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House Armed Services Committee
Subcommittee on Readiness

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Chairman Garamendi, Ranking Member Lamborn, and distinguished members of the Sub-Committee. Thank you for the opportunity to discuss DoD's research, development, and demonstration program related to per- and polyfluoroalkyl substances (PFAS) and a replacement for Aqueous Film Forming Foam.

Background:

PFAS are a large class of chemicals which are present in many industrial and consumer products because of their unique properties that result from the strong carbon-fluorine bonds. As such, they are not uniquely attributable to Department of Defense (DoD) activities.

DoD began large-scale use of PFAS for firefighting in the 1970s, with the introduction of aqueous film forming foam (AFFF) for use against aircraft fuel fires. Other major users of AFFF include commercial airports, the oil and gas industry, and local fire departments. AFFF is mission critical because it quickly extinguishes petroleum-based fires, thus minimizing loss of life and secondary damage from munitions.

DoD has two related programs that involve environmental research, development, and demonstration. The first is the Strategic Environmental Research and Development Program (SERDP), as its title states, is our environmental research and development program, and is planned and executed in partnership with the Department of Energy (DOE), and the Environmental Protection Agency (EPA). The second is the Environmental Security Technology Certification Program (ESTCP) which is DoD's environmental demonstration and validation program. Both programs seek to harness the best science and technology to improve DoD's environmental performance, reduce costs, and enhance and sustain mission capabilities.

These two programs are leading the DoD's R&D efforts on PFAS remediation and a PFAS-free alternative to AFFF through individual research and demonstration projects led by investigators from academia, industry, DoD laboratories, and other Federal agencies. Each of the programs issues an annual call for proposals on topics developed with input from experts in the Military Departments and our partners, DOE and EPA. Potential investigators submit a brief pre-proposal and then, if requested, a full proposal for a research or demonstration project. The full proposals are ranked according to merit and DoD applicability by these same panels of experts and, based on available budgets, funding decisions are made. Both standard, multi-year projects and one-year proof-of-concept projects are supported.

Research and Development Efforts on PFAS Remediation:

The Department is investing over $95 million in research and development related to PFAS remediation. We are making significant progress on several fronts. In particular, there are currently final EPA-approved analytical methods for measuring 29 PFAS in drinking water only, and we're working closely with the EPA to develop new methodologies for PFAS analysis of soil, groundwater, wastewater, and several other mediums. We expect these draft methods to be available early next year. We also have several field demonstrations in place for treatment methods for PFAS in soil and water; these demonstrations should be near completion within the next 18-24 months.

SERDP initiated research into the fate, transport, and remediation of perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) shortly after EPA released the 2009 Provisional Health Advisories for these compounds. Beginning in 2014, follow-on research has targeted developing several approaches for treating groundwater containing PFOS and PFOA. These efforts have matured from small scale laboratory projects to field demonstrations that began under ESTCP in 2017 and have continued into 2020 as new technologies mature and are ready for field demonstration.

We began with what we assumed would be fairly straightforward research to develop treatment technologies, but we soon realized that it was a much more complex issue, and our research expanded into four areas that cover the scope of PFAS in the environment:

- Sampling and Analysis. Sampling and analysis is critical to all of our work on PFAS; a few years ago, we didn't have the analytical capability to be able to measure these chemicals in all affected areas of the environment. Today, our methods are much improved and we currently have a program jointly with the EPA to expand our ability to measure PFAS so that we can have a more accurate assessment of which PFAS chemicals are present and at what concentration.

- Fate Transport and Characterization. We've also funded research to understand which PFAS chemicals are most likely to be present in association with DoD facilities and operations, and how they break down naturally and move in the environment. This helps us to better predict what types of sites may be more likely to be a serious concern. Our most recent focus in this area has been on developing a forensics approach so that we can understand the origins of PFAS found at a specific location; these studies were just started in 2020.

- Ecotoxicity. Our ecotoxicity program is focused on developing an understanding of how these chemicals affect sensitive wildlife species, such as fish and birds. We've been studying the impact of PFAS and recently have expanded to look at the ecotoxicity of some of the PFAS-free firefighting foams.

- Treatment. We've invested the most resources on improving treatment of PFAS impacted sites. This has included developing technologies to treat groundwater at its source as well as once it's pumped aboveground. The treatment approaches have included building on what

we already know by improving existing technologies, such as granular activated carbon or GAC, as well as developing new technologies once we've better understood the chemistry of these materials. We've also recently expanded our research work to explore technologies that could be alternatives to incineration; we have several promising technologies that have passed initial testing including, for example, plasma destruction, smoldering combustion and hydrothermal treatment. In support of these alternative treatment efforts, we've also had a small field effort with the EPA to assist in developing PFAS air emission detection methodologies. Much of this initial work is focused on developing the sampling and analytical methods so that we can detect these chemicals in the emissions.

We consider it essential that our investigators talk to each other and be aware of the methods and results of other work we're funding. To encourage this sort of interaction, we've hosted several workshops and project meetings over the last several years. These workshops have served the purpose of better investigator collaboration, but have also let us identify data gaps that have led to more targeted strategic plans for addressing PFAS in the environment. These workshops have become annual events as the program has grown larger. Summary reports for each of the workshops are available on the SERDP and ESTCP web site (https://www.serdp-estcp.org).

