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Fire Systems Go Hand in Hand with Human Factors

Lack of regular inspection, testing, and maintenance can compromise the performance of fire-protection devices and have deadly results

By Al Niederfringer and Lee West

When their business burned to the ground despite code-compliant sprinklers and noncombustible building materials, the owners of a retail store learned the hard way how a seefmingly small oversight can result in a big loss.

The problem? A valve buried beneath the asphalt street controlling the flow from the public main into the store had never been fully opened after repairs to the public water system were completed. When the automatic sprinklers turned on, there was no water to feed them. The fire engulfed the store's highly combustible goods, and the building collapsed before firefighters could save it.

While, fortunately, no one was injured, the loss topped $4 million - an expensive lesson about the importance of not just *installing* fire-protection devices, but also *inspecting, testing,* and *maintaining* them on a regular schedule.

The best and most advanced fire-protection devices are of little use if the human element - human action or inaction - isn't taken into account and addressed on a planned, periodic, and proactive basis.

Fire Remains a Threat
In this country's early years, before advances in fire-safety technology, fire could - and often did - sweep through a community, completely destroying homes and commercial buildings. Even just a century ago, death and devastating destruction from fire was much too common. The 1906 fires that followed the massive San Francisco earthquake gutted 28,000 buildings and killed 3,000 people. In 1911, New York City's infamous Triangle Shirtwaist Factory fire killed 146, mostly young women trapped by locked doors and missing fire-escape ladders.

These and similar disasters have led to increasingly stringent fire-safety standards and prescriptive building codes that, today, have made buildings much safer. The record for nonresidential structure fires is getting better - an improvement that the Emmitsburg, MD-based U.S. Fire Administration attributes to an extensive focus on protecting public and private buildings with rigorous standards. According to the U.S. Fire Administration, in 2006, there were 111,500 fires in nonresidential structures, killing 85, injuring 1,425, and causing $2.65 billion in property damage. This compares favorably to a decade earlier, when there were 145,500 nonresidential fires, 120 deaths, 2,600 injuries, and $2.5 billion in damages.

Focusing on the Physical
Many of the improvements in fire safety have come from physical requirements in terms of how buildings are constructed and equipped. Today's fire-safety measures often include automatic fire-sprinkler systems, fire pumps, alarm systems, portable fire extinguishers, fire walls, and requirements for noncombustible materials.

Protective measures are becoming increasingly sophisticated and complex. For example, specialized fire-extinguishing systems fixed permanently over cooking equipment are designed to automatically respond to a fire in a grill or deep fat fryer. These systems detect fires quickly, turn off heat sources, and discharge appropriate chemicals to extinguish fires - all without the often-too-late intervention of a human being.

Building design has also improved, often incorporating features, such as protected stairwells, that give occupants smoke-free escape routes, specialized fire barriers, and smoke-control systems.

The All-Too-Human Issues
Despite improvements in design and protective devices, no building is completely fire safe. One of the biggest threats comes from the human element of fire safety. The best protective measures will not be effective if they don't work when they're needed - and, most often, they fail because of human error.

Unfortunately, some examples to illustrate this are easy to come by:

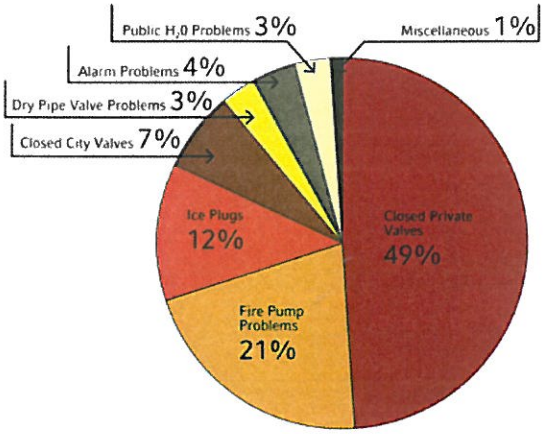
- In one New England laboratory, the building manager duly brought in an outside contractor every year to test the sprinkler system's water supply. But, neither the occupants nor the contractor had ever done anything about the repeated reports that showed water pressure dropping from a normal 75 psi to 0 psi when a drain valve was open. A 10- to 20-percent drop would've been tolerable, but 0 psi indicated that no water would be available for the sprinklers in the event of a fire. When an insurance risk control representative reviewed the reports and pointed out the issue, an investigation determined that a public works project in the street 4 years ago had led to all valves being shut off; they were never completely reopened, leaving the lab at risk - all documented in annual contractor reports that were filed without adequate review and remedial action.
- During one summer, a rapidly expanding business ran short of space and began storing paper goods and records in the unused boiler room. As winter approached, no one thought to move the materials - a definite safety hazard once the boiler was up and running.
- A warehouse's sprinkler system was originally designed for adequate fire suppression when aisles were wide enough to allow movement of goods, and when storage units topped out at 12 feet. But, over the years, the use of the warehouse changed; fire hazards increased as a result. Sprinklers rated to protect the building when wood pallets were used were now expected to cope with the much hotter fires created by plastic pallets; aisles were jammed with goods, increasing the volume stored in the space; and storage units now rose 15 feet (3-feet higher than before), blocking the sprinklers from distributing water appropriately in many cases.

