



# Preface: Early-Career Researchers at Rising Stars Demonstrate the Interdisciplinary and Expansive Nature of Nuclear Expertise

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This special issue of *Nuclear Technology* features selected papers authored by participants in the 2023 Rising Stars Programme. The 2023 Rising Stars Workshop held at Massachusetts Institute of Technology (MIT) in September 2023 featured research presentations and posters by early-career women in nuclear science and engineering from 15 countries. The symposium, jointly hosted by the OECD Nuclear Energy Agency and MIT, marked the first international Rising Stars Workshop. These workshops have since become an annual tradition, with the 2024 Rising Stars Symposium event held at the European Commission's Joint Research Centre in Karlsruhe, Germany, and the 2025 Rising Stars Symposium hosted by the Royal Institute of Technology in Stockholm, Sweden.

The exceptional research and talent showcased at each iteration of the Rising Stars Workshop have demonstrated the expansive and growing terrain of the nuclear field, which, while including (and in some cases expanding) the traditional “core” areas of nuclear engineering expertise, has now grown to encompass broader systemic and societal sociotechnical considerations (Fig. 1 presents this broader scope of nuclear expertise with the traditional nuclear technologies at the center).

Rather than exist in silos as was once the case, these areas of expertise are now marked by rich exchange and co-evolution—leading to a new, more broadminded and holistically trained nuclear expert. The work of the 2023 Rising Stars presented in this special issue richly illustrates this expansive nature of the nuclear field.

To begin this special issue, Shasko and Hurlbert [1] examine the potential of apocalyptic narratives and science fiction films as “messy spaces” for public engagement on radiation and climate change. Their review of eight mainstream science fiction films, such as *Godzilla* (1954 and 2014), *The Hulk* (2003), and *Spider-Man* (2002), shows how fictional depictions of radiation can mirror or construct societal anxieties. They then use the “dynamic split ladder of participation” [2]

framework to propose new approaches for engaging younger people who may suffer from apathy or eco-anxiety. Shasko and Hurlbert argue that fictional apocalyptic scenarios, such as the ones featured in science fiction films, can create a manageable space for audiences to explore survivalist fantasies and complex energy problems without being overwhelmed by real-world fears.

Krauss's paper [3] presents an innovative closed and continuously operating magnetic filter for reducing the volume of secondary radioactive waste generated during the decommissioning of nuclear facilities. In particular, the study addresses the waste problem created by water jet abrasive suspension cutting, which produces a mixture of abrasive and radioactive steel particles. A separation process involving wet sieving and magnetic filtration is used by the author to demonstrate that a significant portion of the abrasive materials can be directly reused, which in turn reduces the secondary waste by 50% to 70%. Krauss highlights the transition from batch to continuous operation as a critical step for upscaling the process, as will be needed for dismantling large components such as reactor pressure vessels.

In her paper, Saxena [4] explores the complex dynamics of negotiating nuclear power project agreements in emerging economies. She focuses, in particular, on Southeast Asia and sub-Saharan Africa. The analysis highlights how technological and financial dependence on foreign vendors can create unequal power dynamics, which often sideline the interests of local communities. Saxena draws on case studies from India, Turkey, and Nigeria to explore how knowledge asymmetries and geopolitical motivations shape project implementation as well as community safety. The paper highlights the importance of transparent stakeholder engagement, which involves independent expertise from international and intergovernmental agencies and establishing robust liability frameworks as essential measures for safeguarding local interests.

Jolovic et al. [5], in their paper, explore methodologies for extending the reactor core lifetime of the Canadian

