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Fire Protection Systems In Power Plants

By Dominique Dieken, P.E., CFPS, HSB Professional Loss Control
The Hartford Steam Boiler Inspection and Insurance Company
Inspection, Testing and Maintenance of Fire Protection Systems at Electric Generating Plants)

Introduction

Every year, fire suppression systems fail to operate satisfactorily in fire situations. In about one-third of these cases, the cause is inadequate inspection, testing and maintenance. An Edison Electrical Institute (EEI) study found that 49 percent of gaseous suppression systems in combustion turbine units failed to operate satisfactorily in a 20-year period, with a total property damage of $15.9 million. An example of a fire with a tragic consequence involved lube oil at a cogeneration plant on Christmas Day in 1992, which resulted in the death of three plant operators. Automatic sprinkler protection was provided for most of the plant, including lube oil hazards, but the systems had been turned off! Had the system been operational, the fire may have been controlled.

Incidents like the one described above can be prevented with a good documented inspection, testing and maintenance program, which will result in achieving maximum reliability of the fire suppression equipment. This article is addressed specifically to electric generating plants because of the wide range of fire protection systems found at these plants. Below is a list of systems typically found at electric generating stations:

- Fire pumps
- Hydrants
- Sprinkler/water spray systems
- Hose houses
- Halon systems
- Dry chemical systems
- Halon-alternative systems
- Carbon dioxide systems
- Detection/alarm systems
- Portable fire extinguishers

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Setting Up A Program

Fire hazards such as large quantities of fuel, combustible/flammable liquids, electrical hazards, combustible dusts, and warehousing are common in electric power generating plants. Although fires are not a daily occurrence, they usually will cause severe property damage and business interruption. Many power generation plants are 10 to 20 years old, and sometimes the fire protection equipment systems have not received attention since they were installed. If these systems are needed, however, they are counted upon to perform reliably and protect vital plant equipment from fire. Fire protection systems are a combination of mechanical and electrical components and, like power generation equipment, need regular attention.

In addition, some people in charge of fire protection do not have an adequate knowledge of necessary inspection and testing frequencies, or they use the minimum frequencies prescribed by their authority having jurisdiction. For example, some jurisdictions only require annual water flow alarm tests on sprinkler systems, a frequency which is considered inadequate by most fire protection professionals.

The information contained in this article is based on the current standards established by the National Fire Protection Association (NFPA), the most widely used in North America, and generally accepted guidelines. Most fire protection systems are designed and installed according to these standards. Unfortunately, information on inspection, testing and maintenance is not contained in a single standard but is contained within the various system-specific standards, making it cumbersome and difficult to obtain an overview of the tasks which need to be accomplished.

Other codes and standards such as UBC, UFC, BOCA, OSHA and MSHA also address fire protection, but their contents are usually based on NFPA documents and may not address testing/maintenance requirements. Members on the NFPA technical committees comprise a wide range of fire protection expertise and include representatives from manufacturers, testing laboratories, users, authorities having jurisdiction and insurance companies. Adherence to NFPA standards will satisfy most jurisdictions and insurance companies.

Getting Started

1. The first step in establishing an inspection, testing and maintenance program is to generate a list of all the fire protection systems at the plant. These typically range from portable extinguishers to detection systems and automatic suppression systems.
2. Once this list is complete, plant management needs to decide which tasks will be completed by in-house personnel and which will be contracted out. This will depend on the number and complexity of the systems as well as the availability and qualification of in-house personnel. In some areas, state law dictates that any physical testing of fire protection equipment must be performed by a contractor with an appropriate state-issued license. A telephone call to the state fire marshal's office should clarify this issue.
3. The next step is to determine the frequencies of the tasks. The guidelines in this article will help to establish these. Other sources for determining frequencies include the property insurance carrier or an independent fire protection consultant. Keep in mind that different carriers have different requirements, although the gist is usually the same.
4. Then, a documentation system needs to be implemented. This can consist of paper forms, a computerized preventive maintenance program (PM), or a modern bar code scanner system. Bar code scanners with their associated software prompt the inspector to report to each assigned station and to input the required data, thus making this type of system a valuable tool for larger plants. Once the round is completed, data from the bar code scanner is downloaded into a personal computer. The associated software then generates reports and highlights any discrepancies, which should be reviewed by plant management.

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Frequencies:

The frequencies below (see Tables at end of article) are intended as a quick reference to help set up a program. See the appropriate standards or consult a fire protection engineer for detailed information. Frequencies may need to be modified based on the results obtained. This will maximize the effectiveness of the program while focusing the time and budget on the problems which are most significant, based on actual test data.

