



contained in this IN do not constitute NRC requirements; therefore, no specific action or written response is required.

## **DESCRIPTION OF CIRCUMSTANCES**

The intent of antifreeze sprinkler systems is to protect sprinkler piping that passes through areas that could be exposed to freezing temperatures. For example, antifreeze sprinkler systems may be used in freezers, loading docks, unheated warehouses, elevator shafts, or unconditioned areas. Sprinkler systems utilizing antifreeze agents may be present at some NRC licensed facilities; however, antifreeze sprinkler systems would not typically be installed in safety-related areas. The NRC is using this IN to heighten awareness and inform licensees of the issue. NFPA 13 only permits the use of non-toxic antifreeze solutions. NFPA 13 references NFPA 25 for regular inspection, testing and maintenance requirements of antifreeze sprinkler systems to verify that an antifreeze sprinkler system has the proper concentration of antifreeze solution.

NFPA began researching the possible effects of antifreeze use in sprinkler systems in 2009. NFPA found that concentrations of 70 percent glycerine or 60 percent propylene glycol in water may be ignited when discharged through sprinkler systems resulting in a substantial fire event. Glycerine and propylene glycol, in pure form, are Class IIIB combustible liquids having flashpoints of 390° Fahrenheit (F) (199° Celsius (C)) and 210° F (99°C) respectively. Depending upon concentration, the addition of water limits the flammability of each compound. NFPA 13 recognizes that in some instances antifreeze solutions may contribute to a fire condition, but that the supply of water following the antifreeze solution mitigates the contribution to the fire.

Following NFPA's completion of full-scale fire tests, the NFPA issued TIAs in March 2011 on NFPA 13 and NFPA 25. The most current provisions regarding antifreeze are contained in the 2013 Edition of NFPA 13 and the 2014 Edition of NFPA 25. The changes to the NFPA codes that may be applicable to licensed facilities for existing construction are as follows<sup>1</sup>:

### **New Sprinkler Systems (i.e., installed after September 30, 2012) Containing Antifreeze – NFPA 13 . . . Sprinkler Systems**

With limited exceptions, all new antifreeze systems (systems installed after September 30, 2012) are required to use listed antifreeze solutions. The listing of the antifreeze solution must indicate that the solution will not ignite when discharged from a sprinkler. The exceptions to the requirement for listed antifreeze solutions are as follows:

- Factory premixed antifreeze solutions of propylene glycol in excess of 40% by volume are permitted in ESFR (Early Suppression Fast Response) sprinkler systems where the sprinklers are listed for such use in a specific application. The listing will indicate the maximum percentage of propylene glycol that can be used with the specific sprinkler. . . .

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<sup>1</sup> The following text on existing and new sprinkler systems is an excerpt from [www.nfpa.org/antifreeze](http://www.nfpa.org/antifreeze), January 2014

- . . . New systems, once installed, must be annually tested in the manner required for existing systems, summarized below.

### **Existing NFPA 13 . . . Sprinkler Systems**

The testing and maintenance provisions for NFPA 13...antifreeze systems are governed by NFPA 25. NFPA 25 provides that, by September 2022, existing systems (systems installed [before] September 30, 2012), like new systems, will be required to use only listed antifreeze solutions. Until then, traditional antifreeze solutions may continue to be used where certain conditions, confirmed by annual testing, have been met, summarized as follows.

Until a listed non-combustible solution is introduced into the system, antifreeze solutions in existing systems must be tested annually, prior to the onset of freezing weather.

- If it is determined, based on records, tests or other reliable information that the solution found in the system is no longer permitted or if the type of antifreeze cannot be reliably determined, the system must be drained and replaced with an acceptable factory premixed solution.
- If the initial review indicates that the solution type is acceptable, test samples must be taken at the top and bottom of each system (in some cases an additional sample must be taken).
- If all the test samples indicate a concentration of glycerine not greater than 38% by volume or propylene glycol not greater than 30% by volume, then the solution is permitted and may remain in the system.
- Where the test samples indicate that the solution is between 38% and 50% glycerine or 30% and 40% propylene glycol, the solution may remain in the system pending the approval of a deterministic risk assessment (see NFPA 25: 5.3.4.2.1(3)).
- If any of the samples indicate a concentration in excess of 50% glycerine or 40% propylene glycol, the system must be emptied and refilled with an acceptable solution or an alternate method of freeze protection must be employed. An acceptable solution would be a solution that contains less than 38% glycerine or 30% propylene glycol, or a solution that has been approved by the AHJ based on a deterministic risk assessment.
- All traditional antifreeze solutions must be replaced by listed antifreeze solutions, or alternative freeze protection methods, by September 2022.