Big-picture problems can have a big impact on fire safety. But, there are many smaller issues that exist - and only increase in scope—when a fire occurs and systems do not respond as designed. How common are these

problems? Insurance risk control specialists often uncover what are called "hidden impairments" (conditions that place millions of dollars' worth of property value at risk because of undetected problems with systems that are supposed to take over during emergencies). The charts on this page show the breadth of problems discovered by just one insurer.

As the 2007 pie chart illustrates, more than two-thirds of problems discovered by insurance risk control representatives come from valves that have been shut down and never reopened, often during the repair or testing of water systems. Fire pumps that fail to start when needed are another major source of risk. Problems with alarm systems, and failures involving dry pipe valves (DPVs), which are critical components of dry sprinkler systems, are also frequent.

REPORTED IMPAIRMENTS 1995-2007



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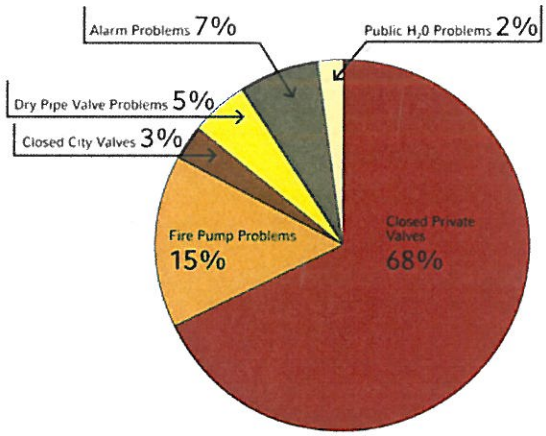

Taking the Right Steps: Fire-Safety Plans

There need to be visible commitment and demonstrated support from top management for fire safety to be taken seriously. It's important to develop a fire-safety plan, including elements such as emergency procedures, evacuation plans, and fire drills that are designed around the specific hazards of a business.

The top-down commitment begins with appointing a person or committee to be responsible for the creation and implementation of the fire plan. This fire-safety manager or committee needs to be held accountable for ensuring that the plan is *followed*, not just shelved. In addition to following the plan's strategy, the fire-safety manager needs to be aware of when conditions change - a building remodeling or a shift in business operations - and focus on the implications from a fire-safety perspective.

Once this is complete, a framework for *inspection*, *testing*, and *maintenance* should be embedded in the fire-safety plan and followed rigorously:

Inspection. The fire-safety manager should routinely inspect the building to make sure that general housekeeping is up to standard. For example, combustible liquids (ink at a printing business, cooking oil at a restaurant, or paint at almost any business) should be stored in proper containers and protected areas. Ducts and exhaust hoods above cooking equipment should be inspected for grease build-up that might feed a fire, and should be cleaned frequently.

The fire-safety manager should also plan to review conditions in the aftermath of a building remodel to make sure that any fire-protection systems that were temporarily out of commission are restored to working order. The manager should be made aware of changes in business operations, such as new warehousing procedures, that may impact fire safety.

In addition, it's important to ensure that occupants follow whatever smoking controls have been established: This may include making sure that smoking only occurs in designated areas and that employees are leaving the building to smoke.

