



## Federal Nuclear Science and Technology (FNST) Work Plan Quarterly Update

QUARTERLY UPDATE Q3 2022/2023

Atomic Energy of Canada Limited's (AECL) Federal Nuclear Science and Technology Work Plan enables nuclear-related science and technology to support core federal priorities in the areas of health, environment, safety and security and energy, while maintaining necessary capabilities and expertise at Canadian Nuclear Laboratories (CNL). AECL is responsible for the management and oversight and engages with the various federal departments and agencies to develop a program of work that meets their needs and priorities and to oversee the delivery of the work to bring value for money for Canada. For more information, or to discuss a potential project, please contact [Farrah Norton, S&T Program Manager](#)

### THEME 1: SUPPORTING THE DEVELOPMENT OR BIOLOGICAL APPLICATION IMPLICATIONS OF RADIATION OF LIVING THINGS



#### CNL's Low Dose Radiation Webinar Series Continues

This fall, CNL, with the support of AECL, Health Canada and the Canadian Nuclear Safety Commission (CNSC), continued its monthly webinar series on low dose radiation. The series brings together members of the low dose radiation research community to share their research and foster future collaboration.

- In the November [webinar](#), Dr. Lydia B. Zablotska, Salvatore Lucia Chair in Preventative Medicine at University of

California, San Francisco