PART II (PART I IS IN THE JUNE 2003 EDITION)

Fire Sprinkler Systems

Corrosion Related Failures

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FSS Design, Operation and Maintenance

For the most part, the systems that are failing are designed and installed to code, but there are a few areas where governing codes do not consider the impact from corrosion. For instance, NFPA 13 (new installations) requires no pitch in a wet system, only designed and installed so the system can be drained. Any trapped water in a wet sprinkler piping shall also be drained (NFPA 13). At the high points of such systems, which often coincides with the ends of branch lines, it is not uncommon to find air pockets with no water and areas with a water and air interface. The same problems can occur at the high points when the system follows the pitch of a roof. This is magnified when wet systems are not properly vented when being charged with water allowing trapped air to eventually settle in the highest parts of the system.

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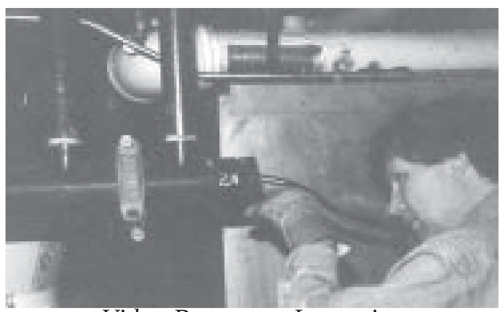
Video-Borescope Inspection

Low points in a dry system should have valves installed so that water from the initial hydrotesting, subsequent testing, or accidental discharge can be effectively removed from the system. NFPA 13 calls for sloping on dry and some preaction sprinkler systems of ½" per ten feet of piping on branch lines and ¼" per ten feet on mains, but in practice, these requirements cannot always be met.

In addition, humidity carried into the system by the on-line air compressors for supervisory air can condense on the pipe interior surfaces and add to any residual water. In all of these scenarios, as it was pointed out in the section on "corrosion basics," these are susceptible areas for localized corrosion attack that can lead to development of pinhole leaks and accumulation of corrosion products.


Water Sampling

The NFPA Research Committee is addressing the frequency of flowing water through a system to check that the alarms are working and multiple discharge of sprinkler water so as not to introduce un-needed aerated water. Also, eliminating the use of untreated non-potable water to limit the microbiological and water quality issues regarding corrosion. Options are being developed, or are already available to circumvent the flow of water through the system. The inspector's test is located above the flow switch in many new installations for convenience, not necessarily to reduce water flow through pipe. In some cases, it is because there is no place at the end of the system to dispose of the sprinkler water.

Limiting FSS Corrosion Problems

To minimize corrosion-related problems for FSS, especially systems protecting mission critical areas or high value inventory, the following tests/evaluations should be performed for new and existing systems.

For new systems that are in the planning/design process and have not been installed, the recommendations are as follows: Test the future system water/water supply. The analysis should include quantitative chemical analyses and microbiological culturing for the bacteria known to contribute to corrosion problems.

Corrosion and/or materials engineers familiar with FSS should review the design configuration. Potential high and low points should be identified and provisions should be made for venting of air in wet systems and complete draining of residual water in dry or pre-action systems.

Maintenance procedures should be reviewed to minimize flushing and re-introduction of oxygen into wet systems and water into dry and pre-action systems.

A condition assessment program for existing systems experiencing corrosion related problems should include the following:

Water Sampling to include water chemistry analyses and microbiological culturing.

Internal video-borescope inspection — with experience, a diagnostic team can look in specific areas. Typically these types of inspections are on a selective basis and are based on previous experience, leak history, and the general layout of the FSS. An experienced team will be able to identify the susceptible areas to investigate. Leak history marked on

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updated drawings will help in planning the inspection.

Pipe samples from specific areas may be taken to assist in the failure analysis and determination of the severity and extent of the corrosion damage. Verification of slope and complete drainage in dry and pre-action systems.

FSS Rehabilitation Options

Following is a list of rehabilitation options that have been undertaken on existing FSS with corrosion failures due to pinhole leaks or accumulation of corrosion products:

Eliminating air from wet systems by purging air through auxiliary vent valves. Without the presence of oxygen the corrosion reaction cannot occur.

Eliminating water from dry or pre-action systems by installing adequate drainage valves. Without the presence of residual water the corrosion reaction cannot occur.

Chemically cleaning (statically or dynamically) to remove accumulated corrosion product deposits. However, this must be done with extreme caution. As corrosion product deposits are removed, leaks may develop due to the removal of the protective corrosion product coating. If all the corrosion product is not removed there is potential for localized corrosion to continue. May be only effective if replacement costs are high and the accumulation of corrosion product deposits is the primary concern.

Replace damaged pipe and add features to deal with identified causes for corrosion. In most cases this will be the most cost effective option.

If MIC is identified as a possible contributor to corrosion, chemical treatment (disinfectants, oxygen scavengers, corrosion inhibitors, vapor phase) of the system water may be needed for corrosion control. However, there may be issues with maintenance/discharge, chemical efficacy, environmental impact, backflow preventers, Fire Department approval, liability of accidental discharge/human contact and component warranty, which has to be dealt with beforehand.

Convert a problematic dry system to a wet system, but ensure proper venting of trapped air so one problem is not replaced by another. Redesign with circulating water so that chemical treatment for corrosion control can be utilized.

Conclusion

Sprinkler systems have repeatedly proven to save lives and limit damage from fire however, we should be careful not to develop a false sense of security. Most will agree that an “out of sight/out of mind” approach is not the best practice for life safety systems. As the private industry, national, state and local governments reduce budgets, we must be careful not to overlook the maintenance of a FSS. The codes must continue to be open to change when better ideas are developed to help with design, installation, operation and maintenance of FSS.

As failures occur in FSS, we must investigate the root cause of the failure so that the problem does not reoccur. Recently, there has been information exchanged between the National Association of Corrosion Engineers (NACE) and the professional fire protection organizations that will benefit everyone.

Although the buildings in the fires in Rhode Island and Chicago were not protected by sprinkler systems, we recently witnessed the devastation of human loss that can occur very quickly. The Fire Protection industry cannot afford to have a similar situation occur in a “sprinklered” building.

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