

# Strategies for Ensuring Appropriate Occupant Response to Fire Alarm Signals

*By Guylène Proulx*

**This Update presents strategies designed to ensure that building occupants respond appropriately when the fire alarm sounds, with the goal of promoting safe and orderly evacuation or relocation.**

Construction Technology Update No. 42 explained why building occupants tend to ignore fire alarms when they should be taking action to protect themselves from the emergency. The reasons for inaction include failure to recognize the signal for what it is, recurring nuisance alarms, and signal audibility problems.<sup>1</sup>

This new Update suggests strategies and procedures for changing the behaviour of occupants and prompting their appropriate response to a fire alarm. Among the key strategies is the installation, in new or refurbished buildings, of a fire alarm signal emitting the Temporal-Three Pattern, as prescribed in the 1995 National Building Code. Using the standardized evacuation signal as the fire alarm signal will facilitate recognition of the fire alarm itself (see Update No. 42).

The use of the Temporal-Three pattern will eliminate many of the problems associated with the diversity of fire alarm signals that have been used in the past. However,



*Figure 1. In office and apartment buildings, occupants should be familiar with the building layout and fire safety plan.*

the Temporal-Three pattern will not, in itself, guarantee appropriate occupant response.

## **Need for a Fire Safety Plan**

Aside from the standard fire-protection features designed into a building, fire safety starts with a fire safety plan. Every building, including the single family home, should have such a plan. It should describe all the fire-safety features of the building, including a description of the fire alarm signal, the possibility of voice communication messages, how the fire department is called, and the actions expected of the occupants (whether they are staff or visitors, including people with disabilities). The plan, which may be known under various names such as “emergency plan” or “evacuation plan,” should be posted in the building, easily seen by occupants, updated regularly, and used during training and drills (Figure 1).

## **Ensuring Appropriate Occupant Response**

An effective way to encourage appropriate occupant response is to follow these steps:

- Stop the show.
- Use a voice communication system to direct occupants to safety.
- Institute protect-in-place measures.
- Educate occupants about the fire-safety plan.
- Train staff to direct occupants to safety.

### **Stopping the Show**

Building occupants may hear and recognize the fire alarm signal but may be so engrossed in an activity that they do not pay any attention to it. What is needed is a change in the environment to switch their attention from their activity to the emergency. The appropriate change depends on the type of building and the type of occupancy. There are also differences in occupant behaviour between public buildings, in which people are usually visitors, and office and apartment complexes, whose occupants are more likely to be familiar with the building's layout and fire safety plan.

In a shopping centre, an appropriate change in environment is to turn off the background music. In a movie theatre, the projector should be stopped and the lights turned on at once. Similarly, in a discotheque or restaurant, the music should be stopped and full lighting should flood the space. This type of sudden and sharp change in atmosphere alerts patrons to the fact that something serious is happening and forces them to shift their attention to the emergency. Protestations die down as information is provided.

As long as the "show goes on," people are very reluctant to shift their attention to an unexpected or ambiguous event. Management and staff can demonstrate their concern for public safety by taking immediate action to "stop the show" as soon as the fire alarm goes off.

### **Using a Voice Communication System**

In large public buildings such as museums, department stores and airport terminals, people are very unlikely to take any action, at least initially, when the alarm signal is activated. Social interactions tend to occur

first: people observe what others are doing and if no one is paying attention to the alarm, they are reluctant to take any action that would make them appear out of place or over-reacting. To motivate response in such occupancies, further information should be provided.

"Visitors" to large public buildings generally feel it is their role to wait for instructions from staff or a figure of authority. They expect to be told what to do if something truly serious is happening. The method of choice for instructing occupants is a voice communication system.

In the past, this tool was rarely used to provide emergency information because of the false idea that occupants will panic if they are told that there is a fire.<sup>2,3</sup> In fact, the opposite is true: being told the truth is more likely to trigger appropriate reaction, not dysfunctional behaviour. Research and studies of actual fires demonstrate that providing information through a voice communication system is one of the best ways to ensure immediate reaction by occupants. Contrary to some beliefs, occupants tend to immediately obey instructions received through the voice communication system.<sup>4,5</sup> It is also known that when occupants are aware that such a system exists and have heard it tested regularly, they wait to obtain information before responding in a real emergency.