Documentation:

Documentation is an essential part of a good program. The information contained on the reports should accurately reflect the tasks performed. The reports should be clear, concise, and well organized. For example, a work order stating "sprinkler inspection" is not adequate because it does not provide information about alarms, system pressures, riser condition, etc. Although there is no ‘universal’ report form, NFPA standards, fire protection manufacturers’ associations and property insurance carriers publish forms which can be tailored to a particular application.

Whichever method of documentation is chosen, the records should be thoroughly reviewed by management for discrepancies, acceptability of the results and any problems noted. The records should be filed in chronological order in an accessible location for review and use by other parties, such as for jurisdictional inspections and insurance company surveys. The usually required record retention time is three to five years. These records can also be used for trending analysis.

Impairments:

An impairment is an expression for a fire protection system which is out of service. Impairments fall into two categories: planned and concealed. A planned impairment is usually the result of maintenance or repair; a concealed impairment is usually inadvertent. Frequent inspections help to prevent concealed impairments.

Whenever an impairment occurs, several procedures need to be followed. First, the person responsible for safety/fire protection should be notified who should then inform the plant manager. Then, appropriate third parties should be notified such as the fire department, alarm company and the property insurance carrier. The severity of the impairment must be analyzed by management. There may be alternative methods of fire protection available while a primary system is impaired or the decision to take the affected equipment out of service may need to be made. Before the system is taken out of service, the affected area should be secured. This would include stopping hazardous activities, shutting equipment down and posting a fire watch.

A conspicuous tag should be attached to the system’s control valve to remind personnel that protection is temporarily unavailable, and to turn the system back on after the work has been completed. HSB Professional Loss Control provides its clients with impairment pamphlets, impairment stickers for fire protection equipment and red impairment tags.

Microbiologically Induced Corrosion (MIC):

A phenomenon found recently across the United States, but mainly in the Southwest and West, this condition has caused premature corrosion in sprinkler system piping and heavy tuberculation (scale which inhibits water flow). Some plants have reported that 5-year-old sprinkler piping has developed leaks that warrant the replacement of piping or extensive repairs. Underground piping does not seem to be affected because of increased circulation. Tests have shown that a chlorine concentration of 3 ppm kills the microbes. This condition is especially likely at plants which have their own water supply (wells, tanks and ponds). If the water supply is from a municipal source, the water has most likely already been chlorinated, but the level of chlorinating may not be enough.

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Common Problems:

Downsizing often results in the reduction or elimination of jobs in the area of maintenance, particularly for systems that do not directly generate revenue. As personnel experienced with fire protection systems leave, fire protection-related tasks often are assigned to inadequately trained personnel, or are not done at all.

- One frequent comment is: "We comply with the state's requirements." Just because a program complies with the requirements of a local jurisdiction or fire department does not mean that the frequencies are adequate, but merely states that certain minimum requirements are met. Compliance with NFPA standards is one of the best ways to maintain an acceptable level of fire safety.
- Otherwise skilled technicians and mechanics are not necessarily qualified to perform inspections, testing or maintenance on fire protection systems. These types of systems have unique features and are usually subject to specific code requirements. Proper training should be provided for personnel who work with fire protection systems.
- Just because a maintenance contract for a particular protection system is in place does not mean that all necessary tasks are performed. For example, a halon system in a combustion turbine enclosure requires testing of ventilation dampers, heat/flame/gas detectors and unit trip interlocks, in addition to weighing cylinders and testing the actuating valves.
- Regular fire department inspections are no substitute for a fire protection equipment inspection and testing program. Contrary to popular belief, fire department personnel are often unfamiliar with automatic fire suppression systems; their emphasis is on rescue, manual suppression and potential hazards to firefighters.
- If private yard hydrants are used for wash-down purposes, the fire pumps should never be turned off. Rather, a larger jockey pump, capable of supplying a small hose stream, should be installed.

For Further Reading:

NFPA publishes several manuals and reference books covering specific systems, such as Fire Protection Systems; Inspection, Test & Maintenance Manual; Fire Alarm Signaling Systems and Automatic Sprinkler and Standpipe Systems. These publications can be obtained directly from the NFPA, telephone (800) 344-3555.

Other relevant codes and standards include the following, each of which can be ordered separately:

- NFPA 10, Portable Fire Extinguishers
- NFPA 12, Carbon Dioxide Extinguishing Systems
- NFPA 12A, Halon 1301 Fire Extinguishing Systems
- NFPA 17, Dry Chemical Extinguishing Systems
- NFPA 25, Testing, Inspection and Maintenance of Water-Based Fire Protection Systems
- NFPA 72, National Fire Code Alarm
- NFPA 1962, Care, Use and Service Testing of Fire Hose Including Couplings and Nozzles

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Tables*
P.P. = Properly Trained Plant Personnel
Contr. = Licensed and Qualified Fire Protection Contractor

