Testimony of

M. John Plodinec, Ph.D.
Vice Chair of the Committee on
Independent Assessment of Science and Technology for the Department of Energy's Defense Environmental Cleanup Program
For the National Academies of Science, Engineering and Medicine

Before the

Committee on Science, Space and Technology

United States House of Representatives

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Chair Bowman, Ranking Member Weber, and Members of the Subcommittee: Thank you to for inviting me to speak to you today. I'm John Plodinec, and I served as Vice-Chair of the National Academies of Sciences, Engineering, and Medicine's (NASEM's) Committee on Independent Assessment of Science and Technology for the Department of Energy's Defense Environmental Cleanup Program. I received my doctorate in physical chemistry from the University of Florida. I have nearly 50 years of experience developing science and technology for the Department of Energy's Environmental Management program and for other programs.

The Department of Energy's Environmental Management program (DOE-EM) has the daunting task of cleaning up the legacies of the Manhattan Project and the Cold War. These reside in 16 DOE sites across the country. They range from contaminated pieces of equipment to entire buildings to the millions of gallons of high-level wastes stored in tanks at Savannah River and Hanford. They pose a variety health risks both radiological and chemical.

In FY 2018, at the request of Congress in Section 3131 of the National Defense Authorization Act of 2017, NASEM formed our committee to

- *Review DOE-EM's technology development efforts, including an assessment of the processes by which technologies are identified and selected for development.*
- *Provide a review and assessment of the types of technologies and / or alternative approaches for the DOE-EM cleanup program that could*
    - *Reduce long-term costs;*

- *Accelerate schedules;*
- *Mitigate uncertainties, vulnerabilities and / or risks, or otherwise significantly improve the cleanup program.*

The return to DOE-EM from investments in science and technology are captured in the last three bullets – cost reduction, cleanup acceleration, and risk and uncertainty reduction.

The Committee was informed by EM (in 2018) that the program would require at least another half-century to complete at a cost of almost $400 billion. The cleanup of tank wastes and facility decommissioning are major drivers of the overall cost of cleanup and the long duration of the program. The Committee recognized the great uncertainty in these numbers for EM's current scope because much of the waste currently has no identified path for disposal. In addition, other sites or facilities (e.g., from the National Nuclear Security Administration) may be added to EM's scope in the future.

In short, the cleanup program and EM's mission will continue to be very expensive and last a very long time. Its ultimate endpoint is uncertain. The underlying – but unstated – assumption of our report (and several earlier reports focused on EM's science and technology efforts) is that a robust science and technology (S&T) program can lead to breakthroughs that will reduce the costs and duration of this program. Underlying our findings and recommendations was an implicit understanding that a successful S&T program has three phases (These are consistent with the U.S. Government Accountability Office's stages of development):

- Knowledge generation (i.e., Science and Technology, S&T),
- Knowledge tailoring (i.e., technology development for specific needs),
- Knowledge use (i.e., deployment in the field).

The Committee's findings and recommendations touched on all three, while focusing on the first two. However, it is important to recognize that no matter how robust a DOE-EM S&T program may be, **a positive return on investment requires successful deployment of the knowledge it has generated**.

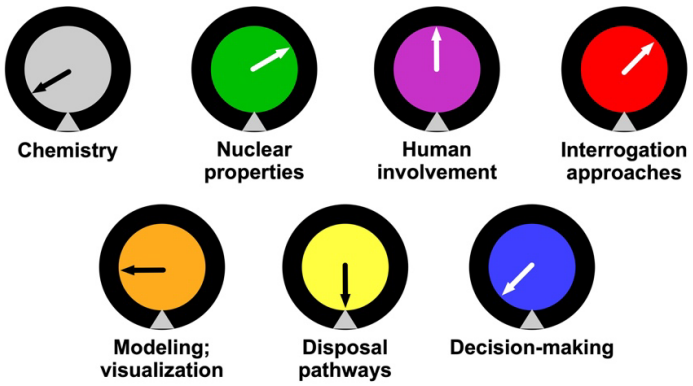
The Committee found that DOE-EM relies on site contractors to identify S&T needs, and to make the investments to meet those needs. The Committee concluded that **DOE-EM's S&T needs are primarily *long-term,* and unlikely to be addressed by contractors focused on *near-term* cleanup projects**. We found virtually no evidence of a comprehensive EM S&T program aimed at achieving a high return on investment: lower costs, quicker cleanup and reduced risks and uncertainties.