There should be no delay in using voice communication. The message should describe the emergency and instruct occupants on the best course of action. On-site managers should be prepared to decide quickly whether to evacuate the premises or to direct occupants to a safe location within the building. Waiting for the fire department to arrive and assess the situation before instructing occupants is not a good idea, for two reasons. First, when firefighters arrive they expect all occupants to be in a safe location, allowing them to focus on controlling the fire instead of performing search and rescue missions. Second, waiting the five to ten minutes it takes for firefighters to arrive could prove lethal: for example, the delay may eventually require occupants to move through smoke-filled areas in an attempt to reach safety.<sup>5</sup>

Messages delivered to the public during a fire emergency should contain three essential pieces of information:

- 1) identification of the problem;
- 2) location of the problem; and
- 3) instructions for action.

Messages should be simple, direct and truthful. Attempting to downplay the emergency or using technical jargon to disguise the real situation could confuse people and prevent them from reacting appropriately. Instead, it is important to identify the problem in common terms such as “we suspect a fire” or “a fire has been detected.” Identifying the location is essential: occupants wonder if they are at immediate risk and knowing where the fire is helps them decide what to do. Finally, the message should clearly explain what is expected of the occupants. In some cases, it might be best for them to remain on location; in others, directing them through a specific route to a specific exit might be more appropriate.

The advantages to live messages are many. First, instructions can be updated as new information is obtained. Second, the tone of the message can convey the urgency of the situation. Finally, occupants are more receptive to live messages because they are more likely to consider the information to be genuine and reliable.

Some buildings are equipped with a voice communication system that delivers pre-recorded messages. Although such a system may save staff time, the use of pre-recorded messages has proven ineffective and even dangerous. A field study demonstrated that such messages could not be precise enough to help occupants locate the nearest exit. During the evacuation of an underground station where the main escalator was blocked, occupants did not know where to go because the pre-recorded message could not pinpoint the location of an alternative way out.<sup>4</sup>

The effectiveness of a pre-recorded message is always limited since it is too general to cover all situations of an alarm activation. There are some new systems that can deliver different messages according to the location of the activated detectors, but this technology has not yet proven totally efficient and dependable. During the Düsseldorf Airport Fire in 1996, pre-recorded messages in different languages were transmitted; unfortunately, the information delivered during the initial 10 minutes was erroneous, directing passengers toward the most dangerous areas of the terminal.<sup>6</sup>

Since many buildings are now equipped with closed-circuit televisions (CCTVs) for security purposes, these can also be a valuable tool for delivering precise messages during an emergency. Strategically placed CCTVs allow the person behind the microphone to view conditions in different areas of the premises. Messages can then be tailored to suit crowd movement and the developing fire situation.

#### **Instituting Protect-In-Place Measures**

There are more and more large buildings whose fire safety plan does not state that occupants should evacuate the building in an emergency. Instead, any one of several actions may be warranted:

remain in place, move to another area, move to an area of refuge, or follow some other plan of action appropriate for the building or specific locations within it. Massive evacuation could bring tragic outcomes; many of the deaths in large buildings occur because people are trying to evacuate through smoke-filled corridors and stairwells. In some cases, such as highrise hotels, it might be safer for occupants to stay in their rooms and start protective measures such as sealing doors and cracks to prevent smoke from entering, and to await further instructions (Figure 2).



*Figure 2. Many deaths in large buildings occur because people are trying to evacuate through smoke-filled corridors and stairwells.*

### **Educating Occupants**

Occupants' knowledge and assumptions regarding the development of a fire are often wrong. The literature is full of anecdotes about people not doing what they were expected to do or, worse, doing things that endangered their lives. During the serious fire at the World Trade Center in New York in 1993, occupants broke windows to vent the smoke, making the situation worse.<sup>7</sup> In one highrise residential fire, occupants did not close the main door upon leaving, judging wrongly that a wooden door would burn right through.<sup>8</sup> Some occupants have been known to pour water on burning oil (newspaper reports); others have attempted to hold their breath while moving long distances through smoke.<sup>5</sup> In another case, people entered a subway station and went down an escalator next to the fire.<sup>9</sup>

If we expect occupants to do the right things during a fire emergency, they must be trained. The public should be educated about fire, how it can start, how it develops and what impact it has on people. Most fire-safety education programs are targeted toward children, but other groups are at risk as well, especially residents of old-age homes and the disabled.