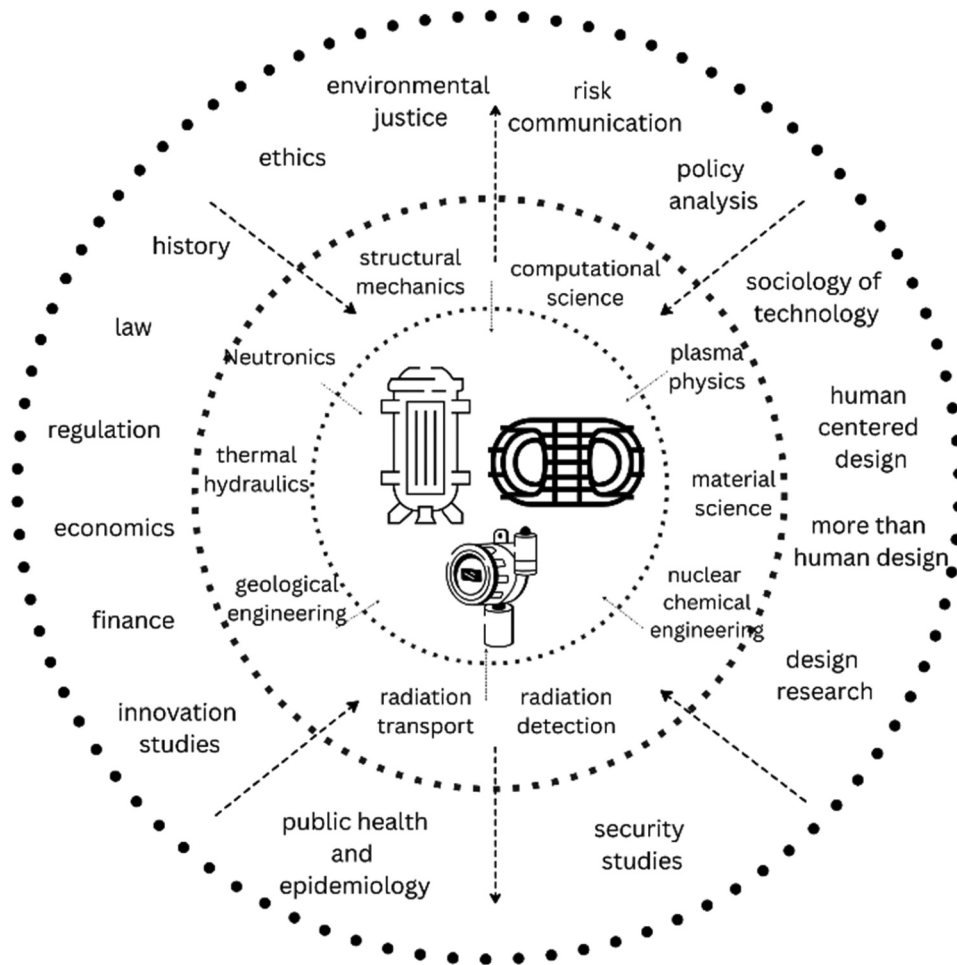


Fig. 1. An expansive conceptualization of nuclear expertise. Traditional nuclear technologies (reactors and detectors) sit at the center, surrounded by the scientific and engineering core of expertise. These core engineering disciplines are surrounded by expertise from the humanities, social sciences, law, policy, and design disciplines, which can enrich and inform the technical core.

Thermal Battery microreactor with low levels of fuel enrichment. They use OpenMC models (a heat pipe model and a parameterized core model) of the Canadian Thermal Battery to analyze univariate effects of parameters such as core materials, reactor geometry, and fuel kernel types on neutron economy. Specifically, they compare three different TRISO particle kernels—uranium dioxide, uranium oxycarbide, and uranium nitride—and find that uranium nitride kernels maintain criticality the longest due to their high fissile density. The authors suggest that while multivariate as well as experimental studies are needed, optimizing the lattice pitch and TRISO packing fraction could provide pathways to achieve the desired 20-year core lifetime even with lowered fuel enrichment levels.

Weihmann et al. [6], in their paper, present a comprehensive workflow for discrete fracture network modeling to evaluate crystalline rock formations as potential hosts for high-level radioactive waste

repositories. They use photogrammetric data from the Odenwald Crystalline Complex in Germany to generate 3D digital outcrop models to extract statistical fracture data. Their study tests various fracture generation methods, including geometric and grown fracture networks, to determine their impact on hydraulic connectivity and flow simulations. The authors emphasize that accurately capturing network topology is essential but remains a major technical challenge for predicting radionuclide migration and ensuring long-term repository safety.

Shasko's second paper in this special issue [7] introduces the Atomic Eve project: a creative experiment that combines storytelling, science fiction, and social media to increase interest in nuclear energy among women and youth. Shasko notes that women have historically been underrepresented in the nuclear workforce (only 23% in Canada)—a gap that can be attributed to models of engagement that have failed to attract women to the

field. Shasko proposes an alternative model of engagement—in this case, one that uses a social media platform (Instagram) and the character of Atomic Eve (a science fiction superhero) to bridge the arts and science binary and overcome gender-based stereotypes as a way to potentially draw young women to the field.

