, to prevent the possibility of dangerous control faults, that could result in life-threatening situations.

(2) The Code Enforcement Authority in one municipality issued a Rule that required the heat detector in the machine room to be connected to the elevator control. The elevator control was then tasked with removing its own power supply, by activating the shunt-trip circuit breaker, and opening the valve to flood the sprinkler system. These actions were not to take place until all cars had returned to the designated level, or a specified time delay had expired. There were serious defects in this Regulation, which has since been revised to conform to the A17.1 Code rules. Elevator controls that were in the fire environment were given the ultimate responsibility for making the sprinklers in the fire area operational. Whether the control is microprocessor-based or relay type, it cannot be relied upon to carry out such critical functions in such an environment. It is very possible that the sprinklers would fail to become operational at all, or at least, they would be delayed during the critical period when the fire is expanding.

(3) "Smoke in the machine room could cause malfunction or shutdowns by causing the failure of photo cells used in elevator control circuits."

Although some elevators have used photo-electric devices on selector machines for

determining position and controlling the final leveling of the elevator, the devices are remarkably insensitive to smoke because of the ability of infrared radiation to penetrate very dense smoke. At any rate, the use of mechanical selectors is not common with modern controls. The more common use of photo-electric devices is in opto-couplers and encoders, where the units are sealed so well that the infusion of smoke into the device is highly unlikely.

(4) "The power should not be removed until all cars have returned to the designated level to prevent trapping passengers between floors."

Much as we are loath to shut down cars with the inevitable possibility of entrapment, it remains the prudent thing to do. The sprinklers cannot be activated until the power has been disconnected, so any delay in shutting off the power allows the fire to become more intense, and to spread. It also allows the penthouse ambient to continue rising. In the normal sequence of events the smoke detector will have caused the recall of the elevators to the designated level prior to the heat detector activating to shut off power. Any elevator which has not returned by this time is probably unable to return for one of many reasons e.g. on inspection control, malfunction, etc. Most modern elevator logic controllers employ microprocessor, which are sensitive to elevated temperature. Once the heat detector in the machine room has activated it is not logical to trust the microprocessor to continue functioning in a reliable fashion. Not only might they cease functioning because of temperature and cause entrapment, but of more concern, they might become unreliable, and could send the car in the wrong direction, or open the doors during a high speed run, etc. When it is determined that the temperature in the machine room is excessive, as evidenced by the actuation of the heat detector, the prudent action is to shut off the elevators whether there is in fact a fire in the penthouse or not, and regardless of the possibility of sprinklers activating. A possibly dangerous condition exists, and the controller is not to be trusted to make logical decisions. Many modern controllers include temperature sensors to monitor heat sinks and ambient temperature. When activated they cause an orderly shutdown at the next available floor or an immediate stop, depending on the location and severity of the elevated temperature.

(5) "The cars should be kept in service for the firemen as long as they will run; firemen have life-support equipment, two- way communication, and carry the necessary tools to break out of a stalled elevator."

It is not just a case of the car operating normally or simply shut down. There are many possible variations between these two extremes. The elevator could start away from a floor with its doors open if water has shorted the door locks or if the brake ceased to hold. The control could take the firemen to the fire floor by accident, or any number of equally dangerous situations.

CONCLUSIONS

Sprinklers serve a real need in elevator pits. The probable benefits far outweigh the cost of waterproofing the pit equipment. They do not pose an additional hazard to elevator operation.

Sprinklers in the upper portion of elevator hoistways are of doubtful value as a means of fire protection, and their use, without an unreasonable increase in the cost and complexity of the car and hoistway equipment, can pose a serious threat to safe elevator operation.

Sprinklers in machine rooms, conforming to the present A17.1 Rule, provide good fire protection, but they have serious drawbacks that suggest that some alternate means should be investigated.

RECOMMENDATION

I would like to see the members of this fire symposium, and other experts, investigate alternate methods of fire protection in elevator machine rooms, so that sprinklers are not required. The points of discussion might include topics such as the following.

(a) Should building Codes require higher fire ratings for machine room floors and walls?

(b) Should all flammable material not essential to the operation of the elevator be prohibited from being stored in the machine room e.g. oil and grease, cleaning rags, paper and maintenance manuals,etc.

(c) Is it reasonable to require some other form of fire protection such as Halon gas ?

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