The Committee recommended the following steps to establish a well-managed comprehensive S&T program with the potential for a high return on investment.

- An independent assessment by a technically competent entity (e.g., the Corps of Engineers) of cleanup program costs, schedules, uncertainties and risks aimed at identifying areas in which S&T can make a positive contribution. For example, the Committee was informed that there were literally thousands of items for which no path to disposal had been identified.

- Development and implementation of a formal S&T management process and program by DOE-EM.
- As part of DOE-EM's S&T program, a portion should be specifically directed toward breakthrough developments with high-return on investment. The Committee recommended that this program should be managed by the Advanced Research Projects Agency-Energy (ARPA-E), because of their record of finding innovative solutions to complex problems such as those faced by EM. Even though ARPA-E would manage this portion of the S&T program, DOE-EM would work with ARPA-E to ensure that potential breakthrough technologies were implemented.

The Committee also identified areas where breakthroughs might be found by an ARPA-E program. As shown in the graphic, we saw these as potential "control knobs" that, if properly tuned, could lead to cost reductions, shortened schedules and reduced risk and programmatic uncertainty.



- Waste chemistry at bulk and interfacial scales to facilitate treatment and disposal.
- Nuclear properties of waste to facilitate treatment and disposal.
- Human involvement in cleanup activities to increase cleanup efficiencies and reduce worker risks.
- Interrogation approaches to characterize wastes and monitor cleanup remedies and environmental impacts.
- Modeling and visualization approaches to manage large cleanup- related data sets and improve predictive capabilities.
- Disposal pathways to increase waste disposition options.
- Decision-making approaches to improve the quality and durability of cleanup decisions.

In summary, we found that DOE-EM did not have a comprehensive S&T program that could lead to potential costs savings, schedule reduction or risk mitigation. We provided guidance on how such a program might be structured. We recommended that a portion of that program should be focused on long-term S&T needs, to be carried out by ARPA-E. We also identified technical areas with the potential for cost reductions, shortened schedules and reduced risk. Let me reiterate, however, that to realize this potential, the products of the S&T program must be deployed in the field.

Thank you for your attention. Our report can be found at https://nap.nationalacademies.org/download/25338.

M John Plodinec, Ph.D.

Short Biographical Sketch

After receiving his Ph.D. from the University of Florida, Dr. Plodinec began a career that has spanned nearly 50 years in research and development. His work on radioactive waste characterization and glass processing was an integral part of the design of the Defense Waste Processing Facility at the Department of Energy's Savannah River Site – the nation's first and the free world's largest facility incorporating high-level nuclear waste (HLW) in glass.

Dr. Plodinec also prepared the technical case that led the US Environmental Protection Agency to declare vitrification to be the Best Demonstrated Available Technology for HLW, and for heavy metals. He was named to the Department of Energy's Tanks Focus Area, and coordinated waste immobilization programs across the DOE complex, and internationally. He was the Department of Energy's primary author for the Waste Acceptance Product Specifications, which govern all of the HLW glass products produced in the US. He has regularly been consulted by several of the DOE sites (e.g., Hanford, Idaho, Fernald, Oak Ridge), by DOE headquarters, and by external groups such as the Defense Nuclear Facilities Safety Board, and the Nuclear Waste Technical Review Board.

Dr. Plodinec organized a team from Argentina, SRNL, and ORNL to demonstrate the destruction of nuclear reactor ion exchange resins via vitrification. This was the first project initiated under the US-Argentina Technical Exchange agreement signed in 1996. Dr. Plodinec also headed up a team helping the Indian glass and metal foundry industries to convert to natural gas from coal to prevent further deterioration of the Taj Mahal in India. As part of a NATO-sponsored team, he prepared recommendations that have been followed by the government of Estonia in cleaning up the Sillamae site, reputedly the most contaminated site in Europe.