Aqueous film-forming foam (AFFF) is a type of firefighting foam that is used to extinguish flammable liquid fires (Class B fires)

Firefighting Foams, Aqueous Film-Forming Foam (AFFF), and PFAS

What is aqueous film-forming foam?

Aqueous film-forming foam (AFFF) is a type of firefighting foam that is used to extinguish flammable liquid fires (Class B fires). AFFF has been used since the 1960s and is considered the gold standard to suppress Class B fires quickly and reliably.

AFFF has received scrutiny because it is manufactured with fluorosurfactants which may include per- and polyfluoroalkyl substances (PFAS), including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which are known carcinogens. PFAS (also known as "forever chemicals") do not break down in the environment, can move through soils and contaminate drinking water sources, and bioaccumulate in fish and wildlife. PFAS exposure in humans may affect reproduction, thyroid function, and the immune system, and injure the liver. When AFFF is used, discharged, or released to the environment, containment and cleanup may be required to prevent adverse health or environmental impacts. Long-term exposure to AFFF is also a concern, particularly for firefighters.

Although AFFF is being phased out and new firefighting foams are being developed, there is considerable uncertainty regarding availability of approved alternatives, the ability of replacement products to meet performance standards, and the regulatory requirements for the use and disposal of the stockpile of legacy AFFF.

Use of firefighting foams

Water is heavier than liquid hydrocarbon fuels and if applied to the fuel surface, it will sink to the bottom, having little or no effect on extinguishment or vapor suppression. If the liquid fuel heat is above 212 degrees F, the water may boil below the fuel surface, throwing the fuel and spreading the blaze. For this reason, Class B foam is the primary fire-extinguishing agent for all hazards or areas where flammable liquids are transported, processed, stored, or used.

Firefighting foam is a stable mass of small air-filled bubbles which have a lower density than oil, gasoline, or water. Unlike other fire extinguishing agents (e.g., water, dry chemical, CO2), firefighting foam can extinguish a flammable or combustible liquid fire by the combined mechanisms of cooling, separating the flame from the product surface, suppressing vapors, smothering, and preventing reflash or reignition. In general, foams use the following mechanism to knock down a fire:

- The foam blankets the fuel surface, blocking the oxygen supply and smothering the fire.
- The foam blanket separates the flames/ignition source from the fuel surface.
- The water content in the foam cools the fuel and any adjacent metal surfaces.
- The foam blanket suppresses the release of flammable vapors that can mix with air.

Class A foams are now widely used for combustible materials such as paper, tires, and wooden structures.

Types of firefighting foam

The most common types of foams currently used by fire fighters include Class A and Class B foams.

Class A foams

Class A foams were originally developed in the mid-1980s for controlling wildfires but are now widely used for combustible materials such as paper, tires, and wooden structures. Class A foam works by reducing the surface tension of water, providing better wetting and penetrating characteristics. This promotes cooling and makes the fuel less combustible. The foam also creates a dense blanket that clings to vertical surfaces and provides an insulating barrier between the fuel and the air. PFAS chemicals are not necessary to give Class A foam these properties and are not found in Class A foams. Class A foams are not designed to contain the explosive vapors produced by flammable liquids.

A wetting agent is very similar to Class A foam. It can be added to firefighting water to increase its wetting effectiveness but does not have the foaming abilities.

Class B foams are widely used to extinguish flammable liquid fires such as gasoline, oil, and jet fuel.

Class B foams

Class B foams are used to extinguish flammable liquid fires such as gasoline, oil, and jet fuel. There are two major subtypes of Class B foams: protein foams and synthetic foams.

Protein foams

Protein-based foams contain natural proteins as the foaming agents and are generally biodegradable. Protein foams flow and spread more slowly than synthetic foams, but provide a foam blanket that is more heat resistant and durable. Protein foams include the following:

