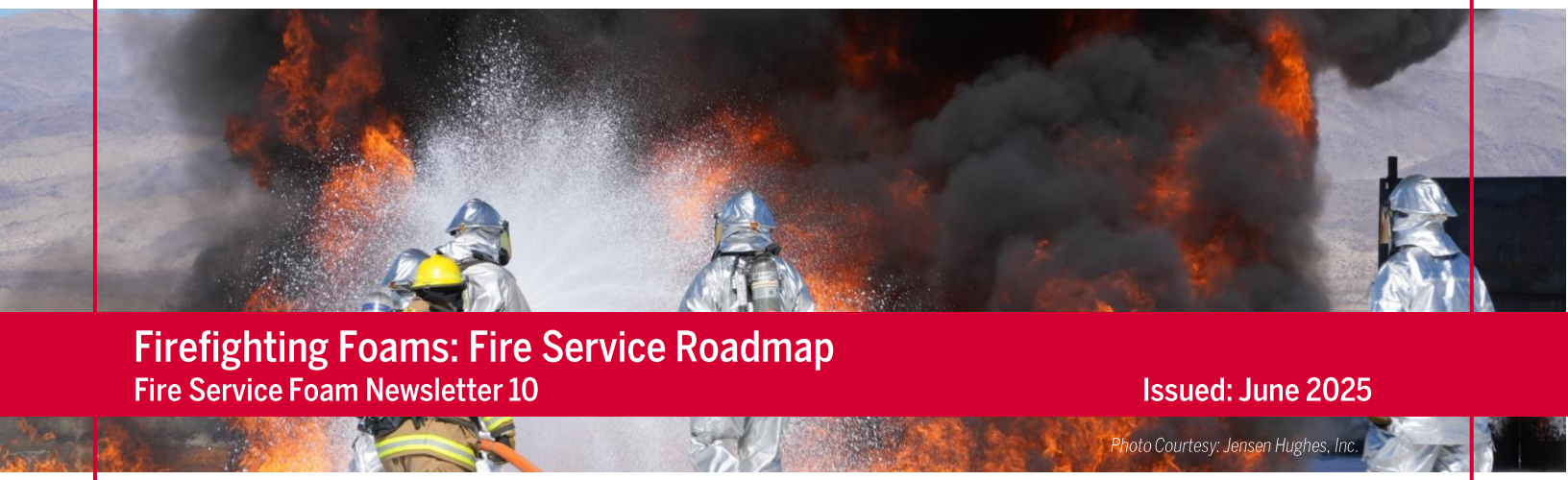

Firefighting Foams: Fire Service Roadmap

Fire Service Foam Newsletter 10

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Photo Courtesy: Jensen Hughes, Inc.

Newsletter Background

This newsletter follows from the *"Firefighting Foams: Fire Service Roadmap"*, a roadmap that provided fire service with the information on the fluorine-free foam (F3) transition, published by the Fire Protection Research Foundation in May 2022. This Newsletter seeks to provide useful, relevant, accurate, credible, and timely information on frequent basis for the fire service to assist with their transition to fluorine-free foams used on class B flammable liquid fires. This Newsletter is developed and circulated by the Foam Roadmap project team for the project facilitated by the Fire Protection Research Foundation. For information about this project and all deliverables, visit the project website at: www.nfpa.org/foamroadmap.

Introduction

The continued use of aqueous film forming foam (AFFF) is being impacted by regulation, lawsuits, liability, market availability, increased costs of legacy products, voluntary phase-outs, and industry recognized best practices. At the time of newsletter publication, there is no Federal prohibition on the use of AFFF with intentionally added per- and polyfluoroalkyl substances (PFAS); however, additional state, industry or government regulation sets requirements and prohibitions for AFFF production, training, use, disposal, and clean-up in the environment. Many foam manufacturers have started to offer fluorine free foam (FFF or F3) as an alternative to AFFF. Organizations will need to develop a path forward for removing legacy AFFF, cleaning/replacing existing systems, selecting a replacement foam and disposing waste materially safely.

