PFAS Forum: Cleanup and Upcoming Regulations

A Summary Report

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AFFF spill, St. Cloud Army Aviation Support Facility

About the Forum

The chemical family PFAS (per- and polyfluoroalkyl substances) has been attracting attention over the past 20 years as experts have grown increasingly aware of the health and environmental risks of certain PFAS compounds. Among many other products, PFAS are key components in the aqueous film-forming foam (AFFF) used to fight petroleum-based fires at aviation facilities.

Efforts to prevent and clean up PFAS discharges have been accelerating in recent years; state and federal regulatory agencies have been instituting policies that prioritize PFAS mitigation and require accountability from facilities that use the chemical. Because of their firefighting systems, airports will be included in these new policies.

In practice, however, removing PFAS foams from airports and monitoring for contamination are logistically and financially difficult. To address these challenges, a forum held on April 5, 2022, in Rochester, Minnesota, gathered environmental experts, state and federal regulatory officials, and airport managers to discuss how best to transition away from PFAS.

The event was sponsored by the MnDOT Office of Aeronautics and administered by the Airport Technical Assistance Program (AirTAP) at the U of M Center for Transportation Studies, in partnership with Minnesota's Local Air Service Action Committee (LASAC).

Strategies for containing and mitigating PFAS contamination

Soil and sediment

- Excavation/dredging
- Containment vaults/capping
- Incineration
- Stabilization/binding
- Soil washing

Groundwater

- Pump and treat:
  - Granulated activated carbon (GAC) and other carbon filtration methods
  - Ion exchange
  - Reverse osmosis
  - Foam fractionation
- Injection/barrier walls
  - Colloidal carbon

A PFAS Overview—And Why You Should Care

Speakers: Ginny Yingling, Hydrogeologist, Minnesota Department of Health; Justin Barrick, Environmental Specialist, Minnesota Pollution Control Agency

PFAS is a family of chemicals that includes between 5,000–9,000 compounds, Ginny Yingling explained in the forum's opening session. PFAS consist of a chain of carbon atoms wrapped in fluorine, which makes them water-and heat-resistant and therefore very useful for manufacturing. They can be broken into two sub-groups: perfluorinated and polyfluorinated compounds.

Perfluorinated substances have historically been considered the more dangerous group, as their tight fluorine coating is difficult to break into shorter PFAS chains. Longer chains are generally less water-soluble,

which means they're more likely to bioaccumulate in body tissues rather than being metabolized. The most well-known PFAS compounds—PFOS and PFOA—belong in this category.

"These perfluorinated PFAS are the ones that are so persistent," Yingling said. "They're the ones that we have the most health information about, and so this is where most of the focus has been."

Polyfluorinated compounds (often called "next generation" chemicals) have historically been considered safer because they have at least one carbon atom that isn't surrounded by fluorine. This makes it possible for them to break down into shorter chains, which are more water-soluble and less likely to bioaccumulate in body tissues.

"But there're still lots of questions about how much less toxic they are," Yingling said, as shorter-chain PFAS might still bioaccumulate in other parts of the body.

Health problems associated with PFAS contamination include:

- Liver effects
- Immunological effects (decreased vaccination response, asthma)
- Developmental effects (reduced birth weight)
- Endocrine effects (thyroid disease)
- Reproductive effects (decreased fertility)
- Cardiovascular effects (pregnancy-induced hypertension)
- Cancer (testicular, kidney)

Yingling noted that many of these problems affect highly vulnerable segments of the population such as pregnant women and breastfeeding infants.

PFAS compounds, Justin Barrick said, are found in many common household goods—such as fishing line, sunscreen, and lipstick—because of their heat- and water-resistant properties. They also appear as a manufacturing byproduct (as in the case of metal finishing and Teflon). In the case of airports, PFAS are mostly found in aqueous film-forming foams (AFFF), which are used to suppress fuel fires. PFAS also turn up in hydraulic fluid and in the fireproof lining of firefighting clothing.

Products that risk releasing PFAS don't always have it listed as an active ingredient on the back, since PFAS is often a breakdown product, Barrick said. Terms such as "fluorosurfactant," "fluoroprotein," and "C6" often indicate that the product might contain PFAS.