### **BACKGROUND**

As stated in 10 CFR 50.48, "Fire protection," each operating nuclear power plant must have a fire protection plan that satisfies Criterion 3, "Fire protection," in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50. The purpose of these requirements is to minimize the probability and effects of fires.

10 CFR 40.32, "General requirements for issuance of specific licenses," and 10 CFR Part 70 Subpart H, "Additional Requirements for Certain Licensees Authorized To Possess a Critical Mass of Special Nuclear Material," establish the NRC's fire protection program requirements for fuel cycle facilities. The purpose of these requirements is to safeguard any nuclear material on site and protect the public from radioactive releases due to a fire event.

NUREG-1537: Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," February 1996 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML042430055) describes the fire protection guidance for non-power reactors. Fire protection guidance for medical radioisotope production facilities is described in the Final Interim Staff Guidance Augmenting NUREG-1537, Part 1, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content," for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors, October 2012 (ADAMS Accession No. ML12156A069). These facilities are expected, at a minimum, to be in compliance with all local building and fire codes. Although there is no NRC requirement to do so, these facilities may also make a commitment to follow nationally recognized codes and standards in order to demonstrate reasonable assurance of fire safety.

## **DISCUSSION**

Existing research and testing performed by NFPA suggests that under certain conditions, antifreeze-water mixtures discharged from fire sprinklers can accelerate a fire when sprayed onto a flame. Increasing the concentration of the antifreeze in the antifreeze-water solution increases the combustibility of the solution. Additionally, existing research indicates that under certain conditions, the energy release rate of some fires increases upon interaction with antifreeze-water mixtures.

For nuclear power plants, non-power reactors, medical radioisotope production facilities, and fuel cycle facilities in areas where temperatures routinely go below freezing, some licensees may have determined that antifreeze is a necessary feature to ensure that sprinklers will operate in the event of a fire. NFPA standards indicate that annual testing is part of maintenance of sprinkler systems with antifreeze to determine the concentration of antifreeze agent present. NFPA recommends that samples be taken at the highest and lowest practical elevations of the system since antifreeze solutions can be unevenly distributed, resulting in pockets with high antifreeze concentrations. If the limits are above those from the NFPA TIA, licensees may drain their sprinkler system and replace it with a premixed water-antifreeze solution as prescribed in the second TIA. Doing so would reduce the risk of fire-spread or explosion due to excessive concentration of antifreeze in the sprinkler discharge.

For locations where the new antifreeze concentration limits are not sufficient to prevent freezing of sprinkler systems, the NFPA suggests pipe insulation, heating systems, or the use of dry pipe or pre-action systems as alternatives. For existing antifreeze systems that have antifreeze concentrations that exceed the information in the recent NFPA TIA, NFPA states that the sprinkler system, "must be emptied and refilled with an acceptable solution or an alternative method of freeze protection must be employed." "Information Notice 2013-06: Corrosion in Fire Protection Piping Due to Air and Water Interaction," provides information regarding concerns

when fire protection piping is drained and refilled and air remains in the piping. In addition, although this IN is not a regulatory requirement, it informs licensees of the potential of antifreeze from such systems to be combustible, and therefore, consideration of antifreeze as a combustible would be treated in accordance with a facility's fire protection program.

At the time this IN was issued, several listed factory premixed antifreeze solutions were on the market. For new sprinkler systems that require the use of antifreeze, NFPA recommends alternative measures, such as those described in the previous paragraph. NFPA 13, 9.2.2.3 states that the concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature

This is an ongoing issue, with updates available through NFPA (<http://www.nfpa.org/antifreeze>). It is recommended that licensees keep up-to-date with the newest developments. For additional information, licensees can read the applicable TIAs for the complete set of proposed code changes and visit the NFPA website for updates (<http://www.nfpa.org/codes-and-standards/standards-development-process/tias-errata-and-fis>).

## CONTACTS

This IN requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate NRC regional office.

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### ADAMS Accession No.: ML14323A176

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