Foam System Clean-Out and Transition

When it is time to transition from legacy AFFF to a PFAS- or fluorine-free foam, it is important to consider all available options for clean-up and disposal. Guidance will vary by organization, locality and governing bodies. At this time, there is no universally agreed upon best practice for cleaning out existing equipment. This cleaning decision will be based on a variety of factors, including type of equipment (e.g., aircraft rescue and firefighting (ARFF) truck, fixed sprinkler installation, metal vs. rubber/polymer components), age of the system, prior AFFF use and economics. PFAS will persist in and on piping, storage tanks and other surfaces that come in contact with AFFF. This will exist as both dissolved PFAS in remaining water and "scale" or other residue build up on the surface. This scale structure and inert nature of PFAS makes clean-out difficult. It may be more practically and economically feasible to completely replace the system and/or replace key components that are more prone to more residual PFAS build up. It is difficult to ensure that there is no remaining PFAS (down to the part per trillion (ppt) level) after clean-out without replacing the system entirely. Studies have found that even after the AFFF has been rinsed out, PFAS levels will "rebound" over time as the PFAS is dissolved in water or replacement FFF. FFF may serve as a good solvent for dissolving PFAS. To clean the scale from the walls, physical disruption may be needed to loosen the material stuck on the surface. Old equipment, piping, tanks, hoses, and nozzles should be disposed of according to all local, state and federal regulation. It should not be treated as bulk trash due to PFAS contamination.

Research across Department of Defense (DoD) and Federal Aviation Administration (FAA) have evaluated multiple cleaning procedures, including water rinse (single rinse up to multiple), solvent assisted, heat / steam, pressure washing, mechanical scrubbing, sonication and others. As one example, the FAA released Part 139 CertAlert 24-05 "Department of Defense's (DoD's) Memorandum on Rinsing Aircraft Rescue Firefighting (ARFF) Vehicles Transitioning from Aqueous Film Forming Foam (AFFF) to Fluorine-Free Foam (F3)" to provide guidance for cleaning ARFF systems. They recommend that the user completely drain

the system and conduct a single water rinse of the AFFF through all components and piping, to discharge nozzles, including external equipment that previously contained AFFF. They recommend appropriate spill prevention measures and containment are incorporated into the process to minimize any releases or impacts. Each of these methods will help to reduce the overall PFAS concentration, but there is no guidance on "how clean is clean" for the final effluent/rinsewater. Some research suggests that cleaning agents/solvents will be more effective than water rinsing alone; however, it will not eliminate PFAS remaining in the system. When cleaning or rinsing out the system, it is best to work with recognized industry experts with experience in transition from AFFF to FFF.

All of the water and/or solvent used to flush the system will be contaminated with PFAS. The rinse water needs to be collected after flush. Anecdotally, this should be somewhere more than 1-3 times the tank/piping volume to ensure thorough surface coverage. PFAS and potentially other contaminants can then be removed from the rinsewater via ion exchange, granulated activated carbon (GAC) or other separation technologies to reduce total contaminated water. All rinse water and/or any separation technology (GAC, resins) should be collected and stored for disposal. Rinse water should be stored in a controlled area in proper packaging that protects against leaching to the environment. It should not be released to the general sewer or wastewater treatment facility. Some organizations may be able to offer mobile, on-site treatment options prior to discharge. Further disposal will be addressed in the following sections.

Waste disposal companies may also recommend testing PFAS concentration before and after clean-out as a benchmark. This could analyze specific target compounds using known EPA test standards or a more broad assessment of total PFAS through non target analysis test methods like Total Oxidizable Precursors or Absorbable Organic Fluorine. Testing for PFAS on the surface may be beyond the scope of a typical clean out process.