The main route by which humans are exposed to PFAS is through drinking water, Yingling said. PFAS can be readily transported by both surface and groundwater, and statewide sampling conducted by the MDH Drinking Water Protection program has found PFAS contamination in 67 percent of municipal systems. The concentrations are usually low and the compounds are generally the less-dangerous varieties, but it's still an alarming trend, Yingling said.

"Because PFAS can travel so far, it's become a major concern for drinking water," Yingling said.

At airport sites, PFAS contamination generally occurs when there's a release of AFFF. This can happen when the fire suppression system goes off in an emergency, Barrick said. However, until very recently, the actual main source of contamination was training and maintenance.

Regulations issued by the Federal Aviation Administration (FAA), known as Part 139, require that AFFF be kept on site for most airports. Until recently, FAA inspections also required that airports regularly test their proportioning systems and conduct fire suppression training using AFFF.

Even if an airport isn't in close proximity to a public well, Barrick said, these releases can be a huge concern for the users of private or public drinking water wells.

"Once it gets in the ground, you've got a more complicated [situation] to worry about because you don't know exactly which way that groundwater is flowing," Barrick said.

FAA regulations have since changed; though AFFF is still required to be kept on site for emergencies, it is no longer required in testing and maintenance.

PFAS contamination remediation is unfortunately still relatively limited, and scientific understanding of PFAS compounds is ongoing and evolving, Yingling said.

"I know it's been dizzying over the last 20 years to try to keep up with what is the health advice for PFAS,"

PFOS contamination warnings

- The Minnesota Pollution Control Agency's site-specific criteria for PFOS concentrations in select surface waters is 0.05 nanograms of PFOS per liter of water, and the limit on PFOS concentrations in fish is 0.37 nanograms of PFOS per gram of fish tissue. (See www.pca.state.mn.us/sites/default/files/p-gen1-22.pdf.)
- The Minnesota Department of Health has published guidelines for fish consumption and a list of bodies of water in the east metro area from which vulnerable populations should avoid eating any fish because of PFOS contamination. (See www.health.state.mn.us/communities/environment/fish/#waterbody.) The list includes:
  - Lake Elmo
  - Horseshoe Lake
  - Eagle Point Lake
  - Rest Area Pond
  - Tartan Pond
  - West Lakeland Ponds
  - Mississippi River

she said. "It's been a long and rapid evolution, and it's not going to get better anytime soon." That's because the situation will continue to evolve as more is learned about these chemicals—and as more are added to the list of chemicals for which growing research supports setting guidance values for them, she noted.

How Regulatory Agencies are Addressing PFAS

Speakers: Justin Barrick, Environmental Specialist, Minnesota Pollution Control Agency; Ginny Yingling, Hydrogeologist, Minnesota Department of Health

The Centers for Disease Control and Prevention first began monitoring for PFAS in 1999, and since then nearly 100 percent of human blood samples in the United States have shown some degree of PFAS contamination. The concentrations of PFOS have been declining since 1999, Barrick said, but the fact that PFAS is in our blood can still be alarming.

In 2008–2009, the Minnestoa Pollution Control Agency (MPCA) and Minnesota Department of Health (MDH) conducted a statewide evaluation of fire training areas and nearby drinking water. PFAS were discovered in low concentrations at almost every location, and several standout locations were identified where PFAS exceeded EPA guidelines (including the Bemidji Regional Airport and the Duluth Air National Guard Base at the Duluth International Airport).

In November 2020, the EPA issued an interim PFAS policy, which requires any facility with potential PFAS contamination to set up a monitoring program in order to obtain a National Pollutant Discharge Elimination System (NPDES) Clean Water Act permit.

In February 2021, the MPCA published its PFAS Blueprint, which was the impetus for the draft Monitoring Plan (finalized in March 2022).

The general goal of the finalized Monitoring Plan, Barrick said, is to gather Minnesota-specific data and identify PFAS contamination sites. The plan includes a list of facility types (identified by NAICS code) that are closely associated with PFAS contamination and that will need to start taking steps to monitor for the chemical. Airports that use AFFF under Part 139 are included on this list.

Finding accredited labs to test for PFAS

Accredited labs qualified to conduct targeted PFAS analysis can be found on the MDH's website: https://eldo.web.health.state.mn.us/public/accreditedlabs/labsearch.seam. Users can type in the PFAS compounds they specifically want to test for. The cost of targeted analysis can run $300–$500, depending on the laboratory and shipping costs.