Since many businesses are too small to hire a full-time fire-safety manager or officer, they should be aware of resources they can tap to help the person they designate for this role - this person may have many other responsibilities and little formal fire-safety training. Some insurers have risk-management operations that provide their customers with training on inspection and maintenance techniques. Local fire departments are also sources of expertise; having them become familiar with a facility prior to an emergency is always a plus.

Testing. All systems should be tested on a regular basis. In many cases, quarterly or annual tests are best conducted by outside experts or contractors, but it's up to property managers and owners to monitor the results and act upon recommendations.

In addition, weekly and monthly testing can be conducted by people on-site. For example, the following test frequencies are recommended for an effective sprinkler system:

- **Control valves**. More than 30 percent of sprinkler-system failures are attributed to closed control valves. All control valves should be secured in the open position with a padlock. If valves are not locked or electronically controlled, they should be inspected weekly to verify that they're open and that sprinkler systems are active. Even if valves are locked or controlled electronically, they should be inspected at least monthly. Electronic anti-tamper switches that sound an alarm when control valves are turned should be tested quarterly. And, annually, each valve should be closed fully and then reopened to ensure proper lubrication and function.
- **Sprinkler systems**. Testing a sprinkler system should determine the operational status of the mechanical devices, including alarms and dry pipe valves. Weekly inspections should include sprinkler riser pressure gauges, heads, and piping. Fire-department connections and hose stations should be inspected monthly. On a quarterly basis, the waterflow alarms and low-air-pressure alarms should be tested, as well as the water supply at the 2-inch main drain. Annual testing should include trip-testing valves and testing the low-point drains on a dry pipe system.
- **Water supply**. A test of the ability of booster fire pumps to start up should be run weekly. Gravity, pressure, or suction tanks should be inspected monthly, as should hydrants. A flow test of the booster fire pump and hydrants should be conducted annually.

Another important duty of the fire-safety manager is to make sure that the right people are notified during testing if systems are shut down. Local fire officials and the agent or carrier for the fire insurance should usually be alerted to the timing and duration of water-supply shutdowns.

Maintenance. For inhabitability, it's important to maintain all building systems in good working order - particularly so when it comes to fire protection. Fire pumps, for example, can mean the difference between having enough water to douse a fire before it becomes fully involved or helplessly watching a building engulfed in flames. But, a fire pump is of little value if it doesn't start when it's needed because its controller deteriorated and was never tested.

The Quincy, MA-based National Fire Protection Association has issued a number of standards (available online) for testing, inspecting, and maintaining fire-prevention features and equipment, such as portable fire extinguishers, sprinkler systems, fire alarms, and fire doors. In addition, the risk-control services of insurance companies and local fire marshals are good resources for maintenance tips.

Innovative measures can help identify areas for building maintenance that can make a difference in fire safety. Infrared thermography, for instance, can be used to locate problems with electrical equipment. Infrared scans can detect electrical hotspots that are wasting energy and producing excessive heat that may lead to fire. In addition to forestalling fires, finding and fixing poor electrical connections before a component fails can save occupants the costs associated with manufacturing downtime and other losses related to electrical outages.

Ultimate Responsibility is Shared

In the aftermath of a fire, there may be finger-pointing and accusations about who should have done what. The tenants may presume that the building manager was taking care of annual inspections. The building manager may rely on a fire-safety contractor without bothering to pay attention to the details of reports dutifully filed away. The building owner may think that complying with building codes during construction completes his/her responsibility.

Obviously, it's much wiser for everyone with an interest in the building to use common sense, take proper preventive measures, and practice constant vigilance. Fire safety isn't one person's job - it should be a cultural value with a commitment to follow through on issues as they arise.

Fire suppression and detection systems in today's buildings are innovative and highly effective - but only if they're inspected, tested, and maintained so they work properly when the need arises. Those who own, manage, and inhabit buildings have joint responsibility - a responsibility they can fulfill by working closely with experts, including local fire departments and insurance risk control consultants, to make sure they're ready if and when a fire breaks out.

Al Niederfringer and Lee West both work for Hartford, CT-based Travelers, the second-largest writer of commercial U.S. property casualty insurance. Niederfringer is second vice president and West is managing specialist for Travelers' risk control department.