Navigating PFAS: Reevaluating the U.S. Navy's Reliance on Aqueous Film-Forming Foam

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The U.S. Navy's use of aqueous film-forming foam (AFFF) for fire suppression aboard ships poses significant environmental and health risks due to the presence of per- and polyfluoroalkyl substances (PFAS) in AFFF. The Department of Defense (DoD) has been a major source of PFAS pollution due to its frequent use of AFFF in firefighting and training. While AFFF is an effective fire suppressant, particularly for aviation fuel fires, its use has contributed to extensive PFAS contamination of groundwater and raises concerns about long-term environmental damage. In response to concerns about PFAS, Congress mandated that the DoD discontinue using AFFF on land. However, Congress allowed continued use of AFFF on ships. This Note explores the environmental implications of AFFF use aboard Navy vessels, addressing both the current regulatory framework and ongoing litigation related to AFFF contamination. Analyzing the arguments for and against shipboard AFFF use, this Note recommends the Navy phase out AFFF on ships.

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INTRODUCTION

The U.S. Navy has approximately 241 active commissioned warships stationed around the country and deployed around the world.[1] They range in size from approximately 1,300 tons, in the case of the smallest operational class of vessels, [2] to over 90,000 tons, in the case of aircraft carriers.[3] In the event of a fuel-based fire aboard one of these ships, a complex system of pipes and pumps are prepared to drop thousands of gallons of aqueous film-forming foam

1. *USS Ships in Commission*, NAVAL VESSEL REG., U.S. DEP'T OF THE NAVY, https://www.nvr.navy.mil/nvr/getpage.htm?pagetype=activeincommission (last visited Dec. 11, 2024). This number includes the USS *Constitution*, which is technically commissioned but serves as a museum in Boston, Massachusetts. The number does not include ships that are in the reserve fleet, non-commissioned ships, or ships operated by the Military Sealift Command. If non-commissioned (support) ships are included, then the total is currently 484 ships.

2. *Mine Countermeasures Ships (MCM)*, U.S. PAC. FLEET, U.S. DEP'T OF THE NAVY, https://www.surfpac.navy.mil/Ships/By-Class/Mine-Countermeasures-Ships-MCM (last visited Oct. 27, 2024). Mine countermeasure ships are the smallest active ships. Technically, the USS *Pueblo*, an intelligence gathering vessel, is smaller. However, the USS *Pueblo* is held captive in North Korea.

3. *Important Links and Info*, U.S. PAC. FLEET, U.S. DEP'T OF THE NAVY, https://www.airpac.navy.mil/Organization/Distinguished-Visitor-Info/Important-Links-and-Info (last visited Nov. 15, 2024).

(AFFF).[4] Once deployed, AFFF coats the surface of everything in the affected area to extinguish the fire.[5] Uniformed personnel routinely train with AFFF to prepare for this contingency. Whether for training or to extinguish a real fire, the deployment of AFFF results in Navy sailors sweeping knee-high accumulations of the frothy mixture into the ocean after use.[6]

AFFF is unmatched as a fire suppressant, especially for fires involving aviation fuel.[7] Unfortunately, it is also harmful to the environment and to the health of the people who use it. The Department of Defense (DoD) is one of the largest polluters of per- and polyfluoroalkyl (PFAS) substances in the United States.[8] Much of this PFAS pollution stems from AFFF, which causes significant PFAS contamination of groundwater.[9] Due to AFFF's health and environmental hazards, Congress required in the National Defense Authorization Act for Fiscal Year 2020 that the DoD discontinue use of AFFF on military installations.[10] Notably, this ban only applies to the use of AFFF on land.[11] AFFF is still widely used on ships, mainly because there are no alternatives that meet military specifications.[12] However, recent PFAS regulations by the Environmental

4. The EPA estimated that 722,500 gallons of AFFF/seawater solution is discharged annually. Approximately 4,244,000 gallons of seawater is used annually to clean the AFFF solution off ships. EPA, APPENDIX A, AFFF NOD (AQUEOUS FILM-FORMING FOAM): NATURE OF DISCHARGE FOR THE PHASE I FINAL RULE AND TECHNICAL DEVELOPMENT DOCUMENT OF UNIFORM NATIONAL DISCHARGE STANDARDS (UNDS) tbl. 3 (1999) [hereinafter EPA AFFF REPORT, APPENDIX A].

5. *See George Washington Completes Countermeasure Wash-Down System Testing*, U.S. DEP'T OF THE NAVY, (May 12, 2015), https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2262470/george-washington-completes-countermeasure-wash-down-system-testing.

6. EPA AFFF REPORT, APPENDIX A, *supra* note 4, at 3.

7. *See* DON DEYOUNG ET AL., NAVAL RSCH. LAB'Y, NRL/MR/1001--06-8951, FULFILLING THE ROOSEVELTS' VISION FOR AMERICAN NAVAL POWER (1923-2005) 37 (2006).

8. Austin Fast & Cecilia Garzella, *Who's to Blame for PFAS in Our Drinking Water? Here's What Hundreds of Cities Say*, USA TODAY, https://www.usatoday.com/story/news/investigations/2024/08/14/military-airport-pfas-pollution-epa/74681775007 (last visited Oct. 4, 2024).

9. INTERSTATE TECH. & REGUL. COUNCIL, AQUEOUS FILM-FORMING FOAM (AFFF) 2 (2022), https://pfas-1.itrcweb.org/wp-content/uploads/2022/09/AFFF_PFAS_FactSheet_082522_508.pdf. AFFF is a foam that contains PFAS. Once it is deployed, it soaks into the ground and eventually enters the groundwater.

10. National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, §§ 322-324, 133 Stat. 1198 (2019). "Installations" is an umbrella term for areas owned by the military. Each service has different naming conventions for areas of military activity, like "base," "fort," or "air station," to name a few. The term "installation" covers all of these.

11. *Id.*

12. OFF. OF THE ASSISTANT SEC'Y OF DEFENSE FOR ENERGY, INSTALLATIONS & ENV'T & OFF. OF THE ASSISTANT SEC'Y OF DEF. FOR INDUS. BASE POL'Y, U.S. DEP'T OF DEF., NO. 1-22557AD, REPORT ON CRITICAL PER- AND POLYFLUOROALKYL SUBSTANCE USES 11 (2023), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/Report-on-Critical-PFAS-Substance-Uses.pdf [hereinafter DOD PFAS REPORT].

Protection Agency (EPA)[13] and ongoing litigation over AFFF contamination[14] call the Navy's continued use of AFFF into question.

Recent EPA regulations reflect an awareness of the harmful effects of PFAS on human health.[15] Literature on AFFF has largely focused on land-based use, rather than the continued use of AFFF on ships.[16] This is understandable, as PFAS in groundwater can contaminate drinking water, directly impacting local communities.[17] In contrast, AFFF that is released at sea mainly impacts the immediate health of U.S. Navy sailors as opposed to the public at large.

However, PFAS contamination in the ocean is a growing concern. There is mounting evidence that PFAS in the ocean negatively impact marine ecosystems.[18] Many sources contribute to PFAS contamination in the ocean, not just AFFF.[19] The Navy's intentional discharge of AFFF into the ocean is notable because it undermines the DoD's role in environmental stewardship and past acknowledgement of climate change as a national security imperative.[20] Recent

13. *See* EPA, NO. EPA-800-K-24-002, EPA'S PFAS STRATEGIC ROADMAP: THREE YEARS OF PROGRESS 3, 5, 7, 11, 15 (2024), https://www.epa.gov/system/files/documents/2024-11/epas-pfas-strategic-roadmap-2024_508.pdf.

14. Docket, In re Aqueous Film-Forming Foams Prods. Liab. Litig., 357 F. Supp. 3d 1391 (J.P.M.L. 2018) (No. 2873).

15. *See Our Current Understanding of the Human Health and Environmental Risks of PFAS*, EPA, https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas (last updated Nov. 26, 2024).

16. Literature on AFFF has focused on land-based use at airports and military installations, but the environmental and liability implications of AFFF use on ships has not received closer study. *See generally, e.g.*, Emery G. Green, *PFAS, Planes, and Problems: PFAS Regulation in the Aerospace and Aviation Industries Comments*, 76 OKLA. L. REV. 441 (2023) (arguing that the Federal Aviation Administration and the DoD should ban AFFF that contains PFAS and authorize an effective alternative to be used at airports and spaceports); Alexandra Dunn & Jessica Ferrell, *Firefighting and Forever Chemicals: The Environmental Impact of PFAS in Firefighting Foam Fire and Water*, 37 NAT. RES. & ENV'T 34 (2022) (arguing that the legal, scientific, and policy communities must work together to develop and implement strategies to respond to the widespread environmental and health impacts of AFFF, but focusing only on land-based uses).

17. Mohammad Sadia et al., *Forever Legacies? Profiling Historical PFAS Contamination and Current Influence on Groundwater Used for Drinking Water*, 890 SCI. TOTAL ENV'T, Sept. 2023, at 2.

18. *See* Bo Sha et al., *Constraining Global Transport of Perfluoroalkyl Acids on Sea Spray Aerosol Using Field Measurements*, 10 SCI. ADVANCES, Apr. 2024, at 1 (showing that PFAS is transported globally between the ocean and atmosphere); Xuerong Li et al., *Assessment of Per- and Polyfluouroalkyl Substances in Biscayne Bay Surface Waters and Tap Waters from South Florida*, 806 SCI. TOTAL ENV'T, Feb. 2022, at 1, 2, 8 (examining how PFAS enters the ocean and the effects they have on marine life); Ali Mahmoudnia, *The Role of PFAS in Unsettling Ocean Carbon Sequestration*, 195 ENVT'L MONITORING & ASSESSMENT, Jan. 2023, at 1 (outlining the impacts that PFAS could have on worsening climate change because they inhibit the marine biological pump that aids in carbon sequestration).

19. Natalia Soares Quinete & Olutobi Daniel Ogunbiyi, *PFAS 'Forever Chemicals' are Getting into Ocean Ecosystems, Where Dolphins, Fish and Manatees Dine – We Traced Their Origins*, THE CONVERSATION (Nov. 14, 2023), http://theconversation.com/pfas-forever-chemicals-are-getting-into-ocean-ecosystems-where-dolphins-fish-and-manatees-dine-we-traced-their-origins-216254.

20. *See, e.g.*, *Tackling the Climate Crisis*, U.S. DEP'T OF DEF., https://www.defense.gov/spotlights/tackling-the-climate-crisis (last visited Nov. 15, 2024). Current Secretary of Defense Pete Hegseth has directed the DoD to remove all mention of climate change from its websites, and it is no longer listed as a national security threat. C. Todd Lopez, *This Week: Defense Department Sharpens*

scholarship has studied the DoD's push to combat climate change through the lens of improving sustainable energy use.[21] While the DoD has been a leader in pushing for clean energy, it needs to proactively address the impact its polluting actions have on the environment and its corresponding contributions to climate change.

This Note explores the Navy's use of AFFF on ships and offers recommendations for phasing out AFFF. Part I provides a brief history of PFAS and discusses their effects on the environment and human health. It then discusses the development of AFFF, why it is especially harmful to the environment, and its impact on the ocean. This sets the stage for a discussion in Part II regarding federal regulations of PFAS that affect the DoD, the ongoing multi-district litigation *In re Aqueous Film-Forming Foams Products Liability Litigation*, and replacement of AFFF on land with PFAS-free foams. Part III examines shipboard AFFF use by the Navy and presents arguments for and against AFFF use on ships. These arguments inform a conversation on practical options available to the Navy going forward. This Note concludes by recommending that the Navy critically consider AFFF alternatives and ways to make AFFF use safer.

I. FROM MIRACLE CHEMICAL TO FOREVER CHEMICAL

PFAS are a family of thousands of manufactured chemicals.[22] They have a variety of useful properties, including the ability to repel oil and water, resist high temperatures, and lower the surface tension of liquids (surfactant properties).[23] These properties led to widespread use of PFAS in consumer products.[24] However, despite growing recognition since the late 1990s about the human health impacts of PFAS, the regulatory response has been slow.[25]

Standards, Flushes Climate Change Policies, Restarts Support of Ukraine, U.S. DEP'T OF DEF. (Mar. 14, 2025), https://www.defense.gov/News/News-Stories/Article/Article/4121054/this-week-defense-department-sharpens-standards-flushes-climate-change-policies.

21. Sarah Light has coined the term "military-environmental complex" to describe the impact of military environmental initiatives in the renewable energy industry. *See generally* Sarah E. Light, *The Military-Environmental Complex*, 55 B.C. L. REV. 879 (2014); Sarah E. Light, *The Military-Environmental Complex and the Courts*, 32 J. LAND USE & ENVT'L L. 455 (2016); Sarah E. Light, *Valuing National Security: Climate Change, the Military, and Society*, 61 UCLA L. REV. 1772 (2014).

22. INTERSTATE TECH. & REGUL. COUNCIL, HISTORY AND USE OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) FOUND IN THE ENVIRONMENT 1 (2020), https://pfas-1.itrcweb.org/wp-content/uploads/2020/10/history_and_use_508_2020Aug_Final.pdf.

23. Juliane Glüge et al., *An Overview of the Uses of Per- and Polyfluoroalkyl Substances (PFAS)*, 22 ENVT'L SCI. PROCESSES & IMPACTS 2345, 2346 (2020).

24. Sara Samora, *The History of PFAS: From World War II to Your Teflon Pan*, MFG. DIVE (Dec. 6, 2023), https://www.manufacturingdive.com/news/the-history-behind-forever-chemicals-pfas-3m-dupont-pfte-pfoa-pfos/698254.

25. JAMES B. POLLACK ET AL., PFAS DESKBOOK xiv (2023).

A. The History of PFAS and AFFF

PFAS are manmade chemicals created by bonding carbon and fluorine, first discovered as a laboratory accident in 1934.[26] In 1938, scientists for E.I. du Pont de Nemours & Co. (DuPont) created polytetrafluoroethylene (PTFE), later trademarked by DuPont as Teflon.[27] Teflon's first major application was in the Manhattan Project during World War II; it enabled scientists to safely store uranium in their quest to build the atom bomb.[28] After World War II, the Minnesota Mining and Manufacturing Company (now 3M) hired Manhattan Project chemists to research and develop a PFAS that was less reactive than PTFE.[29] The commercial value of PFAS was not discovered until 1953 when a 3M researcher accidentally spilled a PFAS sample onto her shoe and it resisted all her attempts to clean it off.[30] This accident eventually led to the sale of Scotchgard in 1955, the first oil and water repellant for textiles that utilized PFAS.[31]

Since 1955, thousands of PFAS have been developed and can be put into two broad categories—long-chain and short-chain—based on the length of the carbon backbone of each PFAS molecule.[32] PFAS were lauded as a "miracle chemical" for their ability to resist oil, water, and heat.[33] Businesses capitalized on these PFAS properties, making them pervasive in consumer products.[34] Accordingly, anything that repels water, oil, or resists high heat likely contains PFAS, including rugs, waterproof apparel, dental floss, food packaging, cosmetics, and cleaning products.[35]

Not only does PFAS have many consumer applications, but 3M's PFAS research had a major impact on the Navy and its ability to combat aviation fuel fires.[36] In 1962, the Naval Research Laboratory and 3M began working together to develop a foam that was effective in putting out jet fuel fires.[37] Aviation mishaps like plane crashes can result in severe fires due to large quantities of

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26. Samora, *supra* note 24.
27. *Id.*
28. NEIL MACKAY, A CHEMICAL HISTORY OF 3M 1933-1990 4 (1991).
29. Samora, *supra* note 24.
30. MACKAY, *supra* note 28, at 69-70.
31. *Id.* at 91-92.
32. Wendee Nicole, *Breaking It Down: Estimating Short-Chain PFAS Half-Lives in a Human Population*, 128 ENVT'L HEALTH PERSPS., no. 11, Nov. 2020, at 114002-1. Any perfluoroalkyl sulfonic acids with six or more carbon atoms or perfluoroalkyl carboxylic acids with seven or more carbon atoms are considered "long-chain."
33. Saul Elbein, *How to Protect Yourself from 'Forever Chemicals*,*'* THE HILL (Mar. 14, 2024), https://thehill.com/policy/energy-environment/4532556-how-to-protect-yourself-from-forever-chemicals.
34. *Id.*
35. *PFAS 101: Everything You Need to Know About Toxic 'Forever Chemicals'*, WASTEBITS BLOG (Apr. 21, 2023), https://blog.wastebits.com/pfas-forever-chemicals-101.
36. MACKAY, *supra* note 28, at 157-61.
37. *Id.* at 158.

spilled jet fuel.[38] Fuel-based fires are difficult to combat because they cannot be extinguished with water.[39] In the Navy, munitions loaded onto planes amplifies the risk of fuel-based fire as demonstrated in the 1967 United States Ship (USS) *Forrestal* disaster.[40] While operating off the coast of Vietnam, an electrical malfunction caused a rocket to misfire from a jet into an external fuel tank of another plane, leading to a jet fuel spill across the flight deck of *Forrestal* that caught on fire.[41] This fire resulted in the second-largest loss of life on a Navy ship since World War II.[42] Soon after the *Forrestal* disaster, the Navy began deploying AFFF on all of its aircraft carriers.[43]

AFFF differed from other firefighting products at the time because it prevented the reignition of fuel-based fires.[44] Researchers found that adding PFAS to firefighting foam produces a film that spreads across the surface of fuel and forms a vapor barrier between the fuel and atmospheric oxygen.[45] This film depletes the oxygen supply that fire needs to burn and extinguishes the fire.[46] The barrier also prevents reignition of any flammable liquid.[47] By the late 1970s, the DoD required that all military bases utilize AFFF for Class B fires.[48] AFFF has also been used to fight Class B fires at almost all civilian fire departments in the United States and across the globe,[49] as well as at airports and other places that use high-hazard flammable liquids.[50]

Today, AFFF can be broken into two broad categories: legacy AFFF that contains long-chain PFAS and modern fluorotelomer AFFF that contains short-chain PFAS.[51] By 2016, all production of legacy AFFF was banned in the United

38. *About the Fire Safety Branch*, FED. AVIATION ADMIN., https://www.fire.tc.faa.gov/About (last visited Nov. 2, 2024).

39. *What Is a Class B Fire?*, HAZARD CONTROL TECHS. (Oct. 31, 2023), https://hct-world.com/what-is-a-class-b-fire. Water can cause the flammable liquid that is fueling the fire to spread, which makes the fire proliferate instead of putting it out.

40. *See* Samuel J. Cox, *H-008-6: USS Forrestal Disaster, 29 July 1967*, NAVAL HIST. & HERITAGE COMMAND, U.S. DEP'T OF THE NAVY, (May 6, 2019), https://www.history.navy.mil/about-us/leadership/director/directors-corner/h-grams/h-gram-008/h-008-6.html.

41. *Id.*

42. *Id.* The USS *Forrestal* disaster killed 134 sailors and injured 161.

43. MACKAY, *supra* note 28, at 160.

44. *Id.*

45. INTERSTATE TECH. & REGUL. COUNCIL, *supra* note 9, at 2.

46. *Id.*

47. *Id.*

48. Class B fires are fueled by flammable liquids like oil, gas, and alcohol. They are best extinguished by smothering the fire to keep the flammable liquid from reacting with oxygen and continuing to fuel the fire. *What is a Class B Fire?*, *supra* note 39.

49. DEYOUNG ET AL., *supra* note 7, at 37.

50. INTERSTATE TECH. & REGUL. COUNCIL, *supra* note 9, at 2.

51. *Id.* The legacy AFFF can be broken further into two categories: (1) AFFF that contains perfluorooctane sulfonate (PFOS) and (2) AFFF that contains all other types of "long-chain" PFAS. The EPA banned the production of AFFF that contains PFOS in 2002. This led to the creation of AFFF that contains other kinds of long-chain PFAS. *Id.*

States due to a growing awareness of the health effects of long-chain PFAS.[52] While the use of legacy AFFF is not prohibited, the production ban has nevertheless driven the predominant use of the modern fluorotelomer AFFF in the United States instead of legacy AFFF.[53] However, there may still be health and environmental impacts related to the use of modern fluorotelomer AFFF.

B. Health Concerns and the Environment

The shift away from legacy AFFF occurred in response to evidence of the harmful effects of long-chain PFAS, like PFOA and PFOS.[54] However, there is a growing body of evidence that short-chain PFAS are also harmful.[55] PFAS of any chain length can enter the human body through water, air, food, and skin exposure.[56] AFFF presents a particular concern because it contains significant amounts of PFAS and is released in high volume when used in firefighting training or combating fires.[57] This directly affects the health of firefighters and servicemembers who are exposed to AFFF.[58] For instance, a study of active-duty Air Force servicemembers with exposure to AFFF, either from firefighting duties or service at a base with high PFAS concentration in drinking water, showed that the airmen had elevated concentrations of PFAS in their systems.[59]

Not only are firefighters and servicemembers exposed to PFAS contamination from AFFF, but nearby communities can also be exposed to PFAS from AFFF through water contamination.[60] PFAS travels easily in water, meaning that water is one of the most widespread means of PFAS exposure for humans.[61] For reference, a study by the U.S. Geological Survey (USGS) found

52. *Id.* The rising tide of public opinion and litigation against PFAS manufacturers led to voluntary phaseouts of PFOA and PFOS through a project called the 2010/2015 PFOA Stewardship Program. *Fact Sheet: 2010/2015 PFOA Stewardship Program*, EPA, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/fact-sheet-20102015-pfoa-stewardship-program (last updated Mar. 6, 2025).

53. INTERSTATE TECH. & REGUL. COUNCIL, *supra* note 9, at 2.

54. *See* Dunn & Ferrell, *supra* note 16, at 35.

55. *See* DANISH MINISTRY OF THE ENV'T, SHORT-CHAIN POLYFLUOROALKYL SUBSTANCES (PFAS) 29-44 (2015), https://www2.mst.dk/Udgiv/publications/2015/05/978-87-93352-15-5.pdf; Fan Li et al., *Short-Chain Per- and Polyfluoroalkyl Substances in Aquatic Systems: Occurrence, Impacts and Treatment*, 380 CHEM. ENG'G J., Jan. 2020, at 1; Nicole, *supra* note 32, at 114002-2.

56. *Our Current Understanding of the Human Health and Environmental Risks of PFAS*, *supra* note 15.

57. Todd B. Bane, *Foam Fundamentals*, FIREHOUSE (Apr. 1, 2019), https://www.firehouse.com/operations-training/extinguishers/article/21070393/foam-fundamentals. In general, a minimum of ninety gallons of AFFF concentrate should be applied to a two thousand square foot fire over the course of fifteen minutes.

58. Paul E. Rosenfeld et al., *Perfluoroalkyl Substances Exposure in Firefighters: Sources and Implications*, 220 ENVT'L RSCH., Mar. 2023, at 4-5; Mark P. Purdue et al., *A Nested Case–Control Study of Serum Per- and Polyfluoroalkyl Substances and Testicular Germ Cell Tumors among U.S. Air Force Servicemen*, 131 ENVT'L HEALTH PERSPS., no. 7, July 2023, at 077007-1.

59. Purdue et al., *supra* note 58, at 077007-1.

60. Jussi Reinikainen et al., *The Occurrence, Distribution, and Risks of PFAS at AFFF-Impacted Sites in Finland*, 829 SCI. TOTAL ENV'T, July 2022, at 12-13.

61. POLLACK ET AL., *supra* note 25, at xiv.

that at least 45 percent of tap water in the United States contains PFAS.[62] After being deployed to fight a fire, AFFF soaks into the ground and contaminates the soil and groundwater.[63] PFAS testing has revealed elevated concentrations of PFOA and PFOS in surface water, soil, groundwater, and drinking water in locations where AFFF is frequently used, including domestic airports, oil and gas sites, and military bases.[64] Though the DoD phase out of AFFF at installations may help reduce future PFAS levels in groundwater around installations, the Navy is still introducing PFAS into the ocean through shipboard AFFF use.

1. The Regrettable Substitution Problem

Once considered "miracle chemicals," PFAS are now more commonly referred to as "forever chemicals."[65] There is no natural way for PFAS to break down once released into the environment, and their effects therefore persist long after their introduction.[66] The health effects of long-chain PFAS like PFOA and PFOS have been the most studied.[67] Exposure to PFOA and PFOS can cause increased risk of prostate, kidney, and testicular cancers, decreased fertility, weakened immune systems, hormonal changes, and increased cholesterol.[68] PFOA and PFOS can also be transmitted to fetuses through the placenta and to children through breastmilk.[69] Exposure is linked to a range of developmental delays including low birth weight, accelerated puberty, and skeletal changes.[70] In 2023, the International Agency for Research on Cancer classified PFOA as carcinogenic to humans and PFOS as possibly carcinogenic to humans.[71]

62. Kelly L. Smalling et al., *Per- and Polyfluoroalkyl Substances (PFAS) in United States Tapwater: Comparison of Underserved Private-Well and Public-Supply Exposures and Associated Health Implications*, 178 ENV'T. INT., Aug. 2023, at 9.

63. Dunn & Ferrell, *supra* note 16, at 34.

64. Ian T. Cousins et al., *The Precautionary Principle and Chemicals Management: The Example of Perfluoroalkyl Acids in Groundwater*, 94 ENV'T. INT'L 331, 331 (2016).

65. Stephanie Ebbs, *EPA Announces Limits on Some 'Forever Chemicals,' but Just a Fraction are Covered*, ABC NEWS (Mar. 14, 2023), https://abcnews.go.com/Health/epa-announces-limit-forever-chemicals-drinking-water/story?id=97853947.

66. *'Forever Chemicals' are Flowing Between the Arctic and Atlantic Oceans, Study Finds*, RHODY TODAY (Jan. 10, 2024), https://www.uri.edu/news/2024/01/forever-chemicals-are-flowing-between-the-arctic-and-atlantic-oceans-study-finds.

67. *See, e.g.*, Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 89 Fed. Reg. 39124 (May 8, 2024) (to be codified at 40 C.F.R. pt. 302). The estimated half-life of PFOA is three years, while PFOS has a half-life of four to five years in humans. *Id.* at 39144.

68. *Our Current Understanding of the Human Health and Environmental Risks of PFAS*, *supra* note 15.

69. *Id.*

70. *Id.*

71. Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 89 Fed. Reg. at 39125.

As a response to the documented health effects of PFOA and PFOS, manufacturers began to use short-chain PFAS instead.[72] The declining use of PFOA and PFOS has been correlated with a reduction in the amounts of those chemicals in blood levels in the United States.[73] However, there is growing evidence that short-chain PFAS also have negative health impacts.[74] Animal experiments show that acute toxicity of short-chain PFAS is low but that repeated exposure to large doses may damage the liver and kidneys.[75] Short-chain PFAS have a shorter half-life than their long-chain counterparts, but they still take "many weeks" to be eliminated from the human body.[76] The longevity of PFAS combined with their mobility in the environment means that communities can experience exposure without realizing it.[77]

Adding to mounting concerns is evidence that short-chain PFAS are more likely to accumulate and remain in groundwater than legacy PFAS.[78] A 2020 study from the University of Auburn found that short-chain PFAS are more persistent and mobile in groundwater and soil and thus can "transport over a long range of distance and pose lasting environmental impacts."[79] Also, current methods for removing long-chain PFAS from the environment are not as effective on short-chain PFAS.[80] This means that short-chain PFAS are harder to remove from drinking water with current technology than legacy PFAS.[81] Until new technology is developed, short-chain PFAS will take longer and cost more to remove from the environment.[82] This has concerning implications for short-chain PFAS that enters the ocean.

2. PFAS in the Ocean

The presence of PFAS in runoff, rivers, and groundwater means that they are eventually introduced into the ocean.[83] PFAS largely enter the ocean through

72. DANISH MINISTRY OF THE ENV'T, *supra* note 55, at 18.

73. *Fast Facts: PFAS in the U.S. Population*, AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, (Nov. 12, 2024), https://www.atsdr.cdc.gov/pfas/data-research/facts-stats/index.html.

74. *See, e.g.*, Nicole, *supra* note 32, at 114002-2.

75. DANISH MINISTRY OF THE ENV'T, *supra* note 55, at 75. There is also evidence that PFAS take longer to leave the human system than some animals' systems, which can increase the impacts of exposure.

76. Nicole, *supra* note 32, at 114002-2. The report also notes that "many weeks" is faster than most studies can be started, which makes studying the health impacts of short-chain PFAS more difficult than legacy PFAS. *Id.* at 114002-1.

77. Smalling et al., *supra* note 62, at 2.

78. Li et al., *supra* note 55, at 16.

79. *Id.* at 3.

80. Cousins et al., *supra* note 64, at 333. Granular activated carbon (GAC) filters are the most cost effective and efficient means of removing PFOS and PFOA from drinking water. However, the effectiveness of GAC filters diminishes with decreasing perfluoroalkyl chain length, and some short-chain PFAS cannot be removed at all using GAC filters. *Id.*

81. *Id.*

82. Li et al., *supra* note 55, at 18-19.

83. *See Surface Runoff and the Water Cycle*, U.S. GEOLOGICAL SURV. (June 8, 2019), https://www.usgs.gov/special-topics/water-science-school/science/surface-runoff-and-water-cycle.

failed septic systems and wastewater leaks in urban areas, which leads to a high concentration of PFAS close to shore in the upper layer of the ocean.[84] Researchers estimate that about forty-nine tons of PFOA and twenty-six tons of PFOS are remobilized into the atmosphere each year through sea spray aerosols,[85] which are small seawater drops that are ejected from the ocean surface by wind or breaking waves.[86] Once in the atmosphere, the pollutants in sea spray can be deposited back onto land through precipitation, wind, or gravity. This cycle contributes to higher concentrations of PFAS in coastal air than inland air.[87] Studies show that humans can be exposed to PFAS through inhalation and dermal contact, but this exposure pathway is not as well studied as contamination from drinking water and food.[88]

Increased PFAS concentrations at the ocean surface have a major impact on the marine food chain, as about 90 percent of marine life is found the epipelagic zone, or the top layer of the ocean.[89] PFAS can bioaccumulate in marine life,[90] meaning the concentration of PFAS increases over time in marine organisms because the PFAS are absorbed faster than the organisms are able to break down and excrete them.[91] Studies have shown that PFAS can alter immune and liver functions in some fish.[92] Moreover, species at the top of the food chain, like marine mammals and humans, may have greater exposure to PFAS due to biomagnification.[93] Biomagnification refers to the increased concentration of absorbed chemicals in each organism up the food chain.[94] One study found that the biomagnification of PFAS may be more significant in marine life than terrestrial life.[95] Researchers posited that this was because aquatic food webs are

84. Quinete & Ogunbiyi, *supra* note 19.

85. Sha et al., *supra* note 18, at 4.

86. *Air-Surface Exchange Process Overview*, EPA, https://www.epa.gov/cmaq/air-surface-exchange-process-overview (last updated June 10, 2025).

87. Sha et al., *supra* note 18, at 1.

88. Nicole M. DeLuca et al., *Human Exposure Pathways to Poly- and Perfluoroalkyl Substances (PFAS) from Indoor Media: A Systematic Review*, 162 ENV'T INT'L, Apr. 2022, at 2.

89. *See Ocean Zones*, LET'S TALK SCI. (Sept. 16, 2024), https://letstalkscience.ca/educational-resources/backgrounders/ocean-zones.

90. Quinete & Ogunbiyi, *supra* note 19.

91. *See Rachel Carson*: *Bioaccumulation and Biomagnification*, AM. CHEM. SOC'Y, https://www.acs.org/education/whatischemistry/landmarks/rachel-carson-silent-spring/rachel-carson-poster.html (last visited Apr. 6, 2025).

92. *See* T. C. Guillette et al., *Elevated Levels of Per- and Polyfluoroalkyl Substances in Cape Fear River Striped Bass (Morone Saxatilis) are Associated with Biomarkers of Altered Immune and Liver Function*, 136 ENV'T INT'L, Mar. 2020, at 8. This study specifically looked at Cape Fear River Striped Bass. There may be species-specific differences in how PFAS affects fish species.

93. Quinete & Ogunbiyi, *supra* note 19.

94. *Rachel Carson*: *Bioaccumulation and Biomagnification*, *supra* note 91.

95. A study in Norway found that marine mammals that fed on aquatic food webs showed higher PFAS concentrations than terrestrial mammals. Dorte Herzke et al., *Targeted PFAS Analyses and Extractable Organofluorine – Enhancing Our Understanding of the Presence of Unknown PFAS in Norwegian Wildlife*, 171 ENV'T INT'L, Jan. 2023, at 5.

more complex and more heavily contaminated with PFAS than terrestrial food chains.[96]

The accumulation of PFAS at the ocean's surface may have implications far beyond the food chain and could potentially impact the ocean's carbon exchange cycle.[97] Studies show that PFAS can bioaccumulate in phytoplankton, which live in the epipelagic zone.[98] This impacts their growth and reproduction, as well as their ability to photosynthesize.[99] PFAS also inhibit reproduction and growth of zooplankton, which feed on phytoplankton.[100] Both of these organisms are crucial to the "biological carbon pump." [101] The biological carbon pump involves the photosynthesis of carbon dioxide by phytoplankton, which are consumed by zooplankton; the carbon is then sequestered to the deep ocean through zooplankton fecal matter.[102] A decrease in the ability to sequester carbon has the potential to increase global warming.[103] While the potential effects of PFAS on the biological carbon pump, and thus on climate change, are complex and require more study, any negative impact to the carbon exchange cycle raises concern.[104]

Though PFAS are most concentrated at coastlines and ocean surface, their mobility has made them widespread throughout the ocean. Ocean circulation routes transport PFAS, moving them into areas that are less populated by humans.[105] Scientists discovered that 123 tons of PFAS traveled into the Arctic Ocean from the Atlantic Ocean, and about 110 tons moved into the Atlantic Ocean from the Arctic Ocean over the course of one year.[106] PFAS have even been found at a depth of three thousand feet.[107] Given how widely they have

96. *Id.* The mammals in the study that fed on aquatic food webs included otters, minks, polar bears, and arctic foxes. The terrestrial mammals studied were wolves, deer, and moose.

97. Mahmoudnia, *supra* note 18, at 1.

98. *Id.* at 3.

99. *Id.*

100. *Id.* at 5.

101. *The Ocean's 'Biological Pump' Captures More Carbon than Expected*, WOODS HOLE OCEANOGRAPHIC INST. (Apr. 6, 2020), https://www.whoi.edu/press-room/news-release/the-oceans-biological-pump-captures-more-carbon-than-expected.

102. C.L. De La Rocha & U. Passow, *The Biological Pump*, *in* TREATISE ON GEOCHEMISTRY 94, 95-96 (2d ed. 2014). This process is significantly more complex than presented in this Note.

103. Mahmoudnia, *supra* note 18, at 2.

104. For more about the importance of the carbon cycle in reducing greenhouse gas, see Marta Fava, *How Does the Ocean Affect the Climate?*, INTERGOVERNMENTAL OCEANIC COMM'N, UNESCO (Jun. 7, 2022), https://oceanliteracy.unesco.org/ocean-and-climate; *The Ocean – the World's Greatest Ally Against Climate Change*, UNITED NATIONS, https://www.un.org/en/climatechange/science/climate-issues/ocean (last visited Nov. 22, 2024); *Carbon Cycle*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.noaa.gov/education/resource-collections/climate/carbon-cycle (last updated Aug. 28, 2025).

105. *'Forever Chemicals' are Flowing Between the Arctic and Atlantic Oceans, Study Finds*, *supra* note 66.

106. *Id.*

107. *Id.* The presence of PFAS at this depth surprised researchers because water at that depth has not been in contact with the atmosphere for decades. Accordingly, researchers expected the water to be

traveled through the oceans, it would be extremely difficult, if not impossible, to remove all PFAS from the ocean.

The impact of PFAS in the ocean is complex and wide-ranging; its effects range from the atmosphere to the food chain, global warming, and the deep sea. By using AFFF at sea, the Navy contributes to the growing problem of PFAS contamination in the ocean. Fortunately, the Navy has moved away from using AFFF with long-chain PFAS, but there are growing public safety concerns around their short-chain replacement.[108]

II. AFFF REGULATION AND LITIGATION

Current federal PFAS regulations do not ban the production or use of AFFF. However, rules promulgated by the EPA under the Biden administration impact the manufacture, disposal, and cleanup requirements involving AFFF.[109] Moreover, Congress has acted directly to limit the DoD's use of AFFF on land given its associated health and environmental concerns.[110] Though the Navy can still use AFFF at sea, the market for AFFF may be severely diminished due to decreasing demand and ongoing litigation. These factors may impact the Navy's access to AFFF. Thus, the EPA's regulation of PFAS, the prohibition of AFFF use on land, and the ongoing litigation of *In Re Aqueous Film-Forming Foams Products Liability Litigation* bring the future of AFFF in the United States into question.

A. EPA Regulation of PFAS

The EPA published final rules under the Safe Drinking Water Act (SDWA)[111] and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[112] in April 2024. While these regulations are notable

free of manmade industrial chemicals. The study posited that PFAS most likely attach themselves to settling particles.

108. *See* Nicole, *supra* note 32, at 114002-2.

109. *See* EPA'S PFAS STRATEGIC ROADMAP: THREE YEARS OF PROGRESS, *supra* note 13, at 15.

110. National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, § 323, 133 Stat. 1198 (2019).

111. PFAS National Primary Drinking Water Regulation, 89 Fed. Reg. 32532 (Apr. 26, 2024) (to be codified at 40 C.F.R. pts. 141, 142). PFAS regulations under SWDA are still in effect as of April 2025. In *American Water Works Association (AWWA), et. al. v. EPA*, No. 24-1188 (D.C. Cir. 2024), water industry groups argued that EPA failed to base PFAS MCLs on the best available science. On February 7, 2025, the court granted EPA a sixty-day stay to reassess the regulation. The court granted an additional thirty-day pause on April 10, 2025. Reza Zarghamee & Jillian Marullo, *Court Grants Additional 30-Day Pause in PFAS Drinking Water Rule Litigation*, PFAS OBSERVER, PILLSBURY (Apr. 10, 2025), https://pfas.pillsburylaw.com/court-30-day-pause-pfas-drinking-water-rule-litigation.

112. Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 89 Fed. Reg. 39124 (May 8, 2024) (to be codified at 40 C.F.R. pt. 302). This regulation is still in effect as of April 2025. In *Chamber of Commerce of the United States of America, et al v. EPA, et al.,* No. 24-1193 (D.C. Cir. 2024), industry petitioners argued that EPA exceeded its authority in listing PFOA and PFOS as hazardous substances under CERCLA. On February

because they are the first federally enforceable PFAS regulations, they are not the first PFAS regulations in the United States. Individual states have been more proactive about passing PFAS regulation than the federal government. State PFAS legislation has increased drastically, starting around 2018.[113] A total of twenty-three states enacted usage restrictions and bans on AFFF between 2019 and 2024.[114] In 2024 alone, thirty-six states considered over two hundred PFAS-related bills and at least seventeen of those states enacted more than forty bills related to PFAS.[115] This patchwork regulatory scheme presents issues for PFAS polluters, like the DoD, due to the lack of a unified framework for addressing PFAS pollution.[116]

The EPA's PFAS regulations under the SDWA and CERCLA are part of a larger framework of regulations meant to address the manufacture, use, and contamination of PFAS.[117] The previous EPA Administrator, Michael Regan, announced a PFAS Strategic Roadmap which laid out the EPA's approach to PFAS from 2021-2024.[118] The roadmap discussed a number of statutes that could be used to regulate PFAS, including the Clean Water Act,[119] Toxic Substances Control Act,[120] and Resource Conservation and Recovery Act.[121] The following provides a brief overview of EPA regulations issued under the Biden administration and discusses the extent to which they impact the DoD and its use of AFFF.

1. Safe Drinking Water Act

The SDWA was adopted in 1974 to provide clean public drinking water.[122] Under the SDWA, the EPA has the authority to set health-based standards for drinking water quality as part of the National Primary Drinking Water Regulations program.[123] Using this authority, the EPA can set a maximum

25, 2025 the court granted EPA a sixty-day stay to consider its position. *See* Zarghamee & Marullo, *supra* note 111.

113. *Per- and Polyfluoroalkyl Substances (PFAS), State Legislation and Federal Action*, NCSL https://www.ncsl.org/environment-and-natural-resources/per-and-polyfluoroalkyl-substances (last updated Jan. 9, 2025).

114. *Id.*

115. *Id.*

116. MAUREEN SULLIVAN, U.S. DEP'T OF DEF., NO. 4-0A57E2B, ADDRESSING PERFLUOROOCTANE SULFONATE (PFOS) AND PERFLUOROOCTANOIC ACID (PFOA) 13 (2018), https://www.denix.osd.mil/derp/denix-files/sites/26/2018/03/FY18-HASC-Brief-on-PFOS-PFOA_Mar2018.pdf.

117. *PFAS Strategic Roadmap: EPA's Commitments to Action 2021-2024*, EPA, https://www.epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024 (last updated June 11, 2025).

118. *Id.*

119. Clean Water Act, 33 U.S.C. §§ 1251-1387.

120. Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901-6992k.

121. *Id.*

122. Safe Drinking Water Act, 42 U.S.C. §§ 300f-300j-26.

123. *Id.* §§ 300f, 300g-1.

contaminant level (MCL) for a contaminant found in drinking water.[124] On April 10, 2024, the EPA announced the MCL for six types of PFAS: PFOA, PFOS, PFNA, HFPO-DA, PFHxS, and PFBS.[125] The rule also regulates PFAS mixtures that include PFNA, PFHxS, HFPO-DA, and PFBS.[126] Water utilities now must monitor water systems for these types of PFAS, alert customers when MCLs are exceeded, and work to reduce contamination levels below the MCLs.[127]

These drinking water regulations inform the amount of PFAS contamination that requires cleanup under CERCLA.[128] DoD officials repeatedly advocated for a federal MCL under the SDWA that would provide uniformity in cleanup measures.[129] In a report to Congress, the DoD stated that establishing a federal MCL "would help all entities faced with the challenge of addressing PFOS and PFOA in drinking water by providing clear, definitive, and consistent requirements on what actions to take and at what levels and would enable stakeholders to understand why those actions were taken."[130] Thus, with the final rule under the SDWA, the DoD now has a single uniform standard it can implement when conducting PFAS cleanup under CERLCA.

124. POLLACK ET AL., *supra* note 25, at 78. The National Primary Drinking Water Regulations program has two components: the maximum contaminant level goal (MCLG) and the MCL. The MCLG is an unenforceable public health goal, which establishes the maximum level of contaminant in drinking water that would have no adverse effect on human health. The MCL is an enforceable standard that is set as close to the MCLG as feasible. When setting an MCL, the EPA must consider health effects of the contaminant and frequency of exposure in public water systems, balanced with a consideration of cost, benefit, and technology available for water treatment.

125. PFAS National Primary Drinking Water Regulation, 89 Fed. Reg. 32532, 32532 (Apr. 26, 2024) (to be codified at 40 C.F.R. pts. 141, 142). The MCL for PFOA and PFOS is four parts per trillion. The MCL for PFNA, HFPO-DA, and PFHxS is ten ppt. PFOA, PFOS, and PFNA are all long-chain PFAS. PFHxS, HFPO-DA (also known as "GenX chemicals"), and PFBS are short-chain PFAS.

126. *Id.* at 32535, 32543. The EPA noted that it is deferring its decision to regulate PFBS individually but is regulating PFBS when it occurs in mixtures with PFHxS, PFNA, and HFPO-DA.

127. POLLACK ET AL., *supra* note 25, at 83.

128. 42 U.S.C. § 9621(d) (2012). The "degree of cleanup" under CERCLA is any "standard, requirement, criteria, or limitation" set by any federal environmental law, or any more stringent state environmental standard that is approved by the EPA. This is referred to as "applicable or relevant and appropriate requirements" (ARARs). The ARARs can be taken from the Toxic Substances Control Act, 15 U.S.C. § 2601 et seq.; the Safe Drinking Water Act, 42 U.S.C. § 300f et seq.; the Clean Air Act, 42 U.S.C. § 7401 et seq.; the Clean Water Act, 33 U.S.C. § 1251 et seq.; the Marine Protection, Research and Sanctuaries Act, 16 U.S.C. §§ 1431 et seq., 1447 et seq., 33 U.S.C. §§ 1401 et seq., 2801 et seq.; and the Solid Waste Disposal Act, 42 U.S.C. § 6901 et seq. Currently, the only enforceable federal ARAR for PFAS are the MCLs the EPA issued pursuant to the Safe Drinking Water Act.

129. *See* SULLIVAN, *supra* note 116, at 13; UNDER SEC'Y OF DEF. FOR ACQUISITION AND SUSTAINMENT, U.S. DEP'T OF DEF., NO. E-2063C3D, ALTERNATIVES TO AQUEOUS FILM FORMING FOAM REPORT TO CONGRESS 6, 7 (2018), https://www.denix.osd.mil/derp/denix-files/sites/26/2018/07/AFFF-Alt-Report-to-Congress_July2018-1.pdf.

130. UNDER SEC'Y OF DEF. FOR ACQUISITION AND SUSTAINMENT, U.S. DEP'T OF DEF., *supra* note 129, at 6.

2. Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA was enacted by Congress in 1980.[131] It established a tax on the chemical and petroleum industries to provide a fund for cleanup of hazardous waste sites (giving CERCLA the nickname "Superfund").[132] CERCLA also provides a means for state and federal agencies to begin site cleanup and hold "potentially responsible parties" accountable for contamination.[133] In addition to providing liability and compensation mechanisms, CERCLA institutes reporting requirements for hazardous substances released into the environment.[134] These liability and reporting provisions only apply to chemicals that have been designated as "hazardous substances."[135]

On May 8, 2024, the EPA published its final rule designating PFOA and PFOS as hazardous substances under CERCLA.[136] With this new designation, facilities must report any releases of over one pound of PFOA or PFOS over a twenty-four hour period to the National Response Center.[137] The EPA rule also mandated the cleanup of PFOA and PFOS contamination, [138] which falls into two response types: removal and remediation. Removals are short-term response actions to immediately address releases;[139] remedial actions are conducted over a longer time period and are designed to provide permanent solutions to mitigate long-term exposure risk.[140] The Secretary of Defense must remove hazardous substances from military facilities in accordance with CERCLA's liability and enforcement requirements.[141]

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131. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675.

132. *Superfund: CERCLA Overview*, EPA, https://www.epa.gov/superfund/superfund-cercla-overview (last updated Oct. 8, 2024).

133. POLLACK ET AL., *supra* note 25, at 95. Potentially responsible parties are owners or operators of contaminated sites who can be held financially responsible for cleanup.

134. 40 C.F.R. § 302.4 (2025).

135. *Id.* Most hazardous substances under CERCLA are defined under other statutes. There are about eight hundred CERCLA hazardous substances. *CERCLA Hazardous Substances Defined*, EPA, https://www.epa.gov/epcra/cercla-hazardous-substances-defined (last updated Jan. 14, 2025).

136. Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 89 Fed. Reg. 39124 (May 8, 2024) (to be codified at 40 C.F.R. pt. 302).

137. *Id.* at 39131. The National Response Center is an emergency call center staffed by the U.S. Coast Guard. It also maintains reports of all releases and spills in a national database. *National Response Center*, EPA, https://www.epa.gov/emergency-response/national-response-center (last updated Sept. 4, 2024).

138. Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 89 Fed. Reg. at 39126.

139. *Id.* at 39137.

140. *Id.*

141. 42 U.S.C. § 9620(a). Some differences exist for governmental polluters under CERCLA. For instance, cleanup is funded through appropriated funds administered by the responsible agency. Also, section 120(e)(1) of CERCLA only requires that federal agencies consult with the EPA. The EPA is not given decision-making authority to dictate how a federal agency performs clean up or the schedule for completing remedial actions. DAVID M. BEARDEN, CONG. RSCH. SERV., R41039, COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT: A SUMMARY OF SUPERFUND

The DoD began remediation and removal actions of PFOA and PFOS prior to their designation as hazardous substances under CERCLA.[142] In the 2019 National Defense Authorization Act, Congress gave the DoD notice that remediation plans for PFAS clean up could be required in the future.[143] Later, in the 2020 National Defense Authorization Act, Congress directed the DoD to submit remediation plans and funding requests for cleanup of all water at, or adjacent to, military installations contaminated with PFOA or PFOS.[144] The DoD thus submitted initial plans, and used seventy parts per trillion as the threshold amount of PFOS and PFOA contamination which would trigger immediate removal action.[145] However, following the EPA's 2024 SDWA and CERCLA PFAS rules, the threshold number for immediate removal action was changed to twelve ppt for PFOS and PFOA, which has significantly expanded the scope of the DoD's PFAS cleanup activity.[146] Notably, these final rules will not impact the Navy's use or cleanup of AFFF at sea, because the rule only applies to military bases on land. However, the designation of PFOA and PFOS as hazardous substances provides a cause of action for states and communities that have been impacted by AFFF contamination to advance CERCLA cleanup claims and receive compensation for PFAS cleanup.[147] While the 2024 PFAS rules under the SDWA and CERCLA have received significant attention, other statutes that can be used to regulate PFAS deserve consideration.

CLEANUP AUTHORITIES AND RELATED PROVISIONS OF THE ACT 28 (2012); *see generally* U.S. DEP'T OF DEF. ENV'T, SAFETY & OCCUPATIONAL HEALTH NETWORK & INFO. EXCH., COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT PROCESS (2022), https://www.denix.osd.mil/army-pfas/denix-files/sites/11/2022/03/Comprehensive-Environmental-Response-Compensation-and-Liability-Act-Process.pdf (providing an in-depth explanation of the DoD CERCLA process).

142. *PFAS Data: Cleanup of PFAS*, PFAS TASK FORCE, U.S. DEP'T OF DEF., https://www.acq.osd.mil/eie/eer/ecc/pfas/data/cleanup-pfas.html (last visited Sept. 20, 2024).

143. John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, § 315, 132 Stat. 1636, 1713 (2018).

144. National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, § 345, 133 Stat. 1198 (2019). Section 332 also required the DoD to enter into cooperative agreements with states at their request to address cleanup of PFAS contamination originating from DoD activity. *Id.* § 332.

145. ASSIST. SEC'Y OF DEF. FOR ENERGY, INSTALLATIONS, AND ENV'T, U.S. DEP'T OF DEF., MEMORANDUM ON PRIORITIZATION OF DEPARTMENT OF DEFENSE CLEANUP ACTIONS TO IMPLEMENT THE FEDERAL DRINKING WATER STANDARDS FOR PER- AND POLYFLUOROALKYL SUBSTANCES UNDER THE DEFENSE ENVIRONMENTAL RESTORATION PROGRAM 2 (2024), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/policies/epa-mcl-implementation-memo.pdf.

146. *Id.* at 2-3. The SDWA MCL is four ppt for PFOA and PFOS. DoD removal action is focused on areas where PFAS concentrations are three times the MCL values. The DoD anticipates that many private drinking wells will require interim removal actions to reduce PFAS levels to expedite compliance.

147. 42 U.S.C. §§ 9607, 9659. A caveat to this is that CERCLA section 113(h) bars federal courts from reviewing any challenges to removal or remedial cleanups that are already ongoing. However, as discussed in *Giovanni v. United States Department of the Navy*, section 113(h) does not preclude claims for costs of private party medical monitoring, though it does bar health assessment or health effects studies. 906 F.3d 94, 109-111 (3d Cir. 2018). CERCLA section 113(h) also does not bar state tort claims.

3. Clean Water Act

While the SDWA focuses on drinking water contamination, the Clean Water Act (CWA) was enacted in 1972 to regulate discharges of pollutants into the waters of the United States.[148] The EPA and states regulate military PFAS discharges into water under the CWA through the National Pollutant Discharge Elimination System (NPDES) permitting program.[149] NPDES permits incorporate technology-based and water-quality-based requirements to limit or prohibit discharges of pollutants from military installations.[150] On January 21, 2025, the Trump administration withdrew the Biden administration's proposed rule to set NPDES effluent limitations for PFAS manufacturers.[151] This means that states will continue to be responsible for determining effluent limits for PFAS discharges.[152] In 2022, the EPA issued guidance to states on how to include PFAS in NPDES permits.[153] Military bases were identified as potential PFAS sources that required permits.[154] The EPA guidance recommends that states set effluent limits for PFAS discharges on military bases based on "best

148. 33 U.S.C. §1251. Waters of the United States under the CWA includes, but is not isolated to, navigable waters and territorial seas. The EPA updated its definition of "waters of the United States" in accordance with the Supreme Court's 2023 decision in *Sackett v. Environmental Protection Agency*. *See generally Current Implementation of Waters of the United States*, EPA, https://www.epa.gov/wotus/current-implementation-waters-united-states (last updated Jan. 17, 2025).

149. POLLACK ET AL., *supra* note 25, at 32. The CWA is more complex than this, but a more thorough description is beyond the scope of this Note. Two other ways that the EPA can address PFAS are through effluent limitation guidelines and water quality criteria. Effluent limitation guidelines do not impact the DoD as the DoD does not fall under one of the fifty-nine industries that require effluent limitation guidelines. On October 7, 2024, the EPA also announced ambient water quality criteria and benchmarks for PFOA and PFOS. *See* Final Recommended Aquatic Life Criteria and Benchmarks for Select PFAS, 89 Fed. Reg. 81077 (2024). These are non-enforceable guidelines that can be used by the EPA, state, and tribal governments to set enforceable water quality standards, or discharge limits when issuing NPDES permits. POLLACK ET AL., *supra* note 25, at 36.

150. LAURA GATZ, CONG. RSCH. SERV., IF12148, REGULATING PFAS UNDER THE CLEAN WATER ACT 1 (Jan. 15, 2025).

151. *OIRA Conclusion of EO 12866 Regulatory Review*, OFF. OF INFO. & REG. AFF., OFF. OF MGMT. AND BUDGET, https://www.reginfo.gov/public/do/eoDetails?rrid=571911 (last visited Apr. 12, 2025).

152. *Issues of the Environment: Trump Administration*'s *Lowered PFAS Standards Pose Risk to Huron River*, WEMU (Feb. 26, 2025), https://www.wemu.org/show/issues-of-the-environment/2025-02-26/issues-of-the-environment-trump-administrations-lowered-pfas-standards-pose-risk-to-huron-river.

153. *See* RADHIKA FOX, ASSIST. ADM'R, EPA, MEMORANDUM ON ADDRESSING PFAS DISCHARGES IN NPDES PERMITS AND THROUGH THE PRETREATMENT PROGRAM AND MONITORING PROGRAMS 1-2 (2022), https://www.epa.gov/system/files/documents/2022-12/NPDES_PFAS_State%20Memo_December_2022.pdf.

154. *Id.* at 2.

professional judgment."[155] The guidance also sets out best management practices to address AFFF that is discharged and later ends up in stormwater runoff.[156]

NPDES permits do not curtail the Navy's use of AFFF at sea because Section 312(n) of the CWA explicitly prohibits states from regulating certain discharges, including AFFF, at sea by military vessels.[157] AFFF released by ships at sea are instead regulated by the Uniform National Discharge Standards for Vessels of the Armed Forces (UNDS).[158] These rules are promulgated jointly by the EPA and DoD pursuant to the CWA.[159] Under UNDS, Navy vessels cannot discharge AFFF within twelve miles of shore unless it is deployed to combat a fire.[160] Thus, AFFF releases at sea are subject to regulation under the CWA through UNDS, but cannot be further regulated by states.

4. Other Final and Proposed Regulations

The EPA can also regulate PFAS under two additional statutes, the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA).[161] TSCA regulates chemicals to protect public health and the environment.[162] The EPA added PFAS to the list of Chemicals of Special Concern under TSCA, which imposes stricter reporting requirements on chemicals that contain PFAS.[163] The EPA also published a final rule in October 2023 that requires manufacturers, including importers, of PFAS and PFAS-

155. *Id.* at 3. Most effluent guidelines are set on an industry-by-industry basis. However, for industries that are not specifically regulated by effluent guidelines, like the military, the permit writer must utilize "best professional judgment" to establish technology-based limits or other means to control discharge. Best professional judgment is a context-based standard and gives the states some leeway in determining effluent amounts. *Learn about Effluent Guidelines*, EPA, https://www.epa.gov/eg/learn-about-effluent-guidelines (last updated July 25, 2025).

156. FOX, *supra* note 153, at 3. These are known as "stormwater permits." The EPA recommended the following best management practices: prohibiting use of AFFF in non-firefighting contexts, eliminating PFOS- and PFOA-containing AFFF, and requiring cleanups in all areas where AFFF has been used to prevent discharge through storm sewer systems.

157. *See* 33 U.S.C. § 1322(n).

158. *See* 40 C.F.R. §§ 1700.1, 1700.4(a), 1700.14, 1700.24 (2020).

159. 33 U.S.C. § 1322.

160. OFF. OF THE UNDER SEC'Y OF DEF. FOR ACQUISITION & SUSTAINMENT, U.S. DEP'T OF DEF., DOD MANUAL 4715.06, VOL. 4, REGULATIONS ON VESSELS OWNED OR OPERATED BY THE DEPARTMENT OF DEFENSE: DISCHARGES INCIDENTAL TO NORMAL OPERATIONS 14 (2022), https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/471506_vol4.PDF?ver=DMfStgq-zR5KkebJmGWEIQ%3D%3D [hereinafter DOD MANUAL].

161. EPA, NO. EPA-100-K-21-002, PFAS STRATEGIC ROADMAP: EPA'S COMMITMENTS TO ACTION 2021-2024 20 (2021), https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf.

162. *See* 15 U.S.C. § 2601 (describing Congress's findings and policy in enacting TSCA).

163. Changes to Reporting Requirements for Per- and Polyfluoroalkyl Substances and to Supplier Notifications for Chemicals of Special Concern, 88 Fed. Reg. 74360, 74360-62 (2023) (to be codified at 40 C.F.R. pt. 372). Previously, the *de minimis* exception allowed facilities to disregard amounts of PFAS in chemical mixtures that were below 1 percent of the entire solution. This exception no longer applies to products that contain PFAS. JAMES POLLACK ET AL., PFAS DESKBOOK RELEASE UPDATE 2 (2024), https://www.eli.org/sites/default/files/files-pdf/PFAS%20Update%20May%202024.pdf.

containing products to report information to the EPA on PFAS use, production, disposal, exposure, and hazard.[164] This rule applies to any PFAS-containing product that the DoD purchases from importers or manufacturers in the United States.[165]

The DoD could also be affected by two proposed regulations under the Resource Conservation and Recovery Act (RCRA), which are currently pending final action.[166] RCRA allows the EPA to regulate hazardous waste from its creation to its disposal.[167] Notably, RCRA contains two definitions of "hazardous waste" that are distinct from CERCLA hazardous substances. One is a broader statutory definition provided by Congress,[168] and the other is a narrower regulatory definition promulgated by the EPA.[169] The EPA proposed the addition of nine PFAS compounds to its list of "hazardous constituents."[170] If this rule is finalized, it would start the process to list these substances as a hazardous waste under RCRA's narrower regulatory definition.[171]

Once listed as a hazardous waste, states could regulate the handling, storage, and disposal of PFAS on military bases through RCRA permits,[172] and direct the cleanup of PFAS through the RCRA Corrective Action Program. [173] Some states have argued that they already have the authority to regulate PFAS on military bases under RCRA because PFAS falls within the broader statutory

164. *Key EPA Actions to Address PFAS*, EPA, https://www.epa.gov/pfas/key-epa-actions-address-pfas (last updated July 29, 2025); *see generally* Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Data Reporting and Recordkeeping Under the Toxic Substances Control Act (TSCA), 89 Fed. Reg. 72336 (2024) (to be codified at 40 C.F.R. pt. 705).

165. Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Data Reporting and Recordkeeping Under the Toxic Substances Control Act (TSCA), 89 Fed. Reg. at 72336. This rule applies to manufacturers and importers.

166. Michal I. Freedhoff, et al., *EPA's PFAS Rulemaking Trajectory: Key Updates Across CERCLA, TSCA, RCRA, SDWA and CWA*, HOLLAND & KNIGHT (Oct. 7, 2025), https://www.hklaw.com/en/insights/publications/2025/10/epas-pfas-rulemaking-trajectory-key-updates.

167. *Resource Conservation and Recovery Act (RCRA) Overview*, EPA, https://www.epa.gov/rcra/resource-conservation-and-recovery-act-rcra-overview (last updated Sept. 5, 2025).

168. 42 U.S.C. § 6903.

169. 40 C.F.R. § 260.10 (2023).

170. Listing of Specific PFAS as Hazardous Constituents, 89 Fed. Reg. 8606, 8609 (Feb. 8, 2024) (to be codified at 40 C.F.R. pts. 261, 271).

171. *Id.* at 8608.

172. Pat Rizzuto, *New Mexico Can't Order PFAS Cleanups For Now, Air Force Says*, BL (Oct. 28, 2024), https://www.bloomberglaw.com/product/blaw/bloomberglawnews/environment-and-energy/BNA%2000000192-d523-d584-a392-dffb87a50001.

173. RCRA cleanup occurs through the Corrective Action Program. This program requires that facilities that treat, store, or dispose of hazardous waste investigate and clean up hazardous releases into soil, ground water, surface water, and air. Unlike CERCLA, there is not a rigid regulatory framework for corrective action under RCRA. Most of the corrective action is implemented through RCRA permits, which include provisions for remedial measures and financial assurance to cover the cost of implementing cleanup measures. Forty-four states and territories are authorized by the EPA to run their own Corrective Action Program. *See Learn about Hazardous Waste Cleanups*, EPA, https://www.epa.gov/hw/learn-about-hazardous-waste-cleanups (last updated Jan. 9, 2025).

definition of hazardous waste.[174] This interpretation is contested.[175] However, the EPA's second proposed rule under RCRA would resolve this debate by explicitly applying the broader statutory definition of hazardous waste to substances that require investigation and cleanup under RCRA.[176] If this rule is finalized, it would allow states to regulate all PFAS under RCRA without waiting for the EPA to go through the long regulatory process of individually listing the hundreds of PFAS chemicals as hazardous wastes.[177]

Overall, the regulatory actions taken pursuant to the EPA's PFAS Strategic Roadmap from 2021 to 2024 represent a pivotal shift in the federal government's approach to PFAS. However, the future of federal PFAS regulation remains uncertain under the Trump administration. While the removal of the existing federal PFAS regulations would be a setback for human health and the environment, state regulation and ongoing litigation will continue to have an impact on PFAS and AFFF manufacturing and use.

B. In Re Aqueous Film-Forming Foams Products Liability Litigation

In Re Aqueous Film-Forming Foams Products Liability Litigation (AFFF MDL) is an ongoing multidistrict litigation involving contamination from AFFF products.[178] Multidistrict litigation (MDL) is a federal legal procedure that consolidates civil actions with common questions of fact into a single district court for pretrial proceedings.[179] The AFFF MDL was consolidated on December 7, 2018 so the claims could be heard together.[180] Common claims in the AFFF MDL include personal injury, a need for medical monitoring, property damage, and other economic losses stemming from PFAS contamination.[181] Most of the

174. Pat Rizzuto, *State Power Over PFAS Waste Cleanups Unclear as US Weighs Rules*, BL (Oct. 30, 2024), https://news.bloomberglaw.com/environment-and-energy/state-power-over-pfas-waste-cleanups-unclear-as-us-weighs-rules-1.

175. *Id.*

176. *See* Definition of Hazardous Waste Applicable to Corrective Action for Releases From Solid Waste Management Units, 89 Fed. Reg. 8598, 8600 (Feb. 8, 2024) (to be codified at 40 C.F.R. pts. 260, 261, 270). This proposed rule would apply the broader statutory definition of hazardous waste found in RCRA section 1004(5) to permitted facilities under the Corrective Action program, instead of the narrower regulatory definition, which includes only specifically listed chemicals or chemicals with hazardous waste characteristics (ignitability, corrosivity, reactivity, and toxicity).

177. Rizzuto, *supra* note 174.

178. *Introduction: Aqueous Film-Forming Foams (AFFF) Products Liability Litigation MDL No. 2873*, U.S. DIST. CT., DIST. OF S.C., https://www.scd.uscourts.gov/mdl-2873/index.asp (last visited Feb. 22, 2025).

179. David L. Noll, *What Do MDL Leaders Do? Evidence from Leadership Appointment Orders*, 24 LEWIS & CLARK L. REV. 433, 437 (2020). This process was created by the Multidistrict District Litigation Act of 1968. District court judges overseeing MDLs can "rule on pretrial motions, manage discovery, appoint masters, hold settlement conferences, enter trial orders, and generally do everything that a district judge does during pretrial." *Id.*

180. *See* Transfer Order at 6, In re Aqueous Film-Forming Foams Prods. Liab. Litig., 357 F. Supp. 3d 1391 (J.P.M.L. 2018) (MDL No. 2:18-mn-2873-RMG).

181. *Introduction: Aqueous Film-Forming Foams (AFFF) Products Liability Litigation MDL No. 2873*, *supra* note 178.

claims have been brought against AFFF manufacturers, but the DoD is also listed as a defendant in several suits.[182]

On April 28, 2023, the Plaintiffs' Executive Committee[183] for the AFFF MDL selected Cannon Air Force Base to serve as the representative site for all claims against the federal government to determine its liability for damage caused by PFAS contamination from AFFF.[184] As a "bellwether" case, the suit against Cannon Air Force Base was selected as the first site to be the subject of litigation because it involves facts, claims, or defenses that are similar to those presented in the larger pool of related cases.[185] The outcome of bellwether cases impacts future litigation strategies in related cases, informs litigation risk analysis, and can initiate settlement negotiations.[186]

The plaintiffs in the Cannon Air Force Base representative case are the state of New Mexico and four dairy farms.[187] The dairy farm plaintiffs alleged that PFAS from the base bioaccumulated in their cows, which either died or had to be slaughtered as a result, and the dairy farms were subsequently shut down.[188] The farms filed claims against the DoD for failure to warn about PFAS contamination, as well as for negligence, trespass, and private nuisance.[189] Additionally, New Mexico sought to enforce state and federal hazardous waste laws.[190] New Mexico requested injunctive relief under the New Mexico Hazardous Waste Act and RCRA, alleging that AFFF was improperly disposed of and was not contained in accordance with RCRA at Cannon Air Force Base.[191] In February 2024, the United States responded with two motions to dismiss: one based on a defense under CERCLA[192] and the other under the Federal Tort Claims Act.[193]

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182. POLLACK ET AL., *supra* note 25, at 74.

183. Plaintiff Executive Committees are court-appointed attorneys that represent the interests of the plaintiffs in MDLs and essentially serve as a board of directors for the litigation. Noll, *supra* note 179, at 438-39.

184. Letter to the Court, from Plaintiffs' Executive Committee, In re Aqueous Film-Forming Foams Prods. Liab. Litig., MDL No. 2:18-mn-2873-RMG (D.S.C Apr. 28, 2023), ECF No. 3050.

185. *See* Eldon Fallon et al., *Bellwether Trials in Multidistrict Litigation*, 82 TUL. L. REV. 2323, 2325 (2008).

186. *Id.*

187. Letter to the Court, from Plaintiffs' Executive Committee, *supra* note 184.

188. Order Relating to Dorene Dairy, Schaap, Teune, Vander Dussen, New Mexico, at 2-3, In re Aqueous Film-Forming Foams Prod. Liab. Litig., MDL No. 2:18-mn-2873-RMG (D.S.C. Feb. 27, 2025), ECF No. 6728.

189. *Id.* at 12.

190. *Id.*

191. *Id.*

192. The government argued that CERCLA section 113(h) strips federal courts of jurisdiction to hear challenges to ongoing removal or remedial actions, so all remedial claims should be dismissed for lack of subject matter jurisdiction. *See* Memorandum of Points and Authorities Supporting United States' Global Motion to Dismiss for Lack of Jurisdiction Based on CERCLA Section 113(h) at 1-2, In re Aqueous Film-Forming Foams Prods. Liab. Litig., MDL No. 2:18-mn-2873-RMG (D.S.C. Feb. 26, 2024), ECF No. 4550-1.

193. *See* United States of America's Memorandum of Law in Support of Site-Specific Motion to Dismiss Pursuant To Federal Rule of Civil Procedure 12(b)(1) at 15, In Re Aqueous Film-Forming

Judge Richard Gergel of the U.S. District Court for the District of South Carolina issued a ruling on February 27, 2024, granting the DoD's motion to dismiss in part and denying it in part.[194] Judge Gergel granted the DoD's motion to dismiss New Mexico's claims based on the fact that the DoD already has an ongoing CERCLA removal action at Cannon Air Force Base.[195] However, he noted that New Mexico could challenge the sufficiency of the DoD's cleanup efforts once they are complete.[196] Notably, it could take over thirty years before the DoD completes PFAS cleanup action at any single site, including at Cannon Air Force Base.[197] Judge Gergel also granted the motion to dismiss the claim that the DoD failed to warn the dairy farms of PFAS contamination, but denied the DoD's motion to dismiss the negligence, trespass, and private nuisance claims.[198] These motions rulings regarding AFFF contamination at Cannon Air Force Base will inform future litigation strategies in the over thirty cases currently pending

Foams Prods. Liab. Litig., MDL No. 2:18-mn-2873-RMG (D.S.C. Feb. 26, 2024), ECF No. 4551-1. The government asserted that all tort claims related to Cannon Air Force Base should be dismissed under the Federal Tort Claims Act (FTCA). The FTCA waives federal sovereign immunity for tort claims against the federal government for personal injury or property damage allegations. One major exception to the waiver of federal sovereign immunity is known as the "discretionary function exception." This could be a difficult hurdle for plaintiffs to overcome as they must show that government officials were engaged in conduct that was not (1) discretionary and not (2) policy-driven when using AFFF. In the past, the government has invoked the discretionary function exception to protect itself from tort liability for cases involving exposure to radiation, asbestos, and Agent Orange. *See* MICHAEL CONTINO & ANDREAS KUERSTEN, CONG. RSCH. SERV., R45732, THE FEDERAL TORT CLAIMS ACT (FTCA): A LEGAL OVERVIEW 18-19 (2023).

194. Order Relating to Dorene Dairy, Schaap, Teune, Vander Dussen, New Mexico, *supra* note 188, at 35.

195. *Id.* at 33-35.

196. Pat Rizzuto, *Judge Rejects US Government's Efforts to Dismiss PFAS Cases*, BL (Feb. 27, 2025), https://www.bloomberglaw.com/bloombergterminalnews/bloomberg-terminal-news/SSDIBBDWRGG0. Of note, the DoD is still in the investigative stage of the CERCLA cleanup process and has not actually begun any long-term remediation action at the 445 installations that require cleanup. There are five stages of CERCLA remediation: (1) preliminary assessment/site inspection, (2) remedial investigation/feasibility study, (3) remedial design/remedial action – construction, (4) remedial action – operations, and (5) long term management. The DoD has not progressed beyond remedial investigation at any installation. *See* OFF. OF THE DEPUTY SEC'Y OF DEF., U.S. DEP'T OF DEF., NO. 7-F107257, FY 2023 REPORT ON STATUS OF PER-AND POLYFLUOROALKYL SUBSTANCES PRELIMINARY ASSESSMENT/SITE INSPECTION TESTING 2 (2024), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/FY23-PA_SI-Report.pdf [hereinafter DOD FY 2023 PFAS REPORT].

197. *See* DOD FY 2023 PFAS REPORT, *supra* note 196, at 2.

198. Order Relating to Dorene Dairy, Schaap, Teune, Vander Dussen, New Mexico, *supra* note 188, at 16-24. Judge Gergel found that the discretionary function exception under the FTCA barred the failure to warn claims. The plaintiffs did not assert a specific policy that required the government to warn them earlier than 2018, and they did not contend that the decision to warn did not involve an element of choice. Regarding the claims of negligence, trespass, and private nuisance, Judge Gergel noted that the plaintiffs were not challenging the permissive use and disposal of AFFF on Cannon Air Force Base, but rather the AFFF releases caused by "carelessness, inattention, and laziness." *Id.* at 23. At least forty-five accidental discharges of AFFF occurred since the early 1990s. Overall, he ruled that the plaintiffs had presented sufficient facts to show that the AFFF releases on Cannon Air Force Base were not (1) discretionary and not (2) policy-driven, and thus that the government was not shielded by the FTCA's discretionary function exception. *Id.* at 16-24

against the DoD across the country, at least two dozen of which involve tort claims.[199]

The tort claims proceeding against the DoD in the Cannon Air Force Base representative case as well as additional ongoing litigation against PFAS manufacturers could impact the production of AFFF in the United States. Some companies have already stopped producing AFFF. For instance, Tyco Fire Products, a major fire protection company, vowed to stop its production of AFFF in June 2024.[200] 3M stopped producing AFFF in 2000[201] and committed to stop manufacturing PFAS in 2025.[202] Settlements between manufacturers and local water suppliers nationwide give some insight into the financial impact of the litigation. For example, water providers have agreed to release their PFAS-related water supply claims against 3M in return for a settlement between $10.5 and $12.5 billion.[203] Furthermore, DuPont reached a settlement with water providers for $1.185 billion in February 2024, and Tyco Fire Products reached a $750 million settlement with water providers in April 2024.[204] These settlements illuminate the high financial cost of litigation, but only represent a small portion of the overall liability as there are still 8,430 pending cases in the AFFF MDL as of March 2025.[205]

C. Phasing Out Land-Based AFFF

The AFFF MDL began in December 2018.[206] A year later, Congress directed the DoD to phase out AFFF on military installations and implement a PFAS-free (also referred to as fluorine-free) replacement.[207] Congress also prohibited uncontrolled release of AFFF at military installations and banned the use of AFFF for firefighting training exercises.[208] Accordingly, the DoD

199. Rizzuto, *supra* note 196.

200. *Tyco Fire Protection Products to Exit Fluorinated Firefighting Foam (AFFF) Market by June 2024*, PR NEWSWIRE (July 18, 2021), https://www.prnewswire.com/news-releases/tyco-fire-protection-products-to-exit-fluorinated-firefighting-foam-affff-market-by-june-2024-301879105.html.

201. *3M's PFAS Stewardship: PFAS and their Uses*, 3M, shttps://www.3m.com/3M/en_US/pfas-stewardship/uses-applications (last visited Apr. 13, 2025).

202. *3M to Exit PFAS Manufacturing by the End of 2025*, 3M (Dec. 20, 2022), https://news.3m.com/2022-12-20-3M-to-Exit-PFAS-Manufacturing-by-the-End-of-2025.

203. Pat Rizzuto, *3M's $10 Billion PFAS Deal Approved by Court as Rule Looms*, BL (Apr. 1, 2024), https://www.bloomberglaw.com/product/blaw/bloomberglawnews/bloomberg-law-news/XBUTCLO000000?bc.

204. POLLACK ET AL., *supra* note 163, at 6.

205. Ronald V. Miller, *AFFF Firefighting Foam Lawsuit*, LAWSUIT INFO. CTR. (Oct. 25, 2024), https://www.lawsuit-information-center.com/afff-firefighting-foam-lawsuit.html.

206. *See* Transfer Order, *supra* note 180, at 1.

207. National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, § 322, 133 Stat. 1198 (2019). Though the replacement of AFFF with F3 products was supposed to be complete in 2024, the Secretary of Defense invoked a one-year waiver to extend the statutory deadline. Letter from Sec'y of Def., Dep't of Def. on Waiver of Prohibition on the Use of AFFF, to Hon. Jack Reed, Chairman, Comm. on Armed Serv. 1 (Aug. 6, 2024), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/AFFF-Waiver.pdf [hereinafter Letter from Sec'y of Def.].

208. National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, §§ 323, 324.

established a Military Specification (MilSpec)[209] for fluorine-free foam (F3) for land-based, freshwater use.[210] Since then, two F3 replacements have been developed and meet the MilSpec requirements, and are available for purchase by the military.[211]

However, F3 is not a perfect replacement for AFFF from the perspective of firefighting proficiency. The Naval Research Laboratory estimates that it takes F3 about one and a half to two times longer than AFFF to extinguish fires.[212] Without PFAS and its unique properties, more precise application of F3 is required to extinguish fires than is necessary when using AFFF.[213] This requires that DoD firefighters train with F3 in live-firefighting scenarios to develop proficiency in responding to actual fires.[214] The DoD identified 1,500 facilities and over six thousand mobile assets that need to be transitioned from AFFF and noted that the process to procure, install, and modify systems to transition to F3 will not be completed prior to 2025.[215]

In addition to the time necessary to phase out land-based AFFF, it is also an expensive undertaking. The total remaining cost of AFFF replacement is estimated to be approximately $1.86 billion.[216] This includes the procurement and installation of new F3 products, facility modifications to convert fire suppression systems to utilize F3 products, and removal and disposal of AFFF currently at sites.[217] Despite the costs and complications, Congress's decision to

209. MilSpec is a term used in the DoD procurement process. It is a set of detailed criteria established by the DoD that dictate quality, reliability, and compatibility for different materials or products used in the defense industry. The DoD sets a MilSpec for a specific product, like F3. If products qualify under the MilSpec, then they are added to the Qualified Products List, which makes them available for purchase by the different military services. DEP'T OF DEF., FLUORINE-FREE FOAM (F3) MILITARY SPECIFICATION FAQS 1-2 (2023), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/news/F3-MILITARY-SPECIFICATION-FAQs.pdf [hereinafter DOD F3 FAQS].

210. *Id.* at 3. Since F3 foams do not contain PFAS, they are more biodegradable than AFFF; however, they may still have some negative impact on the environment. Overall, there is limited environmental and toxicological information about F3 foams. Fatema Tuj Jahura et al., *Exploring the Prospects and Challenges of Fluorine-Free Firefighting Foams (F3) as Alternatives to Aqueous Film-Forming Foams (AFFF): A Review*, 9 ACS OMEGA 37430, 37441 (2024).

211. Letter from Sec'y of Def., *supra* note 207, at 1.

212. JOHN P FARLEY ET AL., FLUORINE-FREE FOAM (F3) APPLICATION TECHNIQUES AND FIREFIGHTING TACTICS 9 (2023), https://apps.dtic.mil/sti/trecms/pdf/AD1201646.pdf.

213. *See id.* at 10-11. The PFAS in AFFF forms a fluorinated film that floats on the surface of fuel, helping to extinguish fire. Since F3s do not contain PFAS, they cannot form a film on the fuel surface and rely solely on a foam blanket to provide a barrier between fuel and the surrounding air. This foam does not flow as well as AFFF, so it requires more precise application to fire.

214. *See* Letter from Sec'y of Def., *supra* note 207, at 2.

215. *Id.*

216. *See* UNDER SEC'Y OF DEF. FOR ACQUISITION AND SUSTAINMENT, U.S. DEP'T OF DEF., NO. 0-444993B, DEPARTMENT OF DEFENSE PLAN TO TRANSITION TO A FLUORINE-FREE FIREFIGHTING AGENT 3 (2024), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/DoD-Plan-to-Transition-to-a-F3-Agent.pdf. The Department of the Army estimates $355,370,000, the Department of the Navy (including the Marine Corps) estimates $964,800,000, and the Department of the Air Force estimates $546,100,000 in AFFF replacement costs.

217. *Id.*

phase out AFFF at military installations on land represents a major commitment to confronting PFAS in the environment and its impacts on health. The legislation was sponsored by Representative Madeleine Dean of Pennsylvania, who stated, "for too long, federal agencies have passed the buck when it comes to our PFAS problem–leaving communities across the country unprotected."[218]

Overall, the impact of PFAS regulations, the ongoing AFFF MDL, and the military's phased transition to F3 will lead to decreased demand for AFFF amid rising costs for its production and use. This may also lead to a decline in companies that are willing, or financially able, to produce AFFF. Currently, the use of AFFF at sea faces few limitations once ships are outside twelve nautical miles from land.[219] However, a shrinking market could affect the Navy's ability to procure AFFF in the future.

III. THE FUTURE OF AFFF IN THE NAVY

Though the PFAS contamination from the military's use of AFFF on land has been curtailed by Congress, federal regulations, state legislation, and litigation, the Navy's continued use of AFFF at sea poses a risk to human health and the environment. Navy ships use AFFF to quickly put out fire in high fuel areas, such as where aircraft or fuel are stored.[220] This is especially important on warships because most have stores of ammunition and ordnance which increase the danger posed by shipboard fires.[221] Currently, to battle fires on Navy ships, a solution of AFFF concentrate mixed with hundreds of gallons of seawater is sprayed through fire hoses and sprinkler systems located throughout the ship.[222] Large ships that transport aircraft, like amphibious ships and aircraft carriers, can carry more than twenty thousand gallons of AFFF concentrate.[223] Sailors regularly train with AFFF to be prepared to combat fires at any time; their exposure to AFFF varies but can be significant.[224]

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218. *House Passes Rep. Madeleine Dean's PFAS Amendments*, CONGRESSWOMAN MADELEINE DEAN PRESS RELEASES (Jul. 12, 2019), https://dean.house.gov/2019/7/house-passes-rep-madeleine-dean-s-pfas-amendments.

219. DOD MANUAL, *supra* note 160, at 14.

220. *See* HERMAN MILLER ET AL., DAMAGE CONTROLMAN, NAVEDTRA 14057-PPR 6-5 (2001). This Note is focused only on firefighting response on surface ships and not submarines. Firefighting on a submarine is significantly different, especially since there are no aircraft onboard. The Navy has separate firefighting manuals for surface ships and submarines. *See generally, e.g.*, NAVAL SEA SYS. COMMAND, U.S. DEP'T OF THE NAVY, NAVAL SHIPS' TECHNICAL MANUAL CH. 555 - VOL. 1, SURFACE SHIP FIREFIGHTING, (2010), https://www.unols.org/sites/default/files/NavalShips TechManual_SurfaceShipFirefighting.pdf. Mine countermeasures ships are the only Navy surface ships currently in service that do not have aviation capabilities. For a list of Navy surface ships, not including aircraft carriers, and their aircraft capabilities, see *Ships By Class*, U.S. PAC. FLEET, U.S. DEP'T OF THE NAVY, https://www.surfpac.navy.mil/Ships/By-Class (last visited Oct. 27, 2024).

221. DOD PFAS REPORT, *supra* note 12, at 11.

222. *See* MILLER ET AL., *supra* note 220, at 6-11.

223. EPA AFFF REPORT, APPENDIX A, *supra* note 4, at 2.

224. *See* MILLER ET AL., *supra* note 220, at 1-5. Firefighting is the responsibility of every person on the ship, though some may be exposed to AFFF more than others based on their "rating." Rating is

The PFAS in AFFF poses health and environmental risks. At the same time, F3 replacements have not proven as efficient at extinguishing fires as AFFF.[225] Congress and the Navy must now consider whether the costs of AFFF on ships outweigh its benefits. Weighing the costs requires accounting for the evolving regulatory landscape and potential for costly litigation.

A. Arguments in Favor of the Navy Continuing to Employ AFFF

There are two main justifications for continuing to use AFFF on ships. First, Class B fuel spill fires can be devastating, and AFFF is critical to putting them out.[226] Second, there is no "drop-in" replacement for AFFF, meaning that the firefighting systems that use AFFF are incompatible with F3.[227] The Navy could advocate to keep shipboard AFFF indefinitely based on these arguments unless and until a perfect alternative is discovered. However, this course of action is environmentally unfriendly, poses risks to sailor health, and is costly for the Navy.

1. Class B Fires and USS Bonhomme Richard

The DoD has relied on references to past catastrophic Class B shipboard fires to justify its continued use of AFFF. For example, in a report on critical PFAS uses to Congress, the DoD referenced fires aboard USS *Forrestal* (1967), USS *Enterprise* (1969), and USS *Nimitz* (1981) as examples of the catastrophic potential of shipboard fires.[228] All three incidents were Class B fires, since they involved flammable liquids, and the intensity of the fires resulted from the tragic combination of munitions and jet fuel.[229] The *Forrestal* fire triggered the need

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the term that refers to an enlisted sailor's occupation in the Navy. Damage Controlmen are responsible for firefighting, maintaining firefighting equipment, and training others on the ship to fight fires. Given the nature of their role, Damage Controlmen have the greatest exposure to AFFF among Navy sailors.

225. *See* FARLEY ET AL., *supra* note 212, at 10; Mohamed Ateia et al., *Sunrise of PFAS Replacements: A Perspective on Fluorine-Free Foams*, 11 ACS SUSTAINABLE & CHEM. ENG'G 7986, 7988 (2023).

226. DOD PFAS REPORT, *supra* note 12, at 11.

227. *See* STRATEGIC ENVT'L RSCH. & DEV. PROGRAM, DEP'T OF DEF., AFFF ALTERNATIVES: ART OF THE POSSIBLE 52 (2019), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/po/2019-AFFF-Alternatives-Summit-Art-of-the-Possible.pdf [hereinafter DOD AFFF ALTERNATIVES].

228. DOD PFAS REPORT, *supra* note 12, at 11.

229. The 1967 *Forrestal* fire was started when a rocket hit another plane's fuel tank, igniting a fire. Multiple planes were fully fueled and loaded with ordnance causing successive explosions. One hundred thirty-four sailors were killed, 161 were injured. Cox, *supra* note 40. The 1969 *Enterprise* fire began when a rocket exploded after being exposed to hot exhaust on the flight deck. The shrapnel perforated the fuel tanks on a jet, igniting a Class B fire that quickly spread to other planes, causing more munitions to explode, and eventually ruptured a six thousand-gallon fuel tank. Twenty-eight sailors died, and 344 were injured. Samuel J. Cox, *H-025-2: The USS Enterprise (CVAN-65) Conflagration, 14 January 1969*, NAVAL HIST. AND HERITAGE COMMAND, U.S. DEP'T OF THE NAVY, (Jan. 31, 2019), https://www.history.navy.mil/about-us/leadership/director/directors-corner/h-grams/h-gram-025/h-025-2.html. The 1981 *Nimitz* fire began when an aircraft coming in to land on the flight deck struck other parked aircraft, one of which had just been refueled, and began an intense Class B fire. The fire was believed to be out after twenty-eight minutes, but then a missile detonated unexpectedly, causing

for more effective firefighting solutions, which led to the Navy's widespread implementation of AFFF on ships.[230] The fires on *Forrestal* took over twelve hours to extinguish.[231] In contrast, it took just over three hours to extinguish the fires on *Enterprise*[232] and seventy minutes to extinguish the *Nimitz* fire using AFFF.[233] One implication that can be taken from these examples is that AFFF has contributed to the ability to extinguish Class B fires more quickly.

Another ship fire that the DoD referenced to support its argument to keep AFFF on ships is the USS *Bonhomme Richard* fire in 2020.[234] *Bonhomme Richard*, an amphibious assault ship, was nineteen months into a two-year maintenance period when a fire started on July 12, 2020, around 8:00 a.m. PST.[235] The fire began as a Class A fire, but included elements of Class B fires when fueled vehicles and oil stored on the ship ignited.[236] The ship burned for more than four days after repeated failures to extinguish the fire.[237] According to an investigation, AFFF sprinkler systems and hoses were available but not used "in part because . . . the crew lacked familiarity with their capability and availability."[238] AFFF was not deployed to combat the fire until the evening of July 14, when it was already too late to salvage the ship.[239] It is impossible to pinpoint the failure to promptly deploy AFFF as the sole reason for the loss of *Bonhomme Richard*; however, the command investigation concluded that if AFFF had been used immediately it would have had a "significant effect on fighting [the] fire and reducing the damage."[240] The timely use of AFFF could have, at the very least, limited the intensity and rate of the fire's spread.[241]

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more munitions to detonate. Fourteen sailors were killed and thirty-nine injured. Raymond Beauregard, *USS NIMITZ (CVN-68) Flight Deck Fire and Munition Explosions*, THE HIST. OF INSENSITIVE MUNITIONS, https://www.insensitivemunitions.org/history/uss-nimitz-cvn-68-flight-deck-fire-and-munition-explosions (last visited Apr 13, 2025) [hereinafter Beauregard, *USS NIMITZ*].

230. DEYOUNG ET AL., *supra* note 7, at 37.

231. Cox, *supra* note 40.

232. Raymond Beauregard, *The USS ENTERPRISE (CVAN-65) Fire and Munition Explosions*, THE HIST. OF INSENSITIVE MUNITIONS, https://www.insensitivemunitions.org/history/the-uss-enterprise-cvan-65-fire-and-munition-explosions (last visited Apr 13, 2025) [hereinafter Beauregard, *USS ENTERPRISE*].

233. George C. Wilson, *Jet Crashes on Carrier Nimitz, Kills 14*, WASH. POST (May 28, 1981), https://www.washingtonpost.com/archive/politics/1981/05/28/jet-crashes-on-carrier-nimitz-kills-14/7092b4dc-2057-4e28-832e-6800c3e11ceb.

234. DOD PFAS REPORT, *supra* note 12, at 11.

235. VICE CHIEF OF NAVAL OPS., U.S. DEP'T OF THE NAVY, SER N09D/21U100550, COMMAND INVESTIGATION INTO THE FACTS AND CIRCUMSTANCES SURROUNDING THE FIRE ABOARD USS BONHOMME RICHARD (LHD-6) ON OR ABOUT 12 JULY 2020 9 (2021), https://www.secnav.navy.mil/foia/readingroom/HotTopics/BHR%20and%20MFR%20Investigations/For%20Release%20BHR%20Command%20Investigation%20(20%20Oct%2021).pdf.

236. *Id.* at 255.

237. *Id.* at 67.

238. *Id.* at 10.

239. *Id.* at 66. Firefighters employed AFFF externally by cutting holes into the ship and pumping AFFF through those holes.

240. *Id.* at 258.

241. *Id.* at 257.

Unfortunately, the $1.2 billion warship was declared a total loss.[242] The Navy estimated that it would cost $3 billion over the course of five to seven years to rebuild the ship.[243] Ultimately, the most cost-effective action was to decommission *Bonhomme Richard* and prepare her to be sold for scrap metal.[244]

However, the cost to the Navy goes beyond the dollar value of the ship. As noted in the DoD report on critical PFAS uses, "the defense industrial base has limitations with respect to repairing or delivering replacement national security assets . . . ."[245] Warships are extremely expensive and take a long time to build, and the United States has limited shipbuilding capacity.[246] The Navy is already facing a ship shortage; funding new ships is a long process planned years in advance.[247] The unplanned loss of even one ship means that other ships will have to deploy longer or more frequently, which puts additional strain on current warships and sailors.[248] The unplanned loss of a ship also has major impacts on operational capabilities. After the maintenance period, *Bonhomme Richard* was supposed to be one of the Navy's "most combat-capable amphibious assault ships,"[249] meaning it would have improved flight deck capabilities and other weapons technology.[250] This asset is no longer available.

Overall, shipboard fires have long-term financial, operational, and safety consequences for the Navy. While AFFF is not the only firefighting tool available to the Navy, it has unique properties due to PFAS's surfactant

242. *Navy to Decommission USS Bonhomme Richard*, U.S. DEP'T OF THE NAVY (Nov. 30, 2020), https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2429949/navy-to-decommission-uss-bonhomme-richard.

243. VICE CHIEF OF NAVAL OPS., U.S. DEP'T OF THE NAVY, *supra* note 235, at 216.

244. *Navy to Decommission USS Bonhomme Richard*, *supra* note 242.

245. DOD PFAS REPORT, *supra* note 12, at 11. The Navy has notoriously faced issues with warship production in the past few decades due to heightened cost, labor shortages at shipyards, and last-minute design changes that further delay construction. Shipbuilding efforts consistently fall behind schedule and go billions of dollars over budget. *See* Steve Cohen, *Almost All Navy Shipbuilding is Hopelessly Behind Schedule*, THE HILL (May 2, 2024), https://thehill.com/opinion/national-security/4624326-almost-all-navy-shipbuilding-is-hopelessly-behind-schedule-as-war-looms; *The Navy and Coast Guard Face a Rising Tide of Issues in Shipbuilding*, U.S. GOV'T ACCOUNTABILITY OFF. (Aug. 8, 2024), https://www.gao.gov/blog/navy-and-coast-guard-face-rising-tide-issues-shipbuilding.

246. *See* Mallory Shelbourne, *OSD Comptroller Says U.S. Shipyards Can't Build 3 Destroyers a Year*, USNI NEWS, https://news.usni.org/2023/03/21/osd-comptroller-says-u-s-shipyards-cant-build-3-destroyers-a-year (last updated Mar. 22, 2023); Mallory Shelbourne, *CNO Gilday: Industrial Capacity Largest Barrier to Growing the Fleet*, USNI NEWS (Aug. 26, 2022), https://news.usni.org/2022/08/25/cno-gilday-industrial-capacity-largest-barrier-to-growing-the-fleet.

247. *See* Cohen, *supra* note 245.

248. *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-23-105481, NAVY SHIP FIRES: ONGOING EFFORTS TO IMPROVE SAFETY SHOULD BE ENHANCED 21 (Apr. 2023).

249. U.S. FLEET FORCES COMMAND & U.S. PAC. FLEET, U.S. DEP'T OF THE NAVY, MAJOR FIRES REVIEW EXECUTIVE SUMMARY 1 (2021), https://www.secnav.navy.mil/foia/readingroom/HotTopics/BHR%20and%20MFR%20Investigations/For%20Release%20Major%20Fires%20Review%20(19%20Oct%2021).pdf; *see also* DOD PFAS REPORT, *supra* note 12, at 11.

250. *See* Bryan McGrath, *More Than Just a Fire: The Implications of the Bonhomme Richard Catastrophe*, WAR ON THE ROCKS (July 16, 2020), https://warontherocks.com/2020/07/more-than-just-a-fire-the-implications-of-the-bonhomme-richard-catastrophe.

qualities.[251] Part of the reason that AFFF is especially effective for aviation is that it can be released quickly through sprinkler systems and smother fires rapidly, allowing responders to rescue pilots and passengers on aircraft.[252] In 2005, the Naval Research Laboratory credited AFFF as "one of the most far-reaching benefits to worldwide aviation safety."[253]Accordingly, the DoD likely has little motivation to retire AFFF from ships, especially ships that carry aircraft, even if its use negatively impacts the environment and health of U.S. Navy sailors. Thus, the effectiveness of AFFF and the high stakes involved in ship fires provides the first argument in defense of the continued use of AFFF onboard ships.

2. Lack of Suitable Alternatives to AFFF

Not only is AFFF an important tool for fighting Class B fires, but replacing AFFF on ships has more complications than replacing AFFF for land-based fires.[254] There are several differences between F3 and AFFF that limit F3's utility to fight fire on ships. One of the biggest obstacles to shipboard use is that the current military-approved F3 can only be mixed with freshwater to create a foam.[255] This is significant because any firefighting foam to be used onboard must use seawater since ships cannot carry enough freshwater to extinguish fires.[256] Inherent space and weight limitations on ships also impact F3 suitability, as more F3 is required to put out a fire than AFFF.[257]

Additionally, the difference in viscosity between F3 and AFFF may require extensive retrofitting to the pumps, pipe networks, and nozzle locations on ships.[258] Based on current F3 research, it is unlikely that a "drop-in" replacement can be formulated.[259] This means that firefighting systems on every commissioned ship in the fleet would need to be retrofitted to work with F3 replacements, which would be extensive and expensive.[260] For instance, the cost

251. *See* DOD AFFF ALTERNATIVES, *supra* note 227, at 22.

252. *See* John Swanson, *TechNotes: The ABC's of AFFF*, NAT'L FIRE SPRINKLER ASS'N (June 20, 2024), https://nfsa.org/2024/06/20/technotes-the-abcs-of-affff.

253. DEYOUNG ET AL., *supra* note 7, at 37.

254. *See* DOD AFFF ALTERNATIVES, *supra* note 227, at 34-35.

255. *See* Ateia et al., *supra* note 225, at 7988.

256. *See* MILLER ET AL., *supra* note 220, at 6-3, 6-5. Firefighting requires hundreds of gallons of water, especially on ships where entire spaces are designated to flood within an hour. To illustrate, sprinkler systems can spray the deck of a ship at the rate of four gallons per minute, per square foot. AFFF pumps can mix AFFF into seawater at a rate of twelve, twenty-seven, or sixty gallons per minute. Given the amount of water required, it would be impossible to use freshwater on ships.

257. *See* DOD AFFF ALTERNATIVES, *supra* note 227, at 34.

258. *See id.*

259. *See id.* at 52. A drop-in replacement is a product that is compatible with current firefighting equipment and requires no modifications to existing systems. *See id.* at 57.

260. *See id.* at 57-59. There are four major considerations. First, there is a difference in viscosity between F3 and AFFF which requires different proportioning systems that measure the amount of concentrate put into water. Second, F3 requires higher flow rates, which necessitates larger pipe sizes and adds additional cost and weight to the system. Third, F3 effectiveness is more dependent on foam

of transition to F3 for land-based systems is estimated to be over $2.1 billion for the entire DoD.[261] This includes the cost of removal, safe disposal, and cleaning of AFFF from firefighting systems.[262] The cost to replace AFFF systems on ships would be similarly costly.

The DoD has indicated that it will continue to use AFFF on ships until a suitable alternative is engineered.[263] A suitable alternative must be able to mix with freshwater and seawater, be compatible with existing ship firefighting foam systems, and have the ability to extinguish fires within a comparable amount of time as AFFF.[264] Alternatives to AFFF developed to date have not been able to meet all of these standards.[265] Moreover, the existence of a commercially-approved F3 product does not necessarily mean it can be used for military purposes, which is why MilSpec sets certain standards that have to be met for military products.[266] The foremost reason is that risk in the military can be significantly higher. For instance, commercial vessels do not launch and recover aircraft that carry live ordnance, which is an essential function of Navy aircraft carriers.[267] As demonstrated by the *Forrestal* disaster, live ordnance and fire can be a catastrophic combination.[268] The acquisition process to test and approve the new foam could take years.[269] Though issuing a MilSpec may sound like a purely bureaucratic process, there is a significant amount of research and testing that goes into creating them.[270] Overall, between the risk that fire poses to personnel

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quality than AFFF and thus needs to be discharged through specific nozzles to maximize quality. Finally, more F3 concentrate is needed to combat fires than AFFF, which requires double the storage tank size for F3 concentrate.

261. U.S. GOV'T ACCOUNTABILITY OFF., GAO-24-107322, FIREFIGHTING FOAM: DOD IS WORKING TO ADDRESS CHALLENGES TO TRANSITIONING TO PFAS-FREE ALTERNATIVES 12 (July 2024).

262. *See* Ateia et al., *supra* note 225, at 7992; DOD AFFF ALTERNATIVES, *supra* note 227, at 56-57.

263. DOD PFAS REPORT, *supra* note 12, at 11.

264. *Id.* The MilSpec for AFFF requires that a product must extinguish a twenty-eight square foot, gasoline-fueled fire within thirty seconds. DOD F3 FAQS, *supra* note 209, at 1.

265. DOD PFAS REPORT, *supra* note 12, at 11.

266. DOD F3 FAQS, *supra* note 209, at 1.

267. *Important Links and Info*, *supra* note 3.

268. Cox, *supra* note 40.

269. *See* DOD F3 FAQS, *supra* note 209, at 3 (noting that the Navy was given three years to develop a land-based MilSpec for F3). The Navy has historically set the AFFF MilSpec for DoD-wide use. Assuming the process for setting shipboard AFFF product specifications follows the land-based F3 process, Naval Sea Systems Command (NAVSEA) (a command within the Navy that is responsible for the building, delivery, and maintenance of ships) would be responsible for developing a new F3 specification for shipboard use. Formulating a land-based F3 MilSpec required significant research and development projects with input from government, industry, and academia over the course of at least four years. Once a MilSpec is released, NAVSEA guides manufacturers through an application process and oversees testing and evaluation of the products. If a product qualifies, it will be listed in the Qualified Products Database. Only then is it available for purchase by the military. *See generally id.* For more about NAVSEA, see *Who We Are*, NAVAL SEA SYS. COMMAND, U.S. NAVY, https://www.navsea.navy.mil/Home/Warfare-Centers/Who-We-Are (last visited May 12, 2025).

270. *See* DOD F3 FAQS, *supra* note 209, at 3; DOD AFFF ALTERNATIVES, *supra* note 227, at 30.

and national security and the hurdles that must be overcome to replace AFFF on ships, the DoD has two compelling reasons to keep AFFF on ships.

B. Arguments Against the Navy Continuing to Employ AFFF

While there are legitimate arguments to keep AFFF, there are also persuasive reasons to replace AFFF as soon as possible. First, the *Bonhomme Richard* case study highlights that AFFF may not always be an effective tool for the Navy. Second, PFAS pollution in the ocean must be addressed. Finally, the PFAS regulatory environment and ongoing litigation could make procurement of AFFF more difficult and expensive. One potential solution to ending AFFF use onboard Navy ships is that Congress or the DoD could order an immediate phaseout of AFFF. This course of action would be environmentally beneficial; however, it would leave the Navy with a major gap in its firefighting capabilities due to the absence of an immediate replacement. Thus, a different solution is required.

1. The Problem of In-Port Fires

As demonstrated by the *Bonhomme Richard* case study, even when its use is approved, AFFF may not always be used effectively. The *Bonhomme Richard* report emphasizes the importance of training with AFFF. The investigation noted that sailors had not trained to put out a fire with AFFF for over a year.[271] No one attempted to activate the AFFF system or even considered its activation.[272] The *Bonhomme Richard* investigation concluded that a properly trained crew could have used AFFF to slow the fire's spread.[273]

Of the fifteen fires studied in the Navy's *Major Fires Review*, an examination of all the major fires in the Navy from 2008-2020, thirteen occurred when undergoing maintenance, including the *Bonhomme Richard*.[274] The *Major Fires Review* found that ships have poor in-port training regimens, which leaves crews unprepared to respond to fires.[275] This presents an issue for sailors today since ships cannot train with AFFF while in-port because training with AFFF is prohibited on land, which includes ships that are portside.[276] The inability to train with AFFF in-port leaves a major gap in the ship's fire preparedness during

271. VICE CHIEF OF NAVAL OPS., U.S. DEP'T OF THE NAVY, *supra* note 235, at 127.

272. *Id.* at 258.

273. *Id.* at 257.

274. U.S. FLEET FORCES COMMAND & U.S. PAC. FLEET, U.S. DEP'T OF THE NAVY, *supra* note 249, at 8.

275. *See id.* at 4.

276. *See NAVADMIN 227/21: Aqueous Film Forming Foam (AFFF) Usage and Spill Response and Reporting*, CHIEF OF NAVAL OPS., U.S. DEP'T OF THE NAVY (Oct. 13, 2021), https://www.mynavyhr.navy.mil/Portals/55/Messages/NAVADMIN/NAV2021/NAV21227.txt?ver=7LMmDOkcCEhmGG1rZNEBRw%3D%3D.

maintenance periods.[277] This limits AFFF's effectiveness as a tool for onboard firefighting. Thus, the *Bonhomme Richard* case can support a larger argument for why the Navy needs to transition to an alternative foam that sailors can train with in-port when the risk of fire is high.

Bonhomme Richard provides a sobering example of the importance of training with the tools and resources available for firefighting.[278] It is unlikely that the Navy can get an exception from Congress to train with AFFF in-port considering the growing PFAS regulations and the ongoing AFFF MDL. Therefore, the inability to train with AFFF limits its usefulness as firefighting tool for ships in-port. To better protect sailors and naval assets, the Navy needs to transition to a PFAS-free firefighting foam that can be used in training and testing during maintenance periods.

2. Environmental and Health Impacts of AFFF

Another reason why AFFF's use by the Navy should be limited are the environmental and health impacts of the foam. In contrast to firefighting preparedness in-port, the *Major Fires Review* found that crews are well-trained to combat fires at sea.[279] U.S. Navy ships are required to regularly test their firefighting systems while at sea to ensure that the ship's systems are functional and the sailors are familiar with all damage control capabilities.[280] Tests of fire main[281] systems must take place at least twelve nautical miles away from land, but ideally occur "as far away from shore as possible."[282]

Fire main testing includes spraying AFFF solution from hoses over the side of the ship and from AFFF sprinkling systems.[283] The combination of these systems allows the delivery of AFFF to areas that are most at risk of Class B fires, specifically any place where fuel is used or stored.[284] Afterwards, the decks are sprayed with seawater to clean off the AFFF solution.[285] This means that the

277. Ships are often emptied of fuel at some point during their maintenance, which reduces the risk of Class B fires. However, this does not mean that ships never have fuel onboard during maintenance, as evidenced by the *Bonhomme Richard* fire. When fuel is on the ship the AFFF firefighting system is supposed to be operational. *See* VICE CHIEF OF NAVAL OPS., U.S. DEP'T OF THE NAVY, *supra* note 235 at 96-103.

278. *Id.* at 103, 272. The investigation noted that use of AFFF in response to a fire had not been practiced for over a year on the *Bonhomme Richard*. The report listed lack of training as a contributing reason for why the sailors failed to deploy AFFF on the day of the fire.

279. *See* U.S. FLEET FORCES COMMAND & U.S. PAC. FLEET, U.S. DEP'T OF THE NAVY, *supra* note 249, at 4.

280. *See* MILLER ET AL., *supra* note 220, at 6-11.

281. A fire main is a seawater supply system for the sprinkling system and hoses on the vessel. *Id.* at 6-1.

282. 40 C.F.R. § 1700.24(a) (2020).

283. EPA AFFF REPORT, APPENDIX A, *supra* note 4, at 2. There are three AFFF sprinkling systems: the bilge system, the flush-deck system (also known as the countermeasure wash down system), and deck-edge sprinkler sprays. MILLER ET AL., *supra* note 220, at 6-11.

284. *See* MILLER ET AL., *supra* note 220, at 6-11.

285. EPA AFFF REPORT, APPENDIX A, *supra* note 4, at 3.

majority of the AFFF used in testing is sprayed or swept off the ship, adding to PFAS contamination in the ocean.

AFFF discharge during firefighting tests occurs on all Navy vessels at least annually.[286] The EPA estimated that over seven hundred thousand gallons of AFFF solution are discharged into the ocean by military vessels each year.[287] Indeed, a single test of AFFF hoses and sprinkler systems on an aircraft carrier uses about two thousand gallons of AFFF solution.[288]

It should be acknowledged that the amount of PFAS pollution that enters the water from AFFF testing is relatively small when compared to the vastness of the ocean.[289] The EPA noted that seawater is used to wash AFFF off the ship, which further dilutes the concentration of AFFF in the mixture that goes overboard.[290] Moreover, the EPA found that the ship's motion through the sea causes the "discharge to be distributed along the ship's track instead of . . . a single spot."[291]

However, the concept of "the solution to pollution is dilution" is no longer an accepted means of pollution management.[292] Dilution of PFAS does not equal degradation of the chemical and does not halt bioaccumulation in marine life or humans.[293] Relatively small amounts of pollution present cumulative risks when added to already significant and widespread amounts of PFAS in the ocean.[294] Such pollution impacts human health through bioaccumulation in the food chain, atmospheric cycling, and the exacerbation of climate change.[295] Importantly, there are no effective means of removing PFAS from the ocean.[296] PFAS are too widespread, and the ocean is too large. The best way of combatting PFAS pollution in the ocean is to find alternatives to PFAS-containing chemicals.

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286. *Id.* at 3. Testing evolutions include Planned Maintenance System, Board of Inspection and Survey underway material inspections, and flight deck certifications. Each of these tests have different schedules but can overlap. For instance, Planned Maintenance System tests occur annually on many ships, while Board of Inspection and Survey underway material inspections occur every three years. However, the tests are often combined. The EPA's AFFF Report, *id.*, breaks down maintenance discharges in more detail by platform and by flight desk versus fire hose certifications.

287. *Id.*

288. *George Washington Completes Countermeasure Wash-Down System Testing*, *supra* note 5.

289. EPA AFFF REPORT, APPENDIX A, *supra* note 4, at 3. The EPA estimates that 722,500 gallons of AFFF/seawater solution is discharged into the ocean annually.

290. *Id.* at 6.

291. *Id.*

292. *The Solution to Pollution Is Dilution: Is There Still Truth to This?*, ENVT'L POLLUTION EDUC. (Apr. 11, 2022), https://pollutioneducation.com/ocean/the-solution-to-pollution-is-dilution-is-there-still-truth-to-this.

293. *See id.*

294. *'Forever Chemicals' are Flowing Between the Arctic and Atlantic Oceans, Study Finds*, *supra* note 66.

295. *See id.*; Mahmoudnia, *supra* note 18, at 2, 6; Quinete & Ogunbiyi, *supra* note 19; Kristin Toussaint, *Ocean Waves Contain More "Forever Chemicals" than Industrial Pollution. That's Bad News If You Live on the Coast*, FAST CO. (Apr. 24, 2024), https://www.fastcompany.com/91111487/ocean-waves-pfas-forever-chemicals.

296. Toussaint, *supra* note 295.

Therefore, due to these myriad adverse impacts of PFAS contamination on environmental and health, the U.S. Navy should reduce its use of AFFF and explore alternatives.

3. Regulatory and Litigation Impacts on Manufacturers

A third reason the Navy should seek to reduce its AFFF use is the current regulatory and litigation landscape, which may make AFFF more expensive and more difficult to obtain. Though PFAS regulations and the AFFF MDL do not directly curtail the Navy's ability to use AFFF at sea, they have the potential to impact the Navy's ability to source AFFF. The DoD highlighted concern that it could lose access to PFAS due to "overly broad regulations or severe market contractions," which would impact the domestic defense industrial base manufacturing and supply.[297] The fact that some manufacturers have already started to move away from AFFF production, as discussed above, shows that this is a live concern.

The impact of the AFFF MDL on manufacturers is just beginning, as litigation will likely continue for many years. We have begun to see some possible impacts. For instance, Kidde-Fenwal, a company that sold AFFF through a subsidiary, filed for bankruptcy in 2023.[298] The company cited the fact that its liability in the litigation substantially exceeded its ability to pay as a reason for its shuttering.[299] Some have voiced concern that more companies will be forced into insolvency because of the litigation.[300] In a July 2024 hearing, Judge Gergel stated that private industry "just doesn't have the capacity to remediate this completely."[301] Similarly, one of the plaintiffs' attorneys in the AFFF MDL stated, "there's not enough gold in Fort Knox to pay the damages and settlements that are [going to] come out of this . . . there's a lot of concern about bankruptcy."[302]

As litigation continues, it could simply become too costly to produce AFFF in the United States, especially as demand for AFFF decreases with the prohibition on land-based use.[303] Even if the EPA repeals PFAS regulations

297. DOD PFAS REPORT, *supra* note 12, at 1.

298. Dietrich Knauth, *Fire Protection Company Kidde-Fenwal Files for Bankruptcy Citing PFAS Lawsuits*, REUTERS (May 15, 2023), https://www.reuters.com/legal/fire-protection-company-kidde-fenwal-files-bankruptcy-citing-pfas-lawsuits-2023-05-15.

299. *Id.*

300. Alex Wolf, *Trillions in PFAS Liabilities Threaten Corporate Bankruptcy Wave*, BL (Oct. 24, 2023), https://www.bloomberglaw.com/product/blaw/bloomberglawnews/bloomberg-law-news/XAM20A6K000000#jcite; Pat Rizzuto, *PFAS Legal Liability Risks and Burdens Point to More Settlements*, BL (June 11, 2024), https://www.bloomberglaw.com/product/blaw/bloomberglawnews/bloomberg-law-news/XC1PMCB0000000?bc.

301. Wolf, *supra* note 301.

302. Rizzuto, *supra* note 301.

303. *See* Jesse Roman, *The New Foam*, NAT'L FIRE PROT. ASS'N (July 21, 2022), https://www.nfpa.org/news-blogs-and-articles/nfpa-journal/2022/07/22/the-new-foam. A potential counterargument is that the DoD can start buying AFFF from overseas manufacturers. While this is true,

under President Trump,[304] regulation of PFAS will continue at the state level and may be prioritized under subsequent presidential administrations. Moreover, the U.S. military, civilian airports, and fire departments have already begun to adopt or mandate F3 formulations to replace AFFF, which represents a huge investment of time and money that will not be abandoned lightly.[305] As shift to F3 decreases the demand for AFFF, continued manufacture of AFFF will become less appealing to companies dealing with the burden of litigation in the AFFF MDL.[306] Already there are predictions within the civilian shipping industry that reduced production of PFAS and AFFF will be the main driver for transitioning to other kinds of firefighting foams.[307] The Navy should pay heed to these concerns and prepare to phase out AFFF.

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the shift to AFFF alternatives is happening on a global scale. The Stockholm Convention prohibits production and use of specifically listed PFAS, which calls for a full ban of AFFF with PFOA, PFOS, and PFHxS by January 1, 2026. Letter from the Nat'l Env't Agency of Sing., to Industry Stakeholders 1 (Mar. 15, 2024), https://www.nea.gov.sg/docs/default-source/default-document-library/phase-out-of-fire-fighting-foams-containing-pfas-chemicals-listed-under-the-stockholm-convention_15mar24.pdf. The European Union has already banned long-chain PFAS in AFFF, and the European Chemicals Agency has proposed regulating all PFAS in foam concentrates. Eike Peltzer, *The PFAS Ban in Firefighting Foam in the EU [2024]*, E.P. FIRE (Sept. 22, 2024), https://epfire.de/en/pfas-ban-firefighting-foam. This proposal has made it through multiple levels of review and comment and is awaiting final adoption by the European Chemical Agency (ECHA) *See Registry of Restriction Intentions until Outcome*, EUR. CHEM. AGENCY, https://echa.europa.eu/de/registry-of-restriction-intentions/-/dislist/details/0b0236e1856e8ce6 (last visited Dec. 1, 2024). Moreover, the International Maritime Organization has also prohibited the use of AFFF that contains PFOS, a mandate that applies to all international, commercial shipping. *Sub-Committee on Ship Systems and Equipment (SSE), 8th Session, 28 February-4 March 2022*, INT'L MAR. ORG., https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/SSE-8th-session.aspx (last visited Nov. 24, 2024).

304. Several published articles consider whether the EPA's PFAS regulations are at risk of repeal under the Trump Administration. While this is mostly speculative, the consensus seems to be that the majority of PFAS regulations will stay in place, in part because PFAS regulation receives bipartisan support. *See, e.g.*, Jacob Wallace, *PFAS Opportunities Coming as Trump Enters Office, Waste Executives Say*, WASTE DIVE (Nov. 25, 2024), https://www.wastedive.com/news/pfas-trump-administration-corporate-growth-conference-nwra/733868; Jordan King, *US Drinking Water Could Change Dramatically Under Donald Trump*, NEWSWEEK, https://www.newsweek.com/donald-trump-drinking-water-fluoride-pfas-regulations-1981374 (last updated Nov. 6, 2024); Bobby Magill, *Trump EPA Pick Seen Supporting PFAS Limits, Revising Water Rules*, BL (Nov. 13, 2024), https://www.bloomberglaw.com/product/blaw/bloomberglawnews/bloomberg-law-news/X5OHLV18000000?bc=; Bobby Magill, *Biden Clean Water Rules Vulnerable in New Trump Administration*, BL (Nov. 6, 2024), https://www.bloomberglaw.com/product/blaw/bloomberglawnews/bloomberg-law-news/X9039004000000?bc=.

305. Congress has also mandated that the Federal Aviation Administration transition from AFFF to new F3 foam at 139 airports. FED. AVIATION ADMIN., AIRCRAFT FIREFIGHTING FOAM TRANSITION PLAN 4-5 (2023), https://www.faa.gov/sites/faa.gov/files/FAA_Aircraft_F3_Transition_Plan_2023.pdf. Some states have required that fire departments stop using AFFF. Robert Avsec, *'Forever Chemicals': What Firefighters Need to Know about AFFF and PFAS*, FIRERESCUE1 (June 8, 2021), https://www.firerescue1.com/firefighting-foam/articles/forever-chemicals-what-firefighters-need-to-know-about-afff-and-pfas-8pdsKB4G2G1fJoIM.

306. For instance, Kidde-Fenwal spent $6 million on litigation costs in 2023 alone. Knauth, *supra* note 299.

307. *Shipowners Need to Prepare for Phaseout of Legacy Firefighting Foam*, THE MARITIME EXEC. (Aug. 21, 2024), https://maritime-executive.com/article/shipowners-need-to-prepare-for-phaseout-of-legacy-firefighting-foam.

C. Preparing for an AFFF-Free Future

Despite arguments for the Navy to stop using AFFF at sea, including those elaborated on above, ordering an immediate cessation is not practical. A decision to remove AFFF without a MilSpec for shipboard F3 would leave ships without a foam-based option to fight Class B fires. This would render naval vessels unprotected from Class B fires at sea and would be detrimental to sailors' safety.[308] Thus, the arguments for continuing AFFF use at sea—the lack of a MilSpec for shipboard F3 to combat Class B fires and the low likelihood of a drop-in alternative—could be the end of the conversation. However, it is important to note that these obstacles, while expensive, are not insurmountable because MilSpecs can be altered, and ships are routinely upgraded.

While the Navy cannot immediately stop using AFFF on ships, there are actions it can take to hasten the replacement of AFFF and lessen the environmental impacts of its use. First, the DoD should continue to fund research on alternatives to AFFF for shipboard use.[309] The Naval Research Laboratory has done testing of commercially available F3 that is saltwater compatible,[310] but it is unclear how much the DoD is prioritizing the development of shipboard F3. Currently, the money requested by the DoD for research and development in fiscal year 2025 is mainly focused on remediation and disposal of PFAS.[311]

In addition to researching AFFF alternatives, the Navy should reassess the MilSpec requirements for firefighting foams on ships. It is unlikely that a PFAS-free replacement exists that is as effective as AFFF and does not require equipment changes.[312] Instead of using this as a justification to keep AFFF, the MilSpec for shipboard firefighting foam needs to be adjusted to account for the properties of PFAS-free foams. There is precedent for this with the creation of the F3 MilSpec for land-based, freshwater use, which utilized an entirely new MilSpec instead of adhering to the requirements of the AFFF MilSpec.[313] Certain properties for shipboard use, like the need for a low-expansion foam, might be nonnegotiable.[314] On the other hand, the differences in how F3 must be applied

308. DOD PFAS REPORT, *supra* note 12, at 11.

309. *Id.* The DoD invested around $45.8 million between 2017 and 2023 toward the development and qualification of F3 technologies.

310. JOHN P. FARLEY ET AL., PRELIMINARY INVESTIGATION INTO FLUORINE-FREE FOAM (F3) PRODUCTS USING SALTWATER SOLUTIONS & ULTRA-HIGH PRESSURE (UHP) HANDLINE TESTING - "QUICK LOOK" SUMMARY REPORT 1 (2023).

311. *See* OFF. OF THE ASSISTANT SEC'Y OF DEFENSE FOR ENERGY, INSTALLATIONS, & ENV'T, U.S. DEP'T OF DEF., NO. 9-8E14986, FY 2025 BUDGET JUSTIFICATION REPORT FOR FUNDING RELATED TO PER- AND POLYFLUOROALKYL SUBSTANCES 1 (2024), https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/PFAS-Budget-Justification.pdf.

312. *See* DOD AFFF ALTERNATIVES, *supra* note 227, at 53.

313. *See* DOD F3 FAQS, *supra* note 209, at 3.

314. DOD AFFF ALTERNATIVES, *supra* note 227, at 26. Low expansion foam is a high-density foam that can be projected from long distances and heights and is more stable than medium and high expansion foams. It is also less sensitive to conditions such as wind or rain. *Use of Low, Medium, High Expansion Foam in Firefighting*, BIOEX, https://www.bio-ex.com/en/our-expertises/low-medium-high-expansion (last visited Sept. 22, 2025).

to a fire versus AFFF could be compensated for through training and preparedness,[315] as well as higher application rates and equipment.[316] Fire main systems on ships will also need to be adjusted to accommodate new foams. Each year, the Navy plans to have a certain percentage of the fleet in shipyards to undergo major maintenance and modification.[317] Thus, fire main system upgrades can be implemented as part of a ship's planned maintenance and modernization plan instead of upgrading all the ships at once.[318]

The Navy can also focus on fire prevention and risk reduction, in addition to firefighting. For instance, one major way that the Navy has reduced the risk of Class B fires on ships is through the introduction of "insensitive munitions."[319] Insensitive munitions are designed to "minimize the violence of a reaction and subsequent collateral damage when subjected to unplanned heat, shock, fragment, or bullet impact . . . ."[320] The conflagrations on *Forrestal*, *Enterprise*, and *Nimitz* all involved munitions that exploded when exposed to heat, which increased the intensity and spread of the fires.[321] Today, all munitions in the Navy must meet insensitive munitions requirements.[322] Overall, finding ways to further reduce the risk and potential intensity of Class B fires on ships can reduce the DoD's reliance on AFFF.[323]

Separately, until the Navy adopts F3 on ships, it needs to be more proactive in reducing the environmental and health impacts of AFFF. When training with AFFF at sea, the Navy should find ways to reduce the amount of AFFF that is

315. *See* FARLEY ET AL., *supra* note 212, at 26.

316. *See* DOD AFFF ALTERNATIVES, *supra* note 227, at 35.

317. NAVAL SEA SYS. COMMAND, U.S. DEP'T OF THE NAVY, REPORT TO CONGRESS ON THE LONG-RANGE PLAN FOR MAINTENANCE AND MODERNIZATION OF NAVAL VESSELS FOR FISCAL YEAR 2020 10 (2019), https://www.secnav.navy.mil/fmc/fmb/Documents/20pres/FY20%20Long%20Range%20Maintenance+Modernization%20Plan.pdf.

318. The Navy has planned maintenance and modernization cycles for every ship, including major overhauls that require the ship to be placed into dry dock, meaning it is completely taken out of the water. For an example of how extensive maintenance planning is for Navy ships, see generally CHIEF OF NAVAL OPERATIONS, U.S. DEPT. OF THE NAVY, OPNAV INSTRUCTION 4700.7N, MAINTENANCE POLICY FOR NAVY SHIPS (2024), https://www.secnav.navy.mil/doni/Directives/04000%20Logistical%20Support%20and%20Services/04-700%20General%20Maintenance%20and%20Construction%20Support/4700.7N.pdf.

319. *See* Raymond Beauregard, *In Conclusion*, THE HIST. OF INSENSITIVE MUNITIONS, https://www.insensitivemunitions.org/history/in-conclusion (last visited Apr 13, 2025).

320. Raymond Beauregard, *What Is an "Insensitive Munition" and Where Did the Term Originate?*, THE HIST. OF INSENSITIVE MUNITIONS, https://www.insensitivemunitions.org/history/what-is-an-insensitive-munition-and-where-did-the-term-originate (last visited Apr 13, 2025).

321. *See* Raymond Beauregard, *The USS FORRESTAL (CVA-59) Fire and Munition Explosions*, THE HIST. OF INSENSITIVE MUNITIONS, https://www.insensitivemunitions.org/history/the-uss-forrestal-cva-59-fire-and-munition-explosions (last visited Apr 13, 2025); Beauregard, *USS ENTERPRISE*, *supra* note 232; Beauregard, *USS NIMITZ*, *supra* note 229.

322. CHIEF OF NAVAL OPERATIONS, U.S. DEPT. OF THE NAVY, OPNAV INSTRUCTION 8010.13E, DEPARTMENT OF THE NAVY POLICY ON INSENSITIVE MUNITIONS 3 (2014), https://www.secnav.navy.mil/doni/Directives/08000%20Ordnance%20Material%20Management%20and%20Support/08-00%20General%20Ordnance%20Material%20Support/8010.13E.pdf.

323. DOD PFAS REPORT, *supra* note 12, at 11.

introduced into the ocean. For instance, the Navy can stop spraying AFFF directly from hoses into the ocean and spray only seawater to test these systems. Importantly, the Navy should also require more stringent use of protective gear for sailors when using AFFF, to avoid direct contact with AFFF.[324] Respirators should be worn around AFFF to avoid respiratory exposure, along with dermal covering to avoid skin contact and gloves to avoid hand to mouth contact of AFFF.[325] Though servicemember personal protective equipment requirements were allegedly in place as early as 2019,[326] photos published by the Navy between 2022 and 2025 show many sailors cleaning and touching AFFF without respirators, gloves, and goggles.[327] In contrast, photos of the AFFF removal at the Red Hill Bulk Fuel Storage Facility in Hawai‘i depicts civilian defense contractors wearing full personal protective equipment to handle AFFF, including respirators and gloves.[328] It is unclear why the same safety precautions

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324. *See* Rosenfeld et al., *supra* note 58, at 5.

325. *PFAS Technical and Regulatory Guidance Document and Fact Sheets*, INTERSTATE TECH. & REGUL. COUNCIL, https://pfas-1.itrcweb.org/3-firefighting-foams (last updated Sept. 2023); Mark Chocola, *Mitigating Health Risks with AFFF in the Workplace*, INDUS. SAFETY & HYGIENE NEWS (Mar. 14, 2024), https://www.ishn.com/articles/114115-mitigating-health-risks-with-afff-in-the-workplace; MICH. PFAS ACTION RESPONSE TEAM, MICHIGAN FIREFIGHTING FOAM AND PFAS 4 (2024), https://www.michigan.gov/pfasresponse/-/media/Project/Websites/PFAS-Response/Workgroups/Fire-Stations/AFFF-Best-Management-Practices.pdf.

326. DOD AFFF ALTERNATIVES, *supra* note 227, at 24.

327. Petty Officer Third Class Riley McDowell, *AFFF HB*, DEF. VISUAL INFO. DISTRIB. SERV. (Feb. 27, 2022), https://www.dvidshub.net/image/7071148/afff-hb (photograph depicting a sailor covered with AFFF, wearing gloves and goggles, but no respirator); Seaman Oswald Felix, *USS Ronald Reagan (CVN 76) Conducts Aqueous Film Forming Foam System Test*, DEF. VISUAL INFO. DISTRIB. SERV. (May 9, 2022), https://www.dvidshub.net/image/7182218/uss-ronald-reagan-cvn-76-conducts-aqueous-film-forming-foam-system-test (photograph depicting three sailors spraying AFFF from a hose without any protective gear on); Mass Communication Specialist Third Class Stephen Mueller, *AFFF*, DEF. VISUAL INFO. DISTRIB. SERV. (Mar. 2, 2022), https://www.dvidshub.net/image/7075875/afff (photograph depicting three sailors spraying AFFF from a hose without any protective equipment on); Petty Officer Second Class Clayton Wren, *Abraham Lincoln Conducts Flight Deck AFFF Tests*, DEF. VISUAL INFO. DISTRIB. SERV. (Oct. 14, 2023), https://www.dvidshub.net/image/8072332/abraham-lincoln-conducts-flight-deck-afff-tests (photograph depicting a sailor covered in AFFF—though he is gloved, he is pulling his goggles off and not wearing a respirator); Petty Officer Third Class Faith McCollum, *Abraham Lincoln Conducts Aqueous Film-Forming Foam (AFFF) Testing*, DEF. VISUAL INFO. DISTRIB. SERV. (Oct. 14, 2023), https://www.dvidshub.net/image/8072461/abraham-lincoln-conducts-aqueous-film-forming-foam-afff-testing (photograph depicting a sailor sweeping AFFF off the ship without any protective equipment on); Petty Officer Third Class Timothy Meyer, *Sailor Takes Sample of AFFF*, DEF. VISUAL INFO. DISTRIB. SERV. (June 21, 2024), https://www.dvidshub.net/image/8491555/sailor-takes-sample-afff (photograph depicting a sailor standing in a spray of AFFF with gloves and goggles, but no respirator); Petty Officer Second Class Aaron Arroyo, *USS John C. Stennis Daily Operations*, DEF. VISUAL INFO. DISTRIB. SERV. (July 31, 2024), https://www.dvidshub.net/image/8579844/uss-john-c-stennis-daily-operations (photograph depicting a sailor transferring AFFF concentrate with goggles on, but no gloves or respirator); Seaman Gladjimi Balisage, *USS Gerald R. Ford (CVN 78) Tests AFFF Sprinkler System*, DEF. VISUAL INFO. DISTRIB. SERV. (Feb. 2, 2025), https://www.dvidshub.net/image/8869620/uss-gerald-r-ford-cvn-78-tests-afff-sprinkler-system (photograph depicting a sailor covered with goggles, but no gloves or respirator).

328. Petty Officer First Class Glenn Slaughter, *NCTF-Red Hill Prepares for AFFF Concentrate Removal*, DEF. VISUAL INFO. DISTRIB. SERV. (Apr. 5, 2024), https://www.dvidshub.net/news/470283/nctf-red-hill-prepares-afff-concentrate-removal (photograph depicting four civilians monitoring the

have not been enforced on Navy ships, especially since service-related AFFF exposure has been linked to increased risk of testicular cancer.[329] Given the health risks associated with PFAS exposure, it is the Navy's duty to maximize protections for sailors as long as it continues to use AFFF.

While the immediate cessation of AFFF on ships is not currently feasible, it does not absolve the Navy of its responsibility to pursue and implement safer, more sustainable firefighting solutions. The continued use of AFFF should not be seen as a permanent solution, but rather a temporary necessity while alternatives are developed. By funding research, updating MilSpecs, integrating fire prevention technologies, and enforcing protective measures for sailors, the Navy can balance operational readiness with human health and environmental stewardship. Ultimately, transitioning away from AFFF is not only possible, but it is essential for safeguarding the environment and those who serve.

CONCLUSION

The PFAS contained in AFFF presents a risk to the environment and human health. Congress and the DoD have taken an important first step in transitioning to PFAS-free foams on land. However, additional work is required to ensure that the Navy is prepared to implement an alternative to AFFF at sea. Environmental, health, and supply chain concerns all point to an AFFF-free future. As evidenced by the *Bonhomme Richard* fire, fire safety is an issue of national security. However, assumptions underlying the necessity of AFFF need to be re-examined. There are instances when national security mandates will, and should, outweigh environmental considerations. However, as an environmental steward, the DoD needs to critically question how necessary certain practices are to upholding national security when they have concerning environmental and health impacts. While the Navy might not be able to immediately prohibit AFFF, it should recognize based on regulatory changes and ongoing litigation that the winds have shifted. The harmful nature of PFAS requires prudent mariners to set a course for an AFFF-free future.

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removal of AFFF concentrate while wearing respirators, goggles, and gloves); Petty Officer First Class Glenn Slaughter, *NCTF-Red Hill Begins AFFF Concentrate Removal*, DEF. VISUAL INFO. DISTRIB. SERV. (Apr. 10, 2024), https://www.dvidshub.net/news/470288/nctf-red-hill-begins-afff-concentrate-removal (photograph depicting civilians draining AFFF concentrate from a pipe while wearing respirators, eye protection, and gloves).

329. Purdue et al., *supra* note 58, at 077007-1. Health risks associated with AFFF exposure are not gender specific. However, this study is significant for the DoD because it was the first study involving servicemembers who had exposure to AFFF.