Starting in 2022, airports that use AFFF must start taking stormwater tests for PFAS contamination, Barrick said. Two or three quarterly samples should be taken from precipitation events within the first half hour of the stormwater discharge, and each set of tests should include a minimum of two testing locations:

- A Benchmark Monitoring Location (BML), to establish a baseline.
- An Area of Concern (AOC), usually where AFFF training/maintenance activities have been happening.

The samples should then be sent to a lab for targeted analysis (which specifically tests for the 30–40 testable PFAS compounds rather than the full 5,000–9,000 compounds). The facility's next steps will be determined by the outcome of the analysis:

- Concentrations under 10 parts per trillion—Broadly, nothing further needs to be done, though facilities should keep in mind that this threshold might change as scientific understanding of PFAS changes.
- Concentrations above 10 parts per trillion but below 1,000—The facility should identify where the PFAS is coming from and submit an exposure-reduction plan to the MPCA within 180 days of the last sampling quarter.
- Concentrations above 1,000 parts per trillion—The facility should identify where the PFAS is coming from and submit an exposure-reduction plan to the MPCA within 90 days of the last sampling quarter.

Barrick recommended that airports inventory AFFF and other products that may contain PFAS.

"The earlier you can eliminate or reduce your exposure, the better off we're all going to be," Barrick said. "It's new to everyone and it's complicated stuff. I'll try to work with you all…as we move forward."

Moving forward, the MDH Drinking Water Protection Program is in the process of conducting a statewide sample of 965 Minnesota community water supply systems using a grant from the EPA, Yingling said. The work will result in a PFAS contamination map that airports can reference when conducting their own monitoring.

The FAA's Aircraft Rescue and Fire Fighting (ARFF) research facility

Progress Report from the FAA: Developing a Fluorine-Free Foam

Speaker: Robert Craven, Director, FAA Office of Planning and Programming

To mitigate PFAS release, the FAA revised its AFFF regulations in 2021, specifying that airports falling under Part 139 do not need to use AFFF when conducting systems tests and firefighting training.

"We researched and approved the use of four input-based testing systems that allow airports to test the proportioning systems of their fire trucks without actually dispersing any PFAS," said the FAA's Robert Craven. The FAA also allows airports to substitute water when conducting firefighting training.

Firefighting foam that meets military specification safety regulations is, however, still required to be kept on-site for actual emergencies, Craven said. Currently, AFFF is the only available foam that meets these requirements. The next big step, therefore, is developing a viable replacement.

Craven said the FAA has been working in partnership with the US Department of Defense (DOD) to develop a fluorine-free replacement for AFFF. In 2019, an aircraft rescue and firefighting testing facility was built to test new and in-development foams. Around 400 tests have been conducted on 15 commercially available prototype foams.

The deadline for the new military specification (Mil-Spec) foam, as specified by Congress, is January 2023, and Craven said that the FAA expects to meet this deadline. Once the new foam becomes available, airports will be required to replace their AFFF.

The distribution process is yet to be determined, Craven said, and the FAA and DOD are still testing whether the new product can be "dropped into" existing equipment or if airports will have to modify or clean their equipment in preparation.

"As the FAA and DOD get closer to understanding the actual Mil-Spec expected, we should have a better understanding of the supply and demand expectations," Craven said. "If needed, we will assist with prioritization, AFFF equipment needs, and policy as permitted by statute."

Shore-Based Versus Sea-Based Specifications

Robert Craven of the FAA said two versions of the Mil-Spec foam will likely become available for general use:

- Shore-based specifications: foam that can be mixed with fresh water for land-based facilities.
- Sea-based specification: foam that can be mixed with salt water for naval vessels.

According to Craven, if the foam passes the required performance objective testing found in the specification, it will be placed on the Navy's Qualified Product Database.

Bemidji's water treatment plant

A Case Study of PFAS Contamination Cleanup: Bemidji Regional Airport

Speaker: Karen Weller, Executive Director, Bemidji Regional Airport

Bemidji Regional Airport was one of the earlier, well-known cases of PFAS contamination in Minnesota. Executive Director Karen Weller said the facility initially bought its AFFF in the late 1990s from 3M and used it to test proportioning systems and firefighting training as required for FAA certification inspections.