- Regular protein foam (P) concentrate is composed of hydrolyzed protein, foam stabilizers, and preservative. Protein foam can become contaminated with fuel if plunged directly into the fuel surface and must be applied gently to the flammable fuel surface. It is mostly obsolete and does not contain PFAS.
- Fluoroprotein foam (FP) was developed in the 1960s. It is derived from a protein foam to which small amounts of fluorosurfactant chemical are added to make the foam flow more easily. Fluoroprotein foam is oleophobic (oil shedding) and can be injected into the subsurface of a flammable liquid storage tank. In general, it performs better than regular protein foam because it has a longer blanket life. Early fluoroprotein foams may have used PFOA and PFOS in low levels. Modern fluoroprotein foams do not contain PFOS, but PFOA may exist at trace levels associated with the manufacturing process.
- Film-forming fluoroprotein (FFFP) is a derivative of AFFF and fluoroprotein foams. It is based on fluoroprotein formulations to which an increased quantity of fluorocarbon surfactants has been added. FFFP was developed to have the quick knockdown of AFFF with the added burn-back resistance of standard fluoroprotein foam. FFFP is used where the burning fuel can form deeper pools. FFFP contains PFAS.
- Alcohol-resistant fluoroprotein foam (AR-FP)
- Alcohol-resistant film-forming fluoroprotein (AR-FFFP)

Synthetic foams

Synthetic foams are manufactured from synthetic materials, including:

- Synthetic foaming agents (hydrocarbon surfactants)
- Solvents (e.g., viscosity leveler, freezing point depressant, foam booster)
- Fluorochemical surfactants (also known as fluorosurfactants)
- Small amounts of salts
- Foam stabilizers (to slow drainage, increase fire resistance)

Synthetic foams provide better flow and spreading over the surface of hydrocarbon-based liquids, for faster knockdown of flames. Today, most Class B foams are synthetic foams. Types of synthetic foams include the following:

- AFFF is the most common type of synthetic Class B foam. It was originally developed by the U.S. Navy in the mid-1960s. AFFF is water-based and is created by combining foaming agents with hydrocarbon-based surfactants such as sodium alkyl sulfate and PFAS-based fluorosurfactants such as fluorotelomers and PFOS.
- Alcohol-resistant aqueous film-forming foam (AR-AFFF) was invented in the early 1970s by National Foam, Inc. Flammable liquids that contain alcohols and polar solvents that readily mix with water are more difficult to extinguish compared to a pure hydrocarbon fire. Polar solvents and alcohols destroy the foam blanket that is generated using standard AFFF. Water in the foam mixes with alcohol, causing the foam blanket to collapse and disappear until the fuel surface is completely exposed again. To overcome this problem, alcohol-resistant foams contain a polymer that forms a protective layer between the burning surface and the foam, preventing foam breakdown by alcohols in the burning fuel.
- Fluorine-free foams (FFF, also called F3) are mostly based on hydrocarbon surfactants and are free of any fluorosurfactants that contain PFAS.

Class B foams can also be generally classified as either fluorinated foams (which contain PFAS) or fluorine-free foams (which, do not contain PFAS):

- Fluorinated foams (contain PFAS)
  - AFFF (legacy PFOS AFFF, legacy fluorotelomer AFFF, and modern fluorotelomer AFFF)
  - AR-AFFF
  - FFFP
  - AR-FFFP
  - FP
  - Alcohol-Resistant Fluoroprotein Foam (FPAR)
- Fluorine-free foams (do not contain PFAS)
- Protein foam (P)
  - Alcohol-resistant protein foam (AR-P)
  - Synthetic FFF or F3
  - Synthetic Alcohol-Resistant FFF (AR-FFF)

Low-expansion versus high-expansion foams

Firefighting foams can also be classified by their air-to-foam expansion ratio:

- Low-expansion foams have low viscosity and an expansion ratio of less than 20, giving them mobility and the ability to cover large areas quickly. Low-expansion foams are used on burning spills. AFFF is a type of low-expansion foam.
- Medium-expansion foams have an expansion ratio of 20 to 100, which makes them useful for applications such as plastic, rubber, and liquid fires or flooding shallow areas. They are used in outdoor applications because they are less affected by wind. Medium-expansion foams do not typically contain PFAS.
- High-expansion foams have an expansion ratio of over 200 to 1000 and are used to fight Class A, Class B, and liquefied natural gas (LNG) fires. Their high air-to-foam expansion ratios make them suitable for enclosed spaces where quick filling is needed such as aircraft hangers, warehouses, ship cargo holds, and mine shafts. High-expansion foams do not typically contain PFAS.

How does AFFF work?

AFFF extinguishes flammable liquid fires using the same mechanisms as protein or fluoroprotein foams. However, AFFF has a unique additional feature: a fluorosurfactant is added, which creates an aqueous film that is formed on the surface of the flammable liquid by the foam solution as it drains from the foam blanket. This film is very fluid and floats on the surface of most hydrocarbon fuels. The film suppresses fuel vapor and seals the fuel surface, helping to prevent the fire from releasing flammable and toxic fumes into the air. This gives AFFF unequaled speed in fire control and knockdown when used on a hydrocarbon spill fire. It is even possible to notice the fire being extinguished by the invisible film before there is a complete foam blanket over the surface of the fuel.