Occupants need to be trained in the fire safety plan for buildings they are visiting. This is easier in the case of buildings that they "visit" every day, such as their place of work. For locations like a movie theatre, a short message about the fire-safety plan could be given before each performance.

### **Training Staff**

With other types of public buildings mentioned earlier, such as airport terminals and shopping or sport centres, occupant training is not practical. For these, much of the responsibility for safety rests with employees. Consequently, staff training is paramount. Occupants are very likely to look to staff members for information. Employees are regarded as knowledgeable and they are expected to know the situation, the best course of action and the closest exit. Whether heard on a speaker or seen in

uniform or with a name tag, staff are likely to be listened to. Evacuations of Marks and Spencer department stores in the U.K. demonstrated that, even though the fire alarm had been ringing for some time, customers were only prompted to evacuate when requested to do so by staff members. Then they complied immediately with instructions.<sup>10</sup>

Staff training should include regular classroom sessions as well as evacuation drills. Drills are a valuable means for staff to put their training into practice and for them to assess the application of the building's fire-safety plan. Feedback from staff and occupants after a drill helps identify problems, as does an assessment after false alarms and actual fires.

New staff should not be allowed to begin work until they have received proper fire-safety training and have become familiar with the building's fire safety plan. The lives of hundreds of people could be in their hands, so they need to be acutely aware of the importance of their roles and responsibilities.

When dealing with large spaces or with large crowds, it is not practical to rely on the entire staff to direct occupants to safety, as the number required might be very large. For such situations, it is more efficient to rely on a few well-trained staff members, the voice communication system and CCTVs.

### **Time to Escape**

When the fire alarm is activated, it should provide enough time for occupants to move to a safe location before conditions become dangerous. If the occupants do not start to move immediately, the time available for safe escape becomes shorter. To minimize the possibility of delay, information should be provided quickly to the occupants to prompt movement. Movement can also be prompted through a dramatic change in the environment as indicated earlier.

It was documented in residential evacuations that the delay time to start evacuation after hearing the fire alarm signal was three-quarters of the total evacuation time.<sup>11</sup>

In other words, if the total evacuation time was four minutes, three minutes were spent in delay time (investigating the situation, gathering family members and pets, finding wallet and keys). Only one minute was spent moving to safety. The delay time could be dramatically shortened if additional means to inform occupants were used.

In one emergency in an underground train station, not all occupants managed to be evacuated; 15 minutes after the activation of the fire alarm signal, some passengers were still patiently waiting for their train. When the fire alarm signal was paired with voice communication messages, the space was cleared in just over five minutes.<sup>4</sup>

### ***Eight Ways to Improve Occupant Response to Fire Alarm Signals***

1. Install the Temporal-Three alarm signal pattern.
2. Develop a fire-safety plan and post it in strategic locations.
3. Conduct evacuation drills twice every year.
4. Limit the number of nuisance alarms to less than three per year.
5. Quickly change the ambience of the environment when the fire alarm sounds.
6. Use live messages, aided by closed circuit television if possible, to broadcast precise information to occupants.
7. Train floor fire wardens to prompt occupant movement.
8. Give feedback to occupants on any alarm activation.

### **Conclusion**

Studies have demonstrated that it is overly optimistic to expect that the fire alarm signal alone will warn all occupants, prompt immediate action, initiate evacuation movement and allow sufficient time to escape safely. In addition to using the Temporal-Three evacuation signal, complementary additions including voice communication messages, staff-warden instruction, training, drills and a well-devised fire-safety plan greatly increase the probability that the occupants of a building will respond appropriately and quickly to a fire emergency.

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