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Training Facility PFAS-Free Firefighter Foams:

Incentives and barriers to adopting PFAS-free firefighter foams in fire training facilities

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Project summary

1. Background

Firefighters are at an increased risk of some cancers and other adverse health effects resulting from continued exposures to per- and poly-fluoroalkyl substances (PFAS) in the course of their duty. Firefighter exposure to PFAS may originate from multiple sources, including from the use of aqueous fire-fighting foams (AFFF) during live fires, fire training and testing of firefighting systems; wearing of turnout gear treated with PFAS; burning of PFAS-containing household products during active firefighting (e.g., residential fires); re-suspension of PFAS-contaminated dust in fire stations; and from other non-occupational exposures such as consumption of PFAS-contaminated water and food.

This project will focus on AFFF – as one important source of PFAS exposures. Fire training facilities are important users of AFFFs, and firefighter instructors are a high-risk group for repeated PFAS exposures. *Elimination of PFAS exposures at the source through product substitution with safer alternatives is the most effective exposure and disease prevention strategy.* Safer alternatives to legacy AFFF have already entered the US market. However, independent assessments of chemical composition, exposure and human safety data are lacking for most alternative products, and adoption of new fluoride free foam (FFF) alternatives to AFFFs is neither easy nor straightforward. Furthermore, thermal degradation and physico-chemical transformations of foams during active fires can produce highly toxic by-products and nano aerosols that are currently not well understood and are important to consider when assessing firefighters' PFAS exposures to AFFFs and the new foam alternatives. There is a need to develop guidance to firefighters on alternative foam selection and use, and independently assess their composition and impact to human health.

2. Project goals and objectives

The main goal of this research project is to provide to the fire service essential information needed to overcome barriers to substitution of AFFF with safer FFF and reduce ongoing firefighter exposures to PFAS during the transition period to safer foams. The project has three main objectives:
1) Document current quantities, trends & uses of AFFF and firefighter foam alternatives in fire training facilities nationwide and identify incentives and barriers to FFF adoption.
2) Develop scalable methods and platforms to characterize thermal degradation and physico-chemical transformation of foam alternatives and common AFFFs under controlled experimental conditions in

laboratory settings.
3) Develop guidance materials on best practices for selecting and using new foam alternatives and reducing ongoing PFAS exposures in fire training facilities.

3. Project tasks

Part I: National survey of fire training facilities

We will conduct a national survey of fire training facilities to collect information on current uses of AFFF alternatives, to identify best practices and effective solutions to overcome barriers to adopting FFF products. This work is a collaboration with several important fire services organizations noted below.

Task 1. Develop the survey tool based on a comprehensive review of existing literature, input from the Fire Protection Research Foundation (FPRF) and other fire service stakeholders, and lessons learned from surveys of AFFF foams.

Task 2. Solicit input from key fire service stakeholders on survey structure and content, survey deployment, interpretation of survey findings in the context of fire service needs, dissemination of the results, and foam selection for the chamber study (see Part II). FPRF will establish the technical advisory panel (representative of fire service stakeholders) and organize online meetings two times per year during the 3-year study period.

Task 3. Deploy and administer the national survey via RedCAP web application. Fire training facilities (FTF) that will be targeted for the survey deployment include: 1) State FTF, 2) Metropolitan Fire Department FTF, 3) Private FTF, 4) Airport FTF and 5) Military FTF. The survey will be distributed with support from the International Public Safety Data Institute (IPSDI) and other fire service partners.

Task 4. Re-deploy the survey for a second time within the study time frame (2021-2024) to collect longitudinal information related the incentives and barriers for substituting AFFF with FFF foams, to capture the impact of any major enacted policy changes, product formulations, and success stories/case studies during the study period.

Task 5. Analyze the survey data and longitudinal information to support development of a guidance document for fire training facilities on the road to transition to fluorine free (FFF) foams.

Part II: Thermal degradation of fire fighting foams - chamber study

Simultaneously with the work on Part I, we aim to characterize thermal degradation products of representative FFF products and compare them to conventional and short-chain AFFFs under controlled conditions in the laboratory.

Task 6. Select representative foams for the thermal decomposition study as follows: 4-6 traditional AFFF, 4-6 short chain PFAS foams, and 4-6 FFF alternatives. Foam selection will be accomplished with direct input from the technical advisory panel, research collaborators, and survey data on FFF use.

Task 7. Set up the experimental testing platform with its three main modules – thermal degradation, post-generation aerosol modification, and exposure characterization.

Task 8. Establish a comprehensive set of analytical methods for measuring PSAS and other thermal breakdown products, as described in Task 9.

Task 9. Conduct comprehensive characterization of thermal degradation products of foams, including total organic fluorine (TOF), total extractable organic fluorine, inorganic fluorine, individual PFAS species, hydrogen fluoride gas, free radicals, nano aerosols, and size fractioned species distribution in aerosols.

Task 10. Evaluate portable Raman spectroscopy as a suitable field-testing technique for semi-quantitative screening of foam products, dust, and other materials for PFAS contamination.

Task 11. Analyze the data and summarize the findings to incorporate in the guidance document for fire training facilities, based on direct guidance from the technical advisory panel and fire services stakeholders' input.

Part III: Dissemination of study results

Task 12. Develop guidance materials specific to fire training facilities based on study findings and their implications. Generalizable results from this work will be used to inform other efforts, such as the strategic roadmap that is being developed by FPRF regarding the transition to fluorine free foams.

Task 13. Disseminate the study results via presentations to national fire service conferences, webinars, and other relevant fire service events, in collaboration with key stakeholders, including the International Society of Fire Service Instructors (ISFSI), FPRF, and IPDSI.

Task 14. Publish the study results in firefighter trade journals, open access peer-reviewed journals, and conduct a webinar for fire service stakeholders and interested researchers to review findings, discuss practical implications, and identify prioritized knowledge gaps.

4. Implementation and Schedule

This project is funded by FEMA's Assistance to Firefighters Grant (AFG) Program. The work will be led UMASS Lowell researchers Anila Bello and Dhimiter Bello in partnership with Fire Protection Research Foundation (FPRF), International Public Safety Data Institute (IPSDI), and International Society of Fire Service Instructors (ISFSI) - as well as collaborators at Rutgers University. The project is scheduled to be completed in 3 years (September 2021-September 2024).

5. Project deliverables

The project will enable identification of new opportunities to overcome barriers to full-scale implementation of PFAS-free firefighter foams, and guide development of best occupational hygiene practices to reduce ongoing PFAS exposures in fire training facilities. Furthermore, the comprehensive testing platform to study thermal degradation products of different foams will lead to improved strategies for toxicity testing of foam alternatives under more realistic application conditions and field sampling of firefighter PFAS exposures for health effects studies.