Ghoneim et al. [8] investigate the technical requirements for leakless water cooling in the time projection chamber and electromagnetic calorimeter of the Multi-Purpose Detector experiment at the Nuclotron-based Ion Collider Facility (NICA). They evaluate various flexible plastic hoses proposed for coolant delivery with a focus on their resistance to radiation-induced activation, chemical stability, and gas permeability under subatmospheric pressure. Through a combination of neutron irradiation testing, Raman spectroscopy, and mechanical tensile testing, the study assesses the long-term degradation of polymer candidates over a projected 10-year operational lifetime. Ultimately, the authors identify reinforced polyvinyl chloride as the most suitable material due to its balanced performance in terms of stiffness, dimensional stability, and irradiation tolerance.

Williams and Scarlat [9], in their paper, advocate for expanding the traditional engineering core by reestablishing the field of nuclear chemical engineering as a formalized subdiscipline, particularly within nuclear engineering education. They identify and offer six constitutive topics for the subdiscipline of nuclear chemical engineering. These include (1) equilibrium thermodynamics, (2) fluid dynamics and heat and mass transport, (3) process design and controls, (4) chemical process safety and environment, (5) fuel cycle and waste management, and (6) chemistry and kinetics. These areas of expertise within nuclear chemical engineering, the authors assert, will be essential for designing, governing, and operating molten salt-based nuclear energy systems. According to Williams and Scarlat, formalizing a nuclear chemical engineering curriculum will be essential for educating future nuclear engineers who will work on advanced fission as well as fusion systems.

The papers in this special issue feature work in sociology, policy studies, law, finance, geology, chemical engineering, reactor physics, and materials science. Across their papers, the Rising Stars invoke and contribute to many different forms of nuclear expertise—work that is situated within and in some cases expands the engineering core of nuclear expertise, and other exciting work that reaches into the humanities and social sciences.

Each of these Rising Stars is a nuclear expert in their own right, and the nuclear field is that much the better for having these bright young minds at the frontier of and as the future of the field.

## References

1. L. Shasko and M. Hurlbert, “Zombies, Superpowers, and Apocalyptic Narratives: Exploring Science Fiction as a Messy Space for Public Engagement on Radiation, Nuclear Power, and Solving Climate Change,” *Nucl. Technol.* **212**, 511 (2026); <https://doi.org/10.1080/00295450.2025.2528179>.
2. M. Hurlbert and J. Gupta, “The Split Ladder of Participation: A Literature Review and Dynamic Path Forward,” *Environ. Sci. Policy*, **157**, 103773 (2024); <https://doi.org/10.1016/j.envsci.2024.103773>.
3. C.-O. Krauss, “Implementation of an Innovative Continuous Magnetic Filter for the Reduction of Secondary Waste Produced from Water Jet Abrasive Suspension Cutting,” *Nucl. Technol.* **212**, 525 (2026); <https://doi.org/10.1080/00295450.2025.2545105>.
4. A. Saxena, “Negotiating Nuclear Power Project Agreements in Emerging Economies: Safeguarding Local Community Interests,” *Nucl. Technol.* **212**, 535 (2026); <https://doi.org/10.1080/00295450.2026.2612756>.
5. E. Jolovic, P. Kriemadis, and A. Buijs, “Methods for Extending the Reactor Core Lifetime of the Canadian Thermal Battery<sup>TM</sup>,” *Nucl. Technol.* **212**, 557 (2026); <https://doi.org/10.1080/00295450.2025.2560754>.
6. S. Weihmann et al., “Validating Fracture Networks for Radioactive Waste Repositories: A DFN Modeling Approach for Crystalline Rock,” *Nucl. Technol.* **212**, 567 (2026); <https://doi.org/10.1080/00295450.2025.2581510>.
7. L. Shasko, “Atomic Eve: Exploring Science Fiction and Social Media to Increase Interest in Nuclear Energy Among Women,” *Nucl. Technol.* **212**, 587 (2026); <https://doi.org/10.1080/00295450.2025.2527499>.
8. Y. Ghoneim et al., “Thermal Stabilization and Cooling System for the TPC and ECAL Detectors of the MPD Experiment on the Collider Facility NICA,” *Nucl. Technol.* **212**, 594 (2026); <https://doi.org/10.1080/00295450.2025.2582259>.
9. H. Williams and R. Scarlat, “A Case for Nuclear Chemical Engineering in the Era of Fission and Fusion Reactors that Employ Molten Salts,” *Nucl. Technol.* **212**, 622 (2026); <https://doi.org/10.1080/00295450.2025.2493991>.