In 2008–2009, the statewide PFAS survey conducted by the MPCA and MDH found possible signs of contamination at Bemidji. Various levels of PFAS turned up at all five of the wells within the airport's grounds, but the levels were, at the time, below the statutory limits set by the MDH, Weller said.

PFAS testing grew more precise, however, and regulations grew tighter as the health effects of the chemicals became more well understood. In 2011, an MPCA follow-up survey listed Bemidji Regional Airport as one of the sites where PFAS limits exceeded state health risk limits.

In 2018, the airport was required to release more AFFF as part of the FAA certification inspection, which had not yet revoked the necessity of spraying AFFF as part of equipment testing.

"We had already realized that the foam was a big issue and we shouldn't be spraying it," Weller said. "Then what we had to do was report it as a spill to the Minnesota State Duty Officer."

Two groundwater samples showed PFAS levels exceeding MDH guidance. However, since it was a limited release, Weller said that Bemidji has requested a letter of "no further action" from the MDH and is waiting to hear back on this matter.

Since then, Bemidji Regional Airport has been taking steps to clean PFAS contamination from its well water and mitigate any future releases, Weller said. In December 2019, the facility disposed of its remaining AFFF to a company called PegEx, which incinerated around 550 gallons of the foam at a cost of about $4,500.

The airport also switched to a shorter-chained, C6 fluorosurfactant foam that was approved by the FAA, and it bought a new truck with an input-based testing system.

"We made an agreement with the city that only water will be sprayed during our certification and no foam will be sprayed unless it's an actual emergency," Weller said.

In 2021, the City of Bemidji began installing a granulated activated carbon treatment facility to remove PFAS from the well water. Phase One, which is complete, cost around $7.4 million to build and has a treatment capacity of 2.1 million gallons of water per day. Phase Two, which is in the works, is expected to cost around $12 million and will have a capacity of 3.6 million gallons per day.

Going forward, Weller said, the City of Bemidji will continue to monitor and filter the well water, and the Airport Authority will not discharge AFFF unless it is an actual emergency.

PFAS Response: The Michigan PFAS Action Response Team Grant Program

Speaker: Bryan Budds, Deputy Administrator, Michigan Department of Transportation Office of Aeronautics

The Michigan PFAS Action Response Team (MPART) was created as a temporary body in 2017 (later made permanent in 2019) to investigate PFAS sources and locations within Michigan and to protect public drinking water and health. It serves as an early example of how to effectively organize a state's PFAS response.

"It pulls together just about every state agency here in Michigan and it serves as the overarching body to direct the state's response to PFAS," said Bryan Budds with the Michigan DOT Office of Aeronautics. "It's really an all-hands-on-deck approach."

MPART has been putting particular focus on issues surrounding AFFF; the organization began having early conversations at the state level with a wary eye on what the FAA would decide to do about PFAS contamination, Budds said. By the time the FAA released its approved testing methods, MPART had already set aside funding to purchase input-based testing carts and was able to deploy the carts within 12 months.

The State of Michigan then led an effort that collected about 45,000 gallons of AFFF from fire departments and airports around the state at a cost of around $1.5 million. A second round of collections is currently in the works.

The next stage, Budds said, is conducting statewide testing for PFAS. MPART has been investigating over 200 PFAS sites, and the state has allocated $4 million—distributed evenly between 19 commercial airports within the state—to test for contaminants.

"Pretty much everywhere we've looked for it on the airport front, we've found some sort of PFAS contamination, and it's a rather costly endeavor to even test there," Budds said.

MPART secured additional funding during the last state funding cycle to investigate mitigation techniques at commercial service airports, Budds said, and the organization has been looking into the possibility of federal-level partnerships to obtain more mitigation funds.

"There are lots of unique issues on the testing side," Budds said, "and probably lots of issues to contend with going into the future."

Organizations within MPART

- Michigan Department of Environment, Great Lakes, and Energy
- Michigan Department of Health and Human Services
- Michigan Department of Agriculture and Rural Development
- Michigan Department of Natural Resources
- Michigan Department of Transportation
- Michigan Department of Licensing and Regulatory Affairs
- Michigan Department of Military and Veterans' Affairs

The CERCLA Cleanup Process: Minnesota Army National Guard

Speakers: Russell Howard, Senior Environmental Program Administrator, Minnesota Army National Guard; Joe LaForce, Environmental Expert, Minnesota Army National Guard

The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) is an EPA program enacted in the 1980s. It provides broad federal authority to directly respond to hazardous substance releases and uses tax funds from the chemical and petroleum industries to clean up abandoned or uncontrolled hazardous waste sites.