AR-AFFF is a type of AFFF that suppresses fires on liquid hydrocarbon fuels as well as polar solvent fuels (e.g., methanol, ethanol, and acetone). AR-AFFF is used in areas where gasoline is blended with oxygenates (e.g., MTBE) or liquids containing polar solvents, which prevent the formation of the film between the AFFF foam and gasoline, breaking down the foam and rendering it useless. AR-AFFF combines a water-soluble polymer (typically a polysaccharide) with surfactants to create a foam blanket with cooling and oxygen-blocking fire suppression mechanisms. In addition, as liquid drains from the foam blanket, it forms either an aqueous film on a hydrocarbon fire or a polymeric membrane on a polar solvent fire that prevents the barrier from being dissolved by the alcohols.

> AFFF is used at operations involving the transport, processing, handling, or storage of flammable liquids.

Where is AFFF used?

AFFF is used at operations involving the transport, processing, handling, or storage of flammable liquids. Typical locations where AFFF is found include:

- Airports
- Aircraft hangars
- Military bases and airfields (the U.S. military is the nation's largest user of AFFF)
- Military and civilian ships
- Oil refineries, terminal, and bulk fuel storage tank farms
- Chemical plants
- Offshore tankers and offshore oil platforms
- Firefighting training facilities
- AFFF storage tanks and transport lines
- Fire stations (some fire stations may only have Class A foam and some may have both Class A and Class B foam)
- Accident and emergency response sites and areas of firefighting water runoff. Although AFFF is typically discharged to land, it can run off into surface water or stormwater and infiltrate to groundwater.

Due to their long shelf lives, older AFFF concentrates (containing PFOS) may be present in inventories at some facilities.

Although the amount of AFFF used at petroleum facilities has been steadily decreasing, large quantities remain at airport and military installations, which are still required by federal standards to use AFFF.

A 2004 study commissioned by the Fire Fighting Foam Coalition estimated that there were roughly 10 million gallons of AFFF concentrate in the United States. About 10 percent of it belonged to municipal fire departments. The vast majority, more than 80 percent, was located on military bases, airports, and gas and oil facilities. Much of the AFFF resides in fixed suppression systems.

According to a report to the U.S. Congress in October 2021, the U.S. Department of Defense (DoD) still has about 3 million gallons of AFFF concentrate remaining at its facilities and it is estimated that civilian airports have at least three times that.

How is AFFF applied to a fire?

AFFF is typically produced as a 1 percent, 3 percent, or 6 percent concentrate depending on its mixture ratio with water. A 3 percent concentration means that for every 100 gallons of foam produced, 3 gallons of the concentrate must be used with 97 gallons of water. A 3 percent foam concentration is twice as concentrated as a 6 percent foam concentrate. On the same size and type of flammable liquid fire, half as much 3 percent foam concentrate would be required compared to a 6 percent foam concentrate.

AFFF can be applied through a wide variety of delivery systems, both manual and automatic. Foams are usually applied to a fire using an in-line eductor which mixes the water, foam concentrate, and air in the correct proportions to form a foam blanket.

Historical AFFF production and PFAS

Three general types of AFFF have historically been produced by foam manufacturers: legacy PFOS AFFF; legacy fluorotelomer AFFF (which contains some long-chain PFAS); and modern fluorotelomer AFF (which contains exclusively short-chain PFAS).