Research and Development Efforts on AFFF Replacement:

Currently available AFFF does not contain PFOS or PFOA, two legacy compounds, above the 800 part per billion (ppb) limit of quantitation. However, these AFFF still contain other PFAS. None of the commercially available PFAS-free foams meet DoD's strict safety standards to rapidly extinguish dangerous fuel fires and prevent their re-ignition during rescue operations. One of the Department's top priorities is finding an effective firefighting alternative that meets the life-saving performance standards of AFFF and does not have negative health or environmental effects.

SERDP and ESTCP are funding over $10 million in this area in FY 2020 with a total of $50 million partially spent and committed through FY 2025 for research, development, testing, and evaluation to identify alternative firefighting material and practices. SERDP and ESTCP are working to increase the world-wide investigator capacity through outreach efforts and technical workshops.

SERDP and ESTCP have initiated four major lines of effort directed toward a PFAS-free alternative to AFFF:

- Development of Alternative to PFAS-containing AFFF. SERDP initiated research into PFAS-free foam formulations in Fiscal Year (FY) 2017 and have since expanded the effort into investigations of non-foam firefighting and innovative equipment and techniques. There are ten active projects in FY 2020 with an additional call for proposals for FY 2022 under development. Some of these projects are producing formulations that will transition to demonstration testing this year and next with others focused on longer term understanding of foam performance that will support future improvements to firefighting formulations.

- Demonstration of PFAS-free Formulations. ESTCP has an on-going program to demonstrate both developmental and commercially available PFAS-free formulations against the requirements of the current Military Specification (MILSPEC). These demonstrations are designed to document in detail the performance of each formulation tested to both provide feedback to the researchers and developers of the formulations and to gather data to support a revised MILSPEC, if required. These demonstrations initially involve tests at lab-scale with promising formulations progressing to 28-sq-ft and then 400 sq-ft demonstration fires. As of the end of August, sixteen unique formulations have been tested using standard military delivery hardware as well as experimental delivery methods and nozzles. This has totaled over 300 28-sq ft tests and 36 400 sq-ft tests.

- Ecotoxicology of PFAS-free formulations. As discussed above, SERDP has an ongoing program examining the ecotoxicology of PFAS compounds. In FY 2020, we initiated six projects to investigate the ecotoxicology of the PFAS-free alternatives. These projects, which are focused on a variety of species and environments, are using both commercially-available and developmental formulations in their test programs.

- Cleaning Technologies for Firefighting Equipment. Once a PFAS-free alternative formulation is identified, existing firefighting equipment, both Aircraft Rescue and Firefighting (ARFF) trucks and hangar systems, will need to be cleaned of PFAS residues to avoid costly replacement of the equipment. It is known that the standard procedure of a triple-rinse with clean water does not remove sufficient residual PFAS to allow reuse of the equipment. ESTCP initiated six projects in FY 2020 to demonstrate technologies to clean the equipment of residual PFAS and decontaminate the rinsate.

To ensure that all participants in our research and demonstration projects are aware of results from other projects and to efficiently identify data gaps and needed investigations, SERDP and ESTCP have hosted three workshops and a number of project meetings on this topic in the last two years. The initial workshop, "AFFF Alternatives: The Art of the Possible" was held November 15, 2019, and allowed representatives from the research community, industry, academia, and international organizations to discuss the challenges with finding a fluorine-free alternative to AFFF and potential research opportunities. At follow-up workshops in January and August 2020, we focused on technical details of the issue; participants discussed the barriers to development of an alternative in the areas of formulations, delivery systems, and ecotoxicology. As in the case of the PFAS program, workshop summaries are posted on the SERDP and ESTCP web site as soon as they are cleared for release.

These workshops and project meetings also allow SERDP and ESTCP to coordinate our efforts with on-going work by other Federal agencies and international partners. We are closely coordinated with the Federal Aviation Administration (FAA), involving both engineers at the FAA Technical Center in New Jersey and at Headquarters. However, live fire testing with our interagency partners to find an effective alternative was delayed due to COVID-19. The testing facilities were shut down in March 2020, and have recently reopened to resume testing. We are in close contact with scientists at EPA and the National Aeronautics and Space Administration (NASA). Scientists and managers from the European Union countries, Canada, and Australia participate in our workshops and we are in contact with Japanese industries to involve their

formulations in our demonstration program. Finally, we exchange results with the testing being conducted by an international industry consortium looking at fires in large fuel storage tanks.

Conclusion

In summary, DoD is investing significant resources in research to develop fluorine-free substitutes for AFFF that meet the military's stringent performance criteria, and to develop technologies to quantify and clean up PFOS and PFOA and related PFAS chemicals. These are very difficult problems but we have assembled investigators from academia, industry, and DoD and other federal laboratories to solve them and several technologies have advanced from the laboratory to pilot-scale testing at DoD installations with more on the way. The work supported by SERDP and ESTCP, in conjunction with work on-going at other federal agencies and internationally, will contribute to the solution of these national issues.