Russell Howard and Joe LaForce, environmental experts with the Minnesota Army National Guard, shared their experiences with the CERCLA process after a PFAS release at the St. Cloud Army Aviation Support Facility.

The facility has around 80,000 square feet of hangar space and a 1,300-gallon AFFF fire suppression system. In June 2013, a thunderstorm rolled through the area and is thought to have triggered the system, Howard said. The AFFF was released into the hangar and later had to be pushed into the facility's stormwater retention basin.

Howard noted that since the facility is federally supported, it was required to undertake the CERCLA cleanup process.

"However, even if you're not a federal facility, the CERCLA process gives you a great framework to guide you through a cleanup project," Howard said.

The steps in the CERCLA process include:

- Preliminary assessment
  - Review historical documents, interview past and present personnel, perform site reconnaissance.
  - Generally identify and document potential releases.
- Site investigation
  - Conduct a limited-scope physical investigation, including soil borings and groundwater samples.
  - Determine whether there was, in fact, a "chemical of concern" release, the extent of the release, and collect data that might be needed later for remediation.

- Remedial investigation/risk assessment
  - Determine the extent of the contamination and perform ecological/human risk assessment.
  - Determine what level of remediation action will be needed.
- Feasibility study
  - Examine different remedial actions and determine which would be most appropriate for the site. This includes weighing pros and cons, plotting out a remediation timeline, and conducting cost analysis.
- Proposed plan
  - Make a good-faith effort to disclose remediation plans to the public.
  - Present the plan at city council meetings, post the plan on a public website for comment, and conduct public outreach meetings.
  - Allow for the required 30-day comment period. If changes have to be made because of public revisions, a new 30-day comment period will be triggered. ("You might have to go through a few of these before you finally settle on something that both you and the public can agree upon," Howard said.)
- Record of decision
  - Create an official document with the final remediation plan.
  - Include cleanup goals, treatment types, and engineering institutional controls and lay out how the plan will protect human health and the environment.
- Remedial design
  - Design the remediation system according to the plan.
- Construction completion
  - Consider the remediation system physically complete at this point and remedial action ready to begin.
- Operational and functional phase
  - Spend a year or longer (depending on the facility) making sure the remediation facility works.
  - If the system meets all its benchmarks within that time frame and no problems arise, send a report to the EPA and the facility's state agency to be signed off on. However, if something goes wrong, the facility may have to go back to the remedial design step and revise the system.
- Operational and maintenance phase
  - Conduct long-term monitoring, which includes submitting 5-year reviews to the state and EPA as well as completing annual progress reports.

AFFF spill in the St. Cloud hangar after the fire system was triggered

- Completion
  - If the state and EPA concur that the facility has achieved all its remediation goals and that the site is within concentration levels, they will give the facility its close-out report.
  - However, be wary of changes to health advisory limits, which might necessitate more remediation efforts, Howard cautioned.

The St. Cloud facility was permitted to stop at the risk investigation/risk assessment step in the process because PFAS were not found above action levels at its site, Howard said.

For anyone going through the process, Howard recommended thinking carefully about how to organize the plan and present the data. Guidance resources on this subject include:

- The US Army Corps of Engineers technical planning process (includes EPA document requirements):
  - https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_200-1-2.pdf
- US EPA Quality Assurance Project Plan:
  - https://epa.gov/sites/default/files/2015-05/documents/assess4.pdf

Howard also stressed that it's important to include pertinent stakeholders throughout the process, especially regulatory agencies such as the MPCA and EPA, both of which need to sign off on remediation efforts once a facility has met its cleanup goals.

A Case Study of PFAS Cleanup: Duluth International Airport

Speaker: Lt. Col. Ryan Blazevic, Aircraft Maintenance Squadron Commander, Minnesota Air National Guard

Similar to Bemidji Regional Airport, the Air National Guard Base at the Duluth International Airport was a facility where the MPCA/MDH drinking water evaluation found possible evidence of PFAS contamination in 2008–2009. A later report from the Department of Defense (DOD) listed the facility as an installation with a known or suspected release of PFOS and PFOA.

