BALANCING FIRE SAFETY AND ENVIRONMENTAL LIABILITIES:
TRANSITIONING FIREFIGHTING FOAMS
Organizations around the world prioritize having adequate fire protection systems and emergency response capabilities. However, effective management of fire safety now must be balanced with environmental effects and liabilities resulting from a large group of man-made chemicals termed PFASs (Poly- and perfluorooalkyl substances), which are present in many firefighting foams.
Industrial use of PFASs began in the 1940s. The substances repel oil and water, making them appealing for use in industrial applications and products such as firefighting foams, fabrics and textiles, cookware, and electronics.

Evidence linking PFASs to human health risks and ecological harm is growing. This, along with discoveries of PFAS in drinking water supplies across the globe, is accelerating media attention on PFAS’ ability to persist indefinitely in the environment and easily travel some distance in groundwater. The evolving understanding of the toxicity, combined with the potential for some PFASs to bioaccumulate in humans, means that extremely low compliance concentrations have been established in drinking water.

**PFASs IN FIREFIGHTING FOAMS**
PFASs are the key ingredient in fluorine-based firefighting foams used to extinguish Class B fires, or fires fueled by flammable or combustible liquids. Firefighting training areas and facilities that have engineered fire suppression systems at airports, refineries, industrial facilities and military bases have been using these foams for drills and training since the mid 1960s. Multiple Class B firefighting foams, such as Aqueous Film Forming Foam (AFFF), Film Forming Fluoroprotein Foam (FFFP) and Fluoroprotein Foams (FP), contain high concentrations of PFASs.

Primary Users of PFASs in Firefighting and Fire Suppression Systems:

01 Aircraft hangars in the aerospace industry/airlines

02 Firefighting training facilities at airports, civil, defense and petrochemical facilities

03 Petrochemical facilities

04 Chemical manufacturing and storage facilities

05 Fuel storage protection in the Oil & Gas and Defense industries

06 Rail industry
Class B firefighting foams have been regularly used for fire incidents, in routine training exercises, equipment maintenance, protecting fuel storage tanks, facility fire protection sprinkler systems and emergency response activities at airports, large petrochemical facilities, military bases and firefighter training areas.

In some parts of the world, the military, airports, civil firefighters and private industry still primarily use a PFASs-based foam for Class B fires. Recently, civil aviation, the petrochemical industry and governmental entities in Australia, Asia and Europe have prioritized the procurement of firefighting foams that don’t contain PFASs. Some foams containing PFASs are being replaced with shorter chain C6 PFASs, but there are increasing concerns and environmental regulations regarding these foams. New, fluorine-free firefighting (F3) foams and modern foam delivery technologies offer equivalent extinguishment performance for the vast majority of fires without the health and environmental risks.

As the regulatory focus on PFASs increased worldwide, the balance between effective fire extinguishment and environmental liabilities has shifted. Fires can now be effectively extinguished without the need for PFASs. Advances in foam delivery technologies, such as compressed air foam systems, means fires can be extinguished far more effectively and from a greater distance than before.

F3 foams have achieved certification under various firefighting foam certification programs (e.g., Underwriters Lab, LASTFIRE and International Organization for Standardization [ISO]), with some foams having passed the highest levels of International Civil Aviation Organization (ICAO) extinguishment tests.

As the extinguishment performance of F3 foams increases to be comparable with PFASs foams, the use of F3 foams represents a future-proofed alternative for fire extinguishment without use of PFASs and the associated environmental liabilities that many sectors are eager to eliminate.
FOAM REPLACEMENT

F3 foams are popular in Europe, Australia and Asia because they biodegrade and eliminate future environmental liabilities associated with fire training activities and incident extinguishment, while providing excellent fire extinguishment performance. There is already wide-scale application of F3 foams across multiple sectors such as aviation and oil and gas. F3 foams have been used by the military in Scandinavia for several years.

Organizations are beginning to swap out PFAS-laced foams for F3 foams and evaluating the conversion of firefighting capabilities for multiple applications. The costs for changing foam delivery infrastructure and eliminating PFAS foams should be balanced with the potential future environmental liabilities associated with continued use of PFASs.

Transition plans to eliminate PFASs include decontamination, disposal of foams, equipment and infrastructure upgrades/replacement, and training. Transitioning foams also involves combining environmental management with fire protection engineering, fire safety strategies and fire risk assessments.

Consideration may also need to be given to the environmental impacts from PFASs to the site and surrounding areas, and environmental plans including:

- Fire training areas
- Areas where PFAS-containing materials are/were used, stored, and handled (fire stations, hangar sprinkler systems, fire truck maintenance and testing areas, fuel tank farms, accident sites)
- Location of surface water and water supplies
- Wastewater treatment plants
- Stormwater management plans
- Procedures for discharging the waste foam from firefighting equipment testing
- Existing hazardous materials management plans or other compliance-related documents

Costs for changing foam delivery infrastructure and incinerating the PFAS foams should be measured against the potential environmental liabilities associated with its continued use.
MANAGING LIABILITIES AND TRANSITIONING TO SUSTAINABLE ALTERNATIVES

There is considerable interest in replacing PFASs in firefighting foams through the adoption of F3 foams, and Arcadis is leading the way with its foam transition program. The foam transition program helps clients manage the lifecycle of liability related to fire suppression and firefighting. We support clients in many sectors with foam transition; on-site treatment, disposal, and equipment retrofits; fire protection engineering; fire safety strategies; fire risk assessments; active fire protection systems; industrial water treatment; and site evaluation and remediation.

