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Supervising Automatic Sprinkler Systems

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Fire Alarm Systems serve various purposes depending on the overall fire protection goals of the system user. As we have discussed in this column in past issues, the first step in designing a fire alarm system requires the user to set the overall fire protection goals for the system. By defining goals for Life Safety, Property Protection, Mission Continuity, Heritage Preservation, and Environmental Protection, a user gives the fire alarm system designer a road map to follow in selecting appropriate system features.

Most of the time, the fire alarm system will simply warn building occupants of the presence of a hostile fire. Sometimes, the fire alarm system will also summon emergency responders, such as a private fire brigade or the public fire department. In other cases, the fire alarm system will actually provide the management of a facility with the means to oversee the other active fire protection systems.

By monitoring the status of such active fire protection systems as automatic sprinkler systems, extinguishing or suppression systems, fire pumps, gravity tanks, and the like, the fire alarm system becomes an important management tool. Let's use the automatic sprinkler system as an example to explore this management capability that a fire alarm system offers.

To set the parameters, we can follow the requirements contained in NFPA 13-1999, *Installation of Sprinkler Systems,* NFPA 72-1999, *National Fire Alarm Code*, and the requirements

provided by various private authorities having jurisdiction, such as the major property insurance carriers, Industrial Risk Insurers and FM Global.

The discharge of water from the automatic sprinkler system should initiate a fire alarm signal. This waterflow alarm signal originates from some type of waterflow alarm initiating device. For wet pipe automatic sprinkler systems -- sprinkler systems where the system piping is always full of water up to the closed sprinkler heads –- installers use three types of waterflow alarm initiating devices: vane-type waterflow switches, pressure-operated waterflow switches, or drop-in-pressure-operated waterflow switches.

An installer mounts a vane-type waterflow switch by using a special collar around the sprinkler riser above the alarm check valve. This collar allows an electric drill equipped with a hole saw to drill out and remove a circular coupon from the pipe. The paddle, or vane, of the vane-type waterflow switch is then rolled up and inserted through the hole into the pipe. Once inside, the vane unrolls and stretches across the inside of the pipe. The external portion of the switch is then clamped to the pipe to hold the assembly in place. When a sprinkler head fuses or a pipe breaks, water flowing past the vane lifts it upward. This actuates a switch assembly, closing a set of contacts and initiating an alarm signal.

If an installer chooses to use a pressure-operated switch, he or she mounts that switch on the alarm line discharge from the alarm check valve. The exact location of this switch often presents a conflict.

The trim package that comes with the alarm check valve usually provides a pressure-operated switch mounted on top of the retard chamber. This switch provides a connection for a local electric bell to supplement or supplant the use of a water motor-operated gong on the outside of the building. Do not connect the fire alarm system initiating device circuit to this switch. A

normally-open valve in the alarm line allows a service person to isolate the retard chamber for repairs. It also allows someone to silence the water motor gong during an extended sprinkler system discharge.

However, NFPA 72-1999, *National Fire Alarm Code*, Section 3-8.3.3.3.2 states:

> 3-8.3.3.3.2 If a valve is installed in the connection between an alarm-initiating device intended to signal activation of a fire suppression system and the fire suppression system, the valve shall be supervised in accordance with the requirements of Chapter 2.

This means that the installer must either locate a pressure-operated switch used to initiate an alarm on the fire alarm system before any valve on the alarm line, or provide a valve supervisory switch for that valve. This switch can initiate a valve supervisory signal at the fire alarm system control unit.

The third type of waterflow alarm initiating device for a wet pipe automatic sprinkler system uses a drop-in-pressure-operated switch in conjunction with a small make-up pump. This small, one gallon-per-minute (gpm) pump maintains an excess pressure above the alarm check valve. When a sprinkler head fuses or a pipe breaks, the small pump tries to overcome the pressure loss. Because it cannot keep up with a substantial flow from a single sprinkler head, the pressure continues to drop until the drop-in-pressure-operated switch actuates, initiating the alarm.

For dry pipe automatic sprinkler systems -- sprinkler systems where the system piping in an unheated area is full of pressurized air back to a dry pipe valve located in a heated area –- installers use a pressure-operated waterflow switch located on the alarm line connected to the dry pipe valve. When a sprinkler head fuses or a pipe breaks, the air pressure drops until the dry pipe valve trips

and floods the piping with water. Water also discharges into the alarm line. This actuates the pressure-operated switch and initiates an alarm.

Both deluge and pre-action sprinkler systems rely on a separate fire detection system to trip a deluge valve and flood the piping with water. Deluge systems have open heads that all discharge at once. Pre-action systems have closed heads. These systems both use a pressure-operated switch on an alarm line connected to the deluge valve to initiate an alarm.

Installers must not use vane-type waterflow switches for dry pipe, deluge or pre-action sprinkler systems. The vane cannot withstand the violent pressure surges when the valves trip.

NFPA 72-1999, *National Fire Alarm Code*, Section 3-8.3.1.2 states:

> 3-8.3.1.2 For fire alarm systems employing automatic fire detectors or waterflow detection devices, at least one fire alarm box shall be provided to initiate a fire alarm signal. This fire alarm box shall be located where required by the authority having jurisdiction.
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> *Exception: Fire alarm systems dedicated to elevator recall control and supervisory service as permitted in 3-9.3.1"*

In addition to fire alarm signals, automatic sprinkler systems can also initiate supervisory signals. All sprinkler system control valves 2 1/2-inches or larger should be equipped with a valve supervisory switch to initiate a supervisory signal if someone closes the valve. Where geographic areas may experience freezing temperatures, low building temperature supervisory switches should be provided for buildings protected by wet pipe automatic sprinkler systems and inside all dry pipe valve or deluge valve closets.

For dry pipe sprinkler systems and pre-action sprinkler systems, the fire alarm system can supervise high and low air pressure in the sprinkler system piping. If the air pressure rises too high

or drops too low, the actuation of an air pressure supervisory switch can initiate a supervisory signal.

Installers should also supervise the water supplies to automatic sprinkler systems. Where the public water system has proven unreliable or where a dead end water main feeds the sprinkler system, the installer should provide a low water pressure supervisory switch. If the pressure in the public water main drops below a set limit, this switch can initiate a low water pressure supervisory signal at the fire alarm system control unit.

If a private gravity tank or fire pump suction tank supplies the water for a sprinkler system, the fire alarm system can monitor the water level in the tank and, if the tank is located in an area subject to freezing temperatures, the water temperature. Similarly, if a pressure tank supplies the water for a sprinkler system, the fire alarm system can supervise tank level, water temperature, and air pressure.

The fire alarm system can receive supervisory signals from an electric motor-driven fire pump controller to indicate pump running, loss of pump power, and phase reversal. The fire alarm system can receive supervisory signals from the controller of a diesel engine-driven fire pump to indicate pump running, controller switch in a position other than “automatic,” controller or engine failure, and failure of the charger for the engine starting batteries. NFPA 20-1999, *Installation of Stationary Pumps*, provides the requirements for fire pump supervision.

In summary, the fire alarm system can provide a very valuable tool to help the management of a facility make certain an automatic sprinkler system will operate properly during a fire.

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