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Special Issue: National Laboratories' Safety Successes, Challenges, Research, and Approaches

When "Turning Outsiders into Insiders: A Call for Papers to Expand the Reach of National Laboratories' Safety Successes, Challenges, Research, and Approaches"[i] was published, the goal was to provide a platform for showcasing the advanced safety research and safety practices implemented across the National Laboratories, opening a window into the world of scientific discovery in an environment where the mission is to continually stretch beyond what is perceived possible in service to our nation. The U.S. National Laboratories have been working toward this end since World War II. Yet, as we proceed through 2025, we see evidence that the world in which we strive to advance science is fundamentally different from what it was at the time of the National Labs' inception; in today's world, volatility, uncertainty, complexity, and ambiguity — collectively referred to as VUCA — is demonstrably greater than before. VUCA is a concept first documented in U.S. Army War College records in the late 1980s to describe challenging and rapidly changing environments.

In chemical safety, VUCA is embodied in the conditions we often work: shifting hazards, evolving technologies, complex systems, and incomplete information. Acknowledging VUCA in our work encourages us to seek more flexible, proactive approaches to risk assessment, safety planning, and decision-making because the science of today is quickly outpaced by the science of tomorrow (or even later today!).

The National Laboratories strive to be at the forefront of scientific research and deliver on this dynamic demand for advancement. They are, collectively, building the nation's safety capacity to be resilient in the face of VUCA. The articles accepted for this Special Issue (https://pubs.acs.org/page/achsc5/vi/national-lab-safety-successes-challenges-research-approaches) share a glimpse of that effort. This VSI explores:

- A framework to identify events with the potential for serious injury or fatality to better denote resources to their analysis for learning and incident prevention[ii]
- An approach to address mental health and psychological safety proactively during the conduct of high-risk, high-consequence work to increase the likelihood of mission success[iii]
- A summary of the proceedings from the 2024 International Union of Pure and Applied Chemistry's 2024 Symposium on Advancing Chemical Safety and Security, where speakers shared a variety of strategies and practical application techniques for integrating security concepts into safety programs[iv]
- A review of a multiyear, in-depth exploration and comparison of existing and novel personnel nuclear accident dosimetry technologies at National Laboratories, with the potential goal of deriving a nuclear accident dosimeter for universal deployment across the DOE Complex[v]
- Advances in analytical and computational methods for measuring radiation exposure and dose rates[vi]
- Occupational exposure data from manganese inhalation associated with four commonly performed arc welding operations to mitigate the hazards of such work appropriately using a risk-based approach[vii]
- Identified best practices to enhance hazardous material inventory management through improvements in radio frequency identification technology and techniques[viii]
- A retrospective risk assessment approach used to determine laboratory readiness to return to normal operations after experiencing a chemical explosion[ix]

- Demonstrated advancements and state-of-the art designs of ceramic HEPA filter technology to improve safety and reduce operational costs for nuclear facilities[x]

These recent articles join the insights published in ACS Chemical Health & Safety from the U.S. National Laboratories previously, which are also highlighted on the Special Issue web site: https://pubs.acs.org/page/achsc5/vi/national-lab-safetysuccesses-challenges-research-approaches. [xi]

In the VUCA world in which we work, we must leverage our colleagues' knowledge as we push the envelope further. And we must do it now. I urge you to explore these articles, as well as those in the larger ACS Chemical Health & Safety collection and continue innovating.

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[i] MacKenzie, C. Turning Outsiders into Insiders: A Call for Papers to Expand the Reach of National Laboratories' Safety Successes, Challenges, Research, and Approaches. *ACS Chemical Health & Safety* **2024** *31* (2), 98-99. DOE: 10.1021/acs.chas.4c00018

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