"PFAS, PFOS, and drinking water investigations all became air force and international guard priority number one, at the top of our environmental list," said bioenvironmental engineer Ryan Blazevic with the Minnesota Air National Guard.

In 2015, the 148th Fighter Wing of the Minnesota Air National Guard began its primary assessments following CERCLA processes, and in 2016 it spent $6.2 million to replace its AFFF with a shorter-chain C6 foam. Remedial site investigations were conducted in 2018, and the 148th Fighter Wing is currently not using AFFF for maintenance and training. According to Blazevic, the facility plans to switch to a fluorine-free alternative once an approved version is released, which is expected by the end of 2023.

"We're looking at a moratorium of current AFFF use in the DOD by the end of calendar year 2024," Blazevic said.

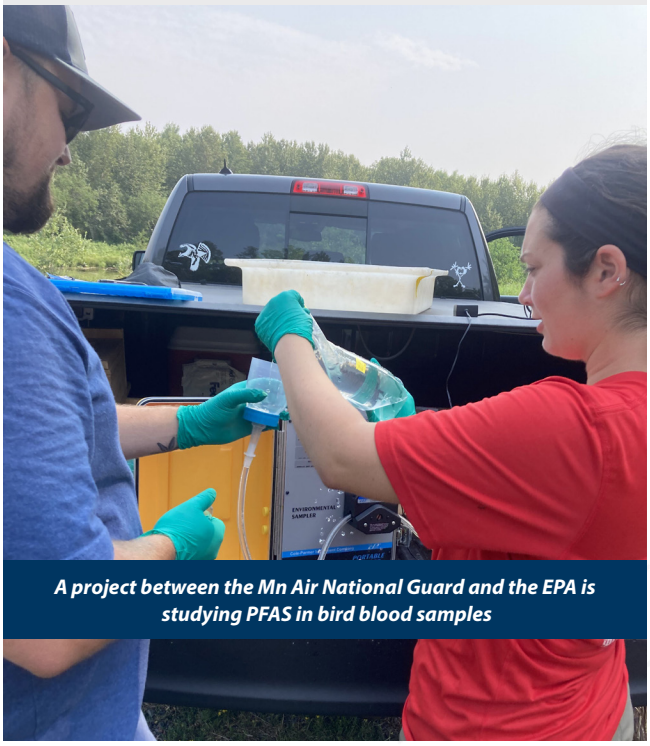
In 2019–2020, the facility produced a communication strategy designed to reach the local community and other stakeholder agencies. Communication and partnerships, Blazevic said, have been integral to the entire process; not only do they allow for greater transparency, but they also make it easier to keep on top of the ever-evolving PFAS research and regulations.

The new monitoring plan will do the job of identifying facilities in need of PFAS cleanup action, Blazevic said. He also expressed hope that the FAA will distribute grant money to assist with cleanup efforts, since airports were using products that were approved at the time.

Blazevic also noted that as of July 2020, the State of Minnesota is requiring that any PFAS discharge of any size be reported to the state within 24 hours of the release. He recommended that facilities develop a good documentation system to help comply with these requirements.

Ongoing PFAS research

- The 148th Fighter Wing of the MN Air National Guard is currently partnering with the EPA on a project studying PFAS uptake in bird blood samples near the airport (pictured above and below).
- The University of Minnesota School of Public Health is conducting DOD-funded research into PFAS treatment methods; see https://sph.umn.edu/news/tackling-persistent-pollutant/.



A project between the Mn Air National Guard and the EPA is studying PFAS in bird blood samples

For Further Information

Minnesota State Agency Panel Perspective on PFAS

- CRF 2012 Title 14 Vol. 3, section 129-317. https://www.govinfo.gov/content/pkg/CFR-2012-title14-vol3/pdf/CFR-2012-title14-vol3-sec139-317.pdf
- Federal Aviation Administration Certalert, Part 139, Extinguishing Agent Requirements. www.faa.gov/airports/airport_safety/certalerts/media/part-139-cert-alert-21-05-Extinguishing-Agent-Requirements.pdf
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The CERCLA Cleanup Process: Minnesota Army National Guard

- U.S. Environmental Protection Agency. Superfund: CERCLA Overview. https://www.epa.gov/superfund/superfund-cercla-overview
- National Guard Facility Report. www.nationalguard.mil/Environmental/PFAS/

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