Foam Concentrate and Rinse Water Disposal

All AFFF concentrate and rinse water produced during clean-up and transition to FFF should be disposed of per all Federal, State and local regulation. This guidance will vary based on location, but significant resources are available through your local environmental authority and/or trusted hazardous waste disposal companies.

For PFAS concentrate, each location should identify remaining material to determine proper disposal. This includes checking labels or contacting the manufacturer to determine PFAS content. Another resource can be Safety Data Sheets, which should provide more details on the chemical make-up and can be used to identify "fluorosurfactants", "fluoroprotein", "C6", or the use of "fluoro compounds" in the formulation.

The current best practice is to contact certified hazardous waste disposal partners to manage and dispose of your concentrate and rinsewater. Individual states (as well as the FAA) have established AFFF take-back programs that may also provide funding or manage disposal directly. These programs are intended to support fire departments and local municipalities through the process of disposal of AFFF concentrate and related materials.

Historically, incineration was commonly used for AFFF solutions and spent treatment media. EPA continues to revise guidance for PFAS disposal (see additional section). Regulation at State and local level may prohibit incineration or other disposal practices.

Best Practices for AFFF and PFAS Disposal (EPA 2024):

Trusted waste disposal organizations, as well as State and local environmental agencies, can provide additional guidance on current best practices for AFFF and rinsate disposal. The EPA is continuing to evaluate the most effective destruction methods. They published Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances— Version 2 on April 8, 2024. This version is still out for public comment. This guidance identified disposal technologies with a lower potential for environmental release of PFAS compared to other technologies in the same category and are viewed as the more protective (i.e., lower risk of PFAS release). The following methods are current best practice for disposal:

- Underground Injection: Permitted Class I non-hazardous industrial or hazardous waste injection wells. Only a limited number of wells are accepting PFAS.

- Landfills: Permitted hazardous waste landfills, like Subtitle C Permitted hazardous waste landfills.
- Thermal Treatment: Permitted hazardous waste combustors include commercial incinerators, cement kilns, lightweight aggregate kilns and GAC.

Storage is considered a viable option until more research is available; however, waste AFFF/PFAS should not be stored indefinitely. The EPA is researching additional technologies, including mechanochemical degradation, electrochemical oxidation, gasification and pyrolysis and supercritical water oxidation that could be implemented pending more research.

Fluorine-Free Foam Disposal / Rinse Water

Fire agencies may also need to dispose of F3 concentrate and rinse water. Again, there is no firm guidance for how to dispose or clean-out F3 from existing systems, but users should reach out to the foam manufacturers for additional support / recommendations. At this time, it is recommended that fire agencies store and contain all foams until more guidance is available and limit release to the environment.

For the most up to date information, refer to the Interstate Technology Regulatory Council (ITRC) website for PFAS (https://pfas-1.itrcweb.org/) and the Environmental Council of the States (ECOS) website on PFAS (https://www.ecos.org/pfas/). Additional research into PFAS clean-out and PFAS remediation in the environment can be found at the Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP) website (https://serdp-estcp.mil).

About this Newsletter

This Newsletter seeks to provide useful, relevant, accurate, credible, and timely information on frequent basis for the fire service to assist with their transition to fluorine-free foams used on class B flammable liquid fires. For the purposes of this project and associated deliverables, the term fluorine free foam refers to the group of firefighting foams that are formulated without any intentionally added Per- and Poly Fluoroalkyl Substances (PFAS). This Newsletter is developed and circulated by the Foam Roadmap project team for the project facilitated by the Fire Protection Research Foundation. This project is funded through US DHS FEMA Assistance to Firefighters Grant, Award#: EMW-2021-FP-00109. Principal Author of this Newsletter: Noah Lieb, Jensen Hughes, Inc. Newsletter Editors: Gerard G. Back, Jensen Hughes, Inc.; Casey Grant, DSRAE, LLC; Edward Hawthorne, DFW Dynamics; Niall Ramsden, ENRG Consultants.

Project Website

For more information, visit the project website: www.nfpa.org/foamroadmap

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