Type of System	Activities	Recommended to be performed by *
Weekly		
Fire Pump	Fire pump churn test by automatic operation, usually drop in sensing line pressure (10 min. for electric, 30 min. for diesel) and associated engine inspections. Verify that pump running alarms are received in control room.	P.P.
Pump Suction Sources	Check level of pond or suction tank. Also check heating system during cold weather.	P.P.
Valves	Inspect indicating sectional and system control valves to verify that they are in the open position (If they have neither locks nor tamper switches. It is recommended that all valves be locked in the fully open position). This should include special suppression systems.	P.P.
Dry Pipe Sprinkler Systems	Inspect dry pipe sprinkler riser enclosures.	P.P.
Low Pressure CO_2 Systems	Inspect liquid level of tanks. Tanks should be refilled if a volume drop of more than 10 percent from the design requirements is observed.	P.P.
Monthly		
Fire Pump	Test battery system, main circuit breaker and isolation switch (electric pumps).	P.P.
Fire Extinguishers	Inspect each fire extinguisher and cart.	P.P. or Contr.
Fire Hoses	Inspect each fire hose station/ hydrant house. Hoses should be properly racked or rolled and the proper nozzles as well as hose wrenches and other hardware should be provided.	P.P.
Sprinkler Systems	Inspect each sprinkler/water spray system riser. This should include water/air pressures and alarm valves.	P.P.
Special Suppression	Inspect each system (agent level and pressures, panels, nozzles).	P.P.
Valves	Inspect indicating sectional and system control valves (locks and/or tamper switches provided). This should include special suppression systems.	P.P.
Quarterly		
Sprinkler Systems	Test water flow alarms and perform main drain test on sprinkler/water spray systems.	P.P. or Contr.
Valves	Test valve tamper switches by turning the supervised valves until an alarm is obtained at the alarm panel.	P.P. or Contr.
Post Indicator Valves (PIV)	Test by turning them through the full cycle and reopening them. Follow by a main drain test at the sprinkler riser controlled.	P.P. or Contr.
Semiannually		
Special Suppression Systems	Weigh high-pressure cylinders (halon, CO_2, halon-alternatives). Cylinders should be refilled if a volume drop of more than 10 percent (CO_2) and 5 percent (halon) from the design requirements is observed. Test system actuators for proper operation.	Contr.

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Flame Detectors	Test all flame detectors (UV/IR).	P.P. or Contr.
Emergency Lighting	30 second functional test.	P.P. or Contr.
Annually		
Special Suppression Systems	Test operation of CO_2, halon and halon-alternative systems, including auxiliary interlocks such as dampers or equipment trips.	Contr.
Sprinkler Systems	Trip test of dry pipe, preaction and deluge sprinkler/water spray systems. A full discharge test should be conducted whenever possible to verify free flow through all piping and nozzles.	P.P. or Contr.
Antifreeze Sprinkler Systems	Test specific gravity of solution in antifreeze systems.	P.P. or Contr.
Fire Pump	Fire pump performance test (usually done with insurance fire protection consultants)	P.P. or Contr.
Hydrants	Yard main flush/ hydrant test (usually done with insurance fire protection consultants).	P.P. or Contr.
Fire Detectors	Test all heat and smoke detectors.	P.P. or Contr.
Fire Doors	Test all automatic-closing fire doors.	P.P. or Contr.
Gas Detectors	Test/calibrate all combustible gas detectors.	P.P. or Contr.
Alarms	Test alarm control equipment (batteries, lamps, power supplies, etc.).	P.P. or Contr.
Manual Fire Alarms	Test all manual fire alarm boxes.	P.P. or Contr.
Fire Extinguishers	Service each extinguisher and cart.	Contr.
Emergency Lighting	90 minute functional test.	P.P. or Contr.
Other Than Annually		
Fire Hoses	Hydrostatic Test at 150 psi for most hose, five years after installation, 3 years thereafter.	Contr.
Portable Extinguishers	Hydrostatic test, every 12 years for halon and dry chemical (steel, brass or aluminum shells). Every five years for all other extinguishers.	Contr.
Carbon Dioxide	Hydrostatic test of high pressure cylinders every five years, 12 years if cylinders have been in continuous service without discharge.	Contr.
Halon	Hydrostatic test of cylinders after discharge, if more than five years have elapsed since the last hydrostatic test.	Contr.
Standpipe Systems	Hydrostatic and flow test every five years.	Contr.

About the Author

Dominique Dieken, P.E., CFPS, is a senior engineer with HSB Professional Loss Control, HSB's subsidiary fire protection engineering and consulting firm headquartered in Tennessee. He provides field engineering for electric power generation facilities in the western United States and Europe. Dominique is a graduate of Cal Poly San Luis Obispo, is a registered fire protection engineer and holds a National Board Commission. He is a member of NFPA and the Society of Fire Protection Engineers.

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