- Legacy PFOS AFFF contains PFOS. These foams were manufactured in the U.S. from the late 1960s until 2002 exclusively by 3M and sold under the brand name "Lightwater". Lightwater AFFF contains PFOS and various precursors that could potentially break down in the environment to PFOS and shorter-chain PFAS such as PFHxS. Older formulations may also contain PFOA as well as fluorinated precursors. PFOA was not an intended ingredient in AFFF, but was a byproduct created during the manufacturing process. The fluorinated precursors may also break down in the environment to PFOA and other perfluoroalkyl carboxylates (PFCAs). Many AFFF formulations contain other unintended PFAS side products that are believed to have have similar health and environmental concerns as PFOS and PFOA.
- Legacy fluorotelomer AFFF contains some long-chain PFAS. These foams were manufactured and sold in the U.S. from the 1970s until 2016 and encompass all other brands of AFFF besides 3M Lightwater. Although not made with PFOA, they contain polyfluorinated precursors that degrade to PFOA and other PFAS in the environment. They may contain trace quantities of PFOA as an unavoidable byproduct of the manufacturing process. Legacy fluorotelomer-based AFFF foams have historically contained predominantly short-chain (C6) PFAS with formulations ranging from about 50–98 percent short-chains and the balance as long-chain PFAS. The long-chain PFAS content of these foams has the potential to break down in the environment to PFOA and other PFAS, but not to PFOS or other PFSAs.
- Modern fluorotelomer AFFF contains exclusively short-chain PFAS. In the U.S., 3M announced the phase-out of manufacturing of PFOS-based products in 2000. After 3M voluntarily ended the production of PFOS-based AFFF, the primary supply of AFFF became fluorotelomer-based. Manufacturers of fluorotelomer AFFF began replacing long-chain fluorosurfactants with short-chain fluorosurfactants. Today, most AFFF is produced using short-chain "C6" fluorochemicals manufactured using a telomer-based process which does not produce PFOS. C6 chemicals may contain trace amounts of PFOA associated with the manufacturing process but do not break down in the environment to form PFOA.

In response to the U.S. Environmental Protection Agency (EPA) 2010/2015 voluntary PFOA Stewardship Program, most foam manufacturers have now transitioned to the production of

> In response to the U.S. Environmental Protection Agency (EPA) 2010/2015 voluntary PFOA Stewardship Program, most foam manufacturers have now transitioned to the production of short-chain (C6) fluorotelomer-based PFAS.

short-chain (C6) fluorotelomer-based PFAS. These foams are referred to as "modern" to distinguish them from the legacy foams manufactured before the phase-out. Short-chain (C6) PFAS do not contain or break down in the environment to PFOS and other long-chained PFAS such as PFHxS and PFOA and are currently considered lower in toxicity and have significantly reduced bioaccumulation potential compared to long-chain PFAS. However, foams made with only short-chain (C6) PFAS may still contain trace quantities (parts per billion [ppb] levels) of PFOA and PFOA precursors as byproducts of the manufacturing process.

Although some of the long-chain PFAS are being regulated or phased out, the most common replacements are short-chain PFAS with similar structures, or compounds with fluorinated segments joined by ether linkages. While some shorter-chain fluorinated alternatives seem to be less bioaccumulative, they may still be as environmentally persistent as long-chain substances or have persistent degradation products. Concerns have been raised that little information is publicly available on the chemical structures, properties, uses, and toxicological profiles of these shorter-chain formulations and that increasing use of fluorinated alternatives could lead to increasing levels of stable perfluorinated degradation products in the environment.

Disposal of AFFF

Although PFAS-based AFFF is not characteristic for hazardous waste, nor is it listed as a Resource Conservation and Recovery Act (RCRA) hazardous waste, AFFF should not be disposed of through septic, stormwater, or municipal sewer systems.

Disposal options are limited for AFFF due to its PFAS content. The U.S. EPA has issued interim guidance on PFAS disposal, but no disposal approaches have yet received final endorsement. Thermal destruction at a RCRA Part B incineration facility is a common disposal option. However, in April 2022, the DoD issued a temporary moratorium on AFFF incineration, pending final guidance from the EPA. Incineration remains a disposal option for private industry.

AFFF can also be solidified and shipped to a nonhazardous waste landfill that will accept it.

Some states have collection and disposal programs that assist fire departments and other entities in getting rid of AFFF.

Regulatory status of AFFF and PFAS

- PFOS and PFOA are not classified as hazardous wastes under the RCRA; however, under the Toxic Substances Control Act (TSCA), these compounds are regulated through Significant New Use Rules which give the EPA the authority to restrict the production and use of PFOS and PFOA-containing products.
- AFFF constitutes a U.S. Occupational Safety and Health Administration (OSHA) hazardous material because of its physical hazards such as skin and eye irritation.
- Discharge of wastewater and runoff containing AFFF on land, at sea, or to surface water bodies is also subject to regulation under the Clean Water Act.
- PFOS and PFOA may also qualify as pollutants or contaminants under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

How to tell if AFFF contains PFAS

It is not always easy to determine if AFFF contains PFAS. PFAS are not required to be reported on safety data sheets (SDS) because they are not considered a hazardous substance. PFAS may also be listed as a proprietary ingredient or a trade secret on an MSDS. The best way to determine if an AFFF contains PFAS is to contact the manufacturer. If in doubt, it is best to assume that AFFF contains PFAS.

