When is firefighting potentially a bigger environmental risk than the fire?

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Background: Use of AFFF at energy sector facilities

A stable aqueous foam can extinguish a flammable or combustible liquid fire by the combined mechanisms of cooling, separating the flame/ignition source from the product surface, suppressing vapors, and smothering the fire. The foam properties also aid with preventing reignition and preventing the fire suppressant from sinking below fuel liquid surfaces. For these reasons, foam is the primary fire-extinguishing agent for all potential hazards or areas where flammable liquids are transported, processed, stored, or used as an energy source.[1] Class B foams are most relevant to the energy sector, as these firefighting foams have been designed to effectively extinguish flammable and combustible liquids and gases, petroleum greases, tars, oils, gasoline, solvents, and alcohols. Class B foams can be synthetic foams, including aqueous film-forming foam (AFFF) or alcohol-resistant aqueous film-forming foam (AR-AFFF). The vast majority of Class B firefighting foam that is currently in stock or service in the United States is AFFF or AR-AFFF and all AFFF products contain per- and polyfluoroalkyl substances (PFAS) and fluorocarbon surfactants.[2] Older legacy formulations, prior to the U.S. Environmental Protection Agency (USEPA) 2010/2015 voluntary PFOA Stewardship Program, contained longer-chained PFAS (C8) that are currently the focus of regulatory agencies across the country.

Although a release of AFFF to the environment has the potential to create adverse environmental impacts, currently, federal law does not prohibit the use of legacy AFFF remaining in existing stocks, whether containing PFOS or other long-chain PFAS. It is the continued use of stockpiled legacy AFFF by both the energy sector and first responders that poses enormous cleanup liability risk associated with facility fuel fires in the energy sector.

Impacts of releases of AFFF

The use and release of legacy AFFF to suppress fires at a given site has the potential to result in costly environmental cleanup programs within the energy sector. While insurance policy underwriting has historically assessed risks based on the chemicals being manufactured, used, handled, or stored at sites, the industry is now also starting to evaluate the potential environmental liabilities associated with the use of AFFF in response to a fire at a site.

During a given event, thousands of gallons of foam solution may be applied that have the potential to impact soil, surface water, and groundwater. While the emergency response of firefighting is prioritized, the use of legacy AFFF could create a parallel emergency related to environmental spill cleanup requiring:

- AFFF containment and capture
  - Prevention of runoff
  - Recovery of standing liquids and foam used during firefighting operations with a vacuum truck, pumps, or handheld equipment (e.g., mops, absorbents, etc.)
- Soil management and/or excavation
  - If PFAS-impacted fluids soaked into the soil, removal of infiltrated soils should be considered in order to prevent impacts from reaching groundwater.
- Potential groundwater remediation
  - If PFAS infiltration reached groundwater, the need for pump and treat remediation (the only currently feasible treatment method) should be assessed.
- Ongoing stormwater runoff management
  - Containment, assessment, and management of stormwater runoff from residual PFAS impacts

1 https://www.chemguard.com/about-us/documents-library/foam-info/general.htm

Delineating the environmental impacts related to the use of legacy AFFF for a particular event get even more complicated when there are suspected or documented historic releases of legacy AFFF at the facility. In those cases, environmental impacts from historic and recent AFFF use may comingle, then triggering the need for an extensive environmental forensic effort to prevent the impacts from this event from becoming blurred with impacts from historic AFFF releases (AFFF spills/leaks, AFFF training, or previous AFFF firefighting) that were never required to be remediated.

An example of representative AFFF cleanup costs from energy sector firefighting

As with all environmental cleanups, a number of site-specific factors can influence the overall cleanup costs at a site, but below we provide an example of how the cleanup of AFFF after firefighting at an energy sector client site can far exceed any anticipated environmental liability.

With some of lowest cleanup standards among regulated contaminants and limited technologies for cleanup of PFAS contamination, the use of AFFF in response to a fire has the potential to become the primary driver of remediation costs at a facility. In recently reviewed environmental claims, the cleanup costs associated with addressing PFAS compounds in AFFF have been estimated to be 5 to 20 times greater than the cleanup costs associated with the released fuels from a bulk petroleum storage facility.[3]

The use of AFFF may result in one or more of the following environmental response activities:

i) Collection and disposal of AFFF/water mixture used to suppress a fire
ii) Remediation of PFAS-impacted soil that comes in contact with the AFFF/water mixture
iii) Remediation of PFAS-impacted groundwater from overlying PFAS-impacted soil
iv) Treatment of stormwater runoff from the PFAS-impacted area