Arcadis focuses on cost efficiency and advocacy strategies to enable a seamless transition to accredited alternatives that pose minimal environmental risk. In addition, we leverage environmental risk assessment and modeling to demonstrate if exposures to human health and ecological receptors is significant and actionable. Arcadis’ Certified Fire Protection Engineers serve as a trusted partner, assisting organizations in making sound investment decisions and verifying that their fire protection systems provide the necessary risk mitigation while complying with applicable codes and standards.

Arcadis’ fire suppression and engineering expertise includes building sustainable sealed and contained fire training areas, as well as cleaning PFASs in pipework and tanks.

As organizations approach the decision to move to F3 foams and manage the transition, emphasis should be on the decontamination and disposal of PFAS-based foams. Changes to regulations require fire professionals to demonstrate a robust, detailed and technically rigorous quality assurance process in the cradle-to-grave management of firefighting foams. This assurance process requires detailed technical knowledge of firefighting technology with environmental assessments from a technical specialist – something typically outside fire professionals’ expertise.

“Arcadis can provide a pragmatic approach to manage PFASs using risk assessment, which defines if any harm may be being caused. This provides a defensible framework to manage any regulatory concerns and potential liabilities.”
LIFE-CYCLE OF FIRE PROTECTION — FOAM TRANSITION SERVICES

Arcadis shares its expertise with clients by leveraging global resources and strategic partners like ENRG Consultants to provide advisory, consulting and engineering services across the life-cycle of fire protection.

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DECONTAMINATION AND DISPOSAL

Arcadis has a detailed understanding of multiple PFAS treatment options and is pioneering the development of cost-effective and pragmatic solutions. For example, Arcadis is sealing concrete pads associated with firefighting training facilities, developing on-site destructive treatments for PFASs in foam concentrates and using innovative water treatment solutions to comprehensively remove PFASs.

With more than 75 projects or portfolios representing 300 individual sites in 12 countries, clients benefit from our knowledge of complex PFAS chemistry combined with significant expertise in fire safety engineering and environmental risk assessment. We work together with organizations and communities to manage PFAS liabilities and transitioning to more sustainable alternatives that improve quality of life for all.
CASE STUDIES

CAVERN FACILITY FIRE WATER SYSTEM UPGRADES
Marathon Petroleum Company | Woodhaven, Michigan

When an existing fire water system needed to be upgraded to meet current NFPA and API codes and standards, Arcadis was hired to manage and design the upgrades. Project management included coordination between design disciplines and providing directives for the design and upgrades of a new fire pump house, new fire water storage/suction tank, new power system, new foundation design for fire pump house and suction tank, and new fire water distribution piping including fire hydrants.

The fire water supply system design layout included diesel fire pumps, jockey pump, fuel oil delivery system, suction tank, piping, valves and appurtenances.

Arcadis also provided construction administration services, including bid solicitation, project management, submittal reviews, responding to contractor requests for information (RFIs), addressing change request/orders, punch lists, and troubleshooting.
Arcadis combines knowledge and understanding of international regulations with a capability in risk-based fire safety engineering. We use computational modeling to help our clients simulate people evacuation and fire/smoke behavior to help manage risk.

Our fire protection team offers technical assistance for fire protection systems, particularly Active Fire Protection systems such as detection and alarm systems and fire suppression (e.g., conventional water sprinklers, clean agent, etc.).

Our expert capabilities span all phases of engineering and project work, including:

- Electrical, civil, structural, mechanical and chemical engineering
- Preparing fire safety strategies using regional, LUL and NFPA codes and standards
- Preliminary and detailed design
- Commissioning and operation of fire protection systems
- Overseeing subcontractors’ installation of fire suppression, detection and alarm systems

ENVIRONMENTAL MANAGEMENT OF PFASs AT UK AIRPORT
Guernsey Airport, United Kingdom

Following identification of PFASs in surface waters and a reservoir that provide the drinking water to Guernsey Island, Guernsey Airport and the Guernsey Public Services Department needed a management strategy for PFASs as a result of the use of PFASs foams in airport operations. Arcadis was hired to identify sources of PFASs and develop a solution to protect the water supply.

PFASs foams were replaced with F3 foams and the source of PFASs to the drainage network was immediately addressed. Then, environmental investigations enabled risk-based decision making through development of a conceptual site model. Concentrations of PFASs in the drinking water reservoir were diminished by more than 75% within nine months of the site assessment. A water treatment solution was provided to ensure concentrations of PFASs in the water were below drinking water criteria, mitigating the risk associated with PFAS contamination and safeguarding the island’s drinking water supply.
Arcadis is the leading global design and consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 27,000 people active in over 70 countries that generate $3.5 billion in revenues.

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