A good indicator that an AFFF contains PFAS is if its ingredients include "fluorinated surfactants", "fluorosurfactants", "fluoroprotein", "C6", or the term "fluoro".

Many AFFF products claim to be "PFAS free", meaning they don't contain long-chain (C8, C10, C12, or longer) PFAS such as PFOS or PFOA. However, many modern AFFF contain short-chain (C6) PFAS. Although C6 PFAS are claimed to be lower in toxicity compared to long-chain PFAS, the toxicological profiles are less well documented and C6 PFAS are still considered to be persistent in the environment.

Some AFFF products include a statement similar to the following: "This AFFF does not contain PFOS and will not break down to yield PFOA in accordance with the goals of the U.S. EPA 2010 PFOA Stewardship Program." However, this does not mean that the AFFF does not contain PFAS. It only means that the AFFF was manufactured with PFAS that did not contain PFOS.

- Various states have established soil and groundwater cleanup levels of PFOS, PFOA, and other PFAS.
- In 2002, the U.S. EPA restricted the future manufacture and import of most PFOS-based products, including firefighting foams, through two Significant New Use Rules (SNURs) (40 CFR 721.9582, Final Rules published 03-11-02 [13 PFAS] and 12-9-02 [75 PFAS]).
- In 2006, the U.S. EPA instituted the 2010/2015 voluntary PFOA Stewardship Program that resulted in the elimination of PFOA and other long-chain PFAS production by eight major fluorochemical manufacturers by 95 percent by 2010 and entirely by 2015. As a result, foam manufacturers have transitioned to the production of modern fluorotelomer AFFF (based on short-chain C6 PFAS) and other fluorinated Class B foams.
- In 2007, the U.S. EPA issued an amendment to 40 CFR 721.9582 regulating another 183 PFAS (SNUR on 10-09-07).
- In 2015, the U.S. EPA proposed a SNUR for PFOA and other long-chain PFAS as a regulatory follow-up to the voluntary PFOA Stewardship Program; the SNUR has not been finalized. The SNURs subject specific PFAS chemicals to reporting requirements, but do not restrict the use of existing stocks of legacy AFFF containing those PFAS chemicals.

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AFFF replacements and alternatives

The first PFAS and FFF (F3) were introduced in 2002. Most major foam suppliers have had F3 products available for the past several years. Extensive testing by the Fire Protection Research Foundation, the U.S. DoD, and the petroleum industry research group LASTFIRE has demonstrated F3 to be effective on Class B hydrocarbon and polar solvent fires as well as Class A fires under the right conditions. However, F3 foams don't make a film on the fuel like AFFF. Rather, they work simply by providing a physical barrier of bubbles that contains the fuel vapors and prevents them from mixing with oxygen.

The performance of new F3 can vary dramatically depending on factors such as the manufacturer, the type of fuel burning, how aspirated the foam is, the discharge devices used, and the techniques and tactics used by the firefighters. Whereas AFFF is extremely forgiving and versatile and able to put out fires regardless of the quality of the foam, new F3 formulations are highly dependent on dense, highly aspirated bubbles. Even with a denser foam blanket, it can take twice as much foam and twice as long to extinguish a liquid fuel fire with F3 compared to AFFF.

For decades, the U.S. DoD has had its own performance specification standards for firefighting foams on its bases, referred to as "MIL-SPEC". AFFF foams that meet the MIL-SPEC are required for use in military applications and at Federal Aviation Administration (FAA)-regulated airports. Since 2017, the DoD has funded research to identify F3 that can pass MIL-SPEC performance tests, which includes being able to extinguish a fuel fire in less than 30 seconds. To this point, no F3 has managed to pass each part of the rigorous tests and therefore no military facilities or FAA-regulated airports have abandoned the use of AFFF. The widespread adoption of F3 has been limited by its historic inability to conclusively meet standards such as the U.S. DoD's firefighting performance specifications.

All other AFFF foams are specified to UL Standard 162 (UL, 2018) or other specifications for application outside of military and FAA facilities.

The transition from AFFF to F3 is complicated by many factors. Things to consider when selecting a fluorine-free foam replacement for PFAS-containing AFFF include:

- Equipment compatibility: F3 products are not drop-in replacements for legacy or modern AFFF. Whereas AFFF products have viscosities similar to water, some F3 have much higher viscosity and will not work with existing equipment. Existing equipment such as tanks and nozzles need to be evaluated or replaced for compatibility with F3. At some facilities, every part of an AFFF system may need to be replaced to use F3.
- Performance characteristics of F3 may be different than AFFF.
- Firefighters will need to retrain on how to extinguish Class B fires.
- Shelf life and long-term stability and effectiveness of F3 due to temperature exposure and cycling, storage containers, air exposure, evaporations, dilution, and contamination
- Compatibility of one foam concentration to be mixed with another concentrates

- Decontamination of old equipment so it does not contaminate F3
- Disposal of remaining stockpiles of AFFF and contaminated equipment
- The ingredients may be protected as proprietary or confidential business information. There is some concern whether the F3 are truly fluorine-free.
- The toxicity and impacts on human health of F3 and their ingredients have not been fully assessed. There is a reluctance in the industry (referred to as "transition regret") to replace AFFF with F3 until there is more certainty regarding the safety and hazard level of F3.

Although the DoD has yet to officially approve a F3 for use at its facilities, there are now a few dozen F3 products that have passed performance tests developed by other credible testing and approval authorities (e.g., the UL). Of the 70 or so F3 product on the market, about half have credible approvals.

The National Fire Protection Agency (NFPA) standards that address foam suppression — including NFPA 11 (Standard for Low-, Medium-, and High-Expansion Foam) and NFPA 30 (Flammable and Combustible Liquids Code), as well as NFPA's suite of standards for the protection of airfield and airport facilities — focus mainly on hardware and do not stipulate which type of foam can or should be used. Because the new foam concentrates are still undergoing testing, there hasn't yet been a need for significant changes to the design or protection strategies outlined in NFPA 11 for fixed-system foam application.

Bans on AFFF

There have been phase-outs and bans on AFFF:

- The 2020 National Defense Reauthorization Act requires the U.S. DoD to stop purchasing PFAS-containing foam by October 2023 and to replace all AFFF by October 2024.
- On January 6, 2023, the DoD released specifications for F3. The new MIL-SPEC regulations pave the way for both airports and military bases to make the switch to F3.
- The U.S. Congress imposed earlier mandates on the FAA to transition airports to F3 by October 2021, but that deadline was missed.
- The phase-out of PFAS-containing AFFF in private industry remains discretionary. It has been estimated that only 20 percent of the petroleum industry has made the switch. Larger oil and gas companies (e.g., Shell, Chevron, Exxon, and BP) have conducted extensive studies on F3 and are either in the process of converting the AFFF system or have already done so.
- In 2021, at least 15 U.S. states had banned or severely limited AFFF. In 2022, legislation was pending in at least five other states to do the same.
- Large-city fire departments (e.g., Chicago, Los Angeles, Atlanta, and New York) have been more progressive in transitioning to F3. However, the vast majority of smaller fire departments in the U.S. have not transitioned to F3 yet.
- Under the 2017 European Union Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) regulation on PFOA and PFOA-related substances, AFFF foams based on short-chain PFAS could contain no more than 25 ppb PFOA and 1,000 ppb total PFOA-related substances to be sold in the European Union (EU) after July 4, 2020.
- In February 2022, the European Chemicals Agency proposed an outright ban on the manufacture, use, and export of AFFF for the entire European Union.

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Best management practices for AFFF

Until there is widespread use of new firefighting foams, fire departments and facilities that use AFFF should consider these guidelines and best management practices to limit the use of AFFF:

- Older AFFF containing PFOS and long-chain PFAS should only be used in emergencies where insufficient amounts of newer short-chain AFFF or other foams are available and where there is an immediate risk to life, public safety, or property.
- For training, only use foam that does not have PFAS. Training foam does not contain PFAS and is used to simulate AFFF for firefighting training purposes. It is not intended for live fire training or for actual firefighting.
- Only use Class B AFFF for hydrocarbon fires, alcohol-based products, and aviation accidents to save lives or protect critical infrastructure.
- Store Class B AFFF on site until disposed of through a collection and disposal program.
- Particular care should be used when AFFF is used near sensitive environmental areas such as wetlands, surface water bodies, reservoirs or rivers with municipal water supply intakes, sensitive or endangered species habitat, areas close to public and private drinking water supply wells, sole source aquifers, and groundwater recharge areas.
- Report the use of AFFF to the local environmental regulatory agency immediately after a firefighting incident.

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