AFFF/water mixture collection and disposal

Given that the AFFF/water mixture used in response to a fire is the source of contamination, the removal of this mixture of fluids (along with the released fuels) was captured, collected, and properly disposed of at an off-site facility. While the costs to capture and collect these fluids are no different for any other liquid, the cost to transport and dispose of said liquid is guaranteed to be substantial. Although PFAS-waste is not regulated by the Resource Conservation and Recovery Act (RCRA) at this time, PFAS waste is currently being managed by waste disposal companies as a federal hazardous waste at a cost of approximately $2.25 per gallon.[3] At the representative site, approximately 1,000,000 gallons of AFFF/water/fuel were collected and disposed of at a hazardous waste management facility — **resulting in $2.25M in environmental cleanup costs.**

For comparison purposes, petroleum-impacted water would typically be managed at costs ranging from $1.35 to $1.60 per gallon.[2]

Soil remediation

At this time, proven technologies to treat PFAS in soil are limited to excavation and landfill disposal or destruction in an incinerator — hindering our ability to address PFAS contamination in a more cost-effective manner similar to other contaminants. While these are the available technologies for addressing PFAS impacts in soil, there are a very limited number of landfills and incinerators accepting these wastes due to the potential extraordinary liabilities associated with managing PFAS wastes at this time. Given the limited number of these facilities across the United States, the transportation costs associated with PFAS-impacted soil have the potential to be substantial and, in many cases, the driver of soil remediation costs. Transportation costs for managing PFAS-impacted soil in this recent environmental claim were approximately $220 per ton, with a total transport and disposal (T&D) cost of approximately $350 per ton.

At the representative site, soil remediation has not been completed to date, but the total costs to clean up PFAS-impacted soil are projected be somewhere between **$12M to $54M**.

2 Data derived from Ironshore technical engineers and consultants, 2020.

These costs are substantially higher than the costs associated with transporting and disposing of petroleum hydrocarbon-impacted soil, which can be managed at costs ranging from $50 to $165 per ton. Further, while the remediation technologies for PFAS are limited at this time, there are other remedial technologies available that may be more cost-effective at remediating petroleum hydrocarbon impacts in soil, depending on site-specific conditions.

Groundwater remediation

Proven technologies to treat PFAS in groundwater are limited to ex-situ technologies that include groundwater extraction wells and above groundwater treatment systems consisting of either granular activated carbon (GAC) or ion exchange resins. Groundwater extraction and treatment systems were best-available treatment technology for many contaminants 30 years ago; however, more cost-effective treatment techniques have been developed over past decades and are more commonly being used to address other contaminants in groundwater at this time.

Given the limited technologies to treat PFAS impacts in groundwater at this time, the costs to address PFAS in groundwater will likely be much greater than the costs to treat other contaminants (e.g., petroleum hydrocarbons). The costs to treat PFAS-impacted groundwater are dependent on the size of a PFAS groundwater plume and the concentrations of PFAS in groundwater, with the driver of the costs being directly related to concentrations of PFAS in groundwater. With the relatively low cleanup levels required for PFAS impacts in groundwater, a groundwater extraction and treatment system may need to operate as long as 30 to 40 years to clean up groundwater, resulting in significant operation and maintenance costs. In addition, with the relatively low standards for the discharge of PFAS from a treatment system, PFAS water treatment systems typically consume significantly greater amounts of GAC or ion exchange resins relative to other contaminants, further increasing the additional operation and maintenance costs.

At the representative site, groundwater cleanup activities have not yet been performed for PFAS impacts; however, remediation costs of pre-existing historical PFAS impacts and the possibility of some inclusion from the recent PFAS release are projected to range from approximately **$10M to $15M.**

Stormwater runoff treatment

If PFAS impacts in soil are not addressed following a fire response, stormwater runoff across an area of PFAS-impacted soil may be required to be addressed depending on site-specific conditions and state or local regulations. Stormwater runoff can be treated using an above-ground treatment system; although procuring a permit to discharge treated water with potential PFAS impacts may not be a viable option depending on local regulations. Alternatively, stormwater can be collected and disposed of at an off-site facility, which is the method that was used to manage stormwater runoff in this recent claim.

At the representative site, approximately 800,000 gallons of stormwater runoff were collected, transported, and disposed of at an off-site hazardous waste management facility in a single year at an approximate unit cost of $2.25 per gallon — an approximate total stormwater management runoff cost of **$1.8M**.

Again, for comparison purposes, petroleum-impacted stormwater can typically be managed as a nonhazardous waste at costs ranging from $0.50 to $0.75 per gallon.

Lessons learned

Emergency spill response and environmental cleanup of PFAS from the use of legacy AFFF for firefighting at energy sector facilities can readily cost tens of millions of dollars.

Insurance premiums should be calibrated on the true spectrum of environmental liability associated with energy sector clients, virtually all who use AFFF at their facilities or have emergency response forces that use AFFF.

Implement loss control measures to help prevent avoidable use of legacy AFFF, contain releases when legacy AFFF is used, and avoid confusion with PFAS impacts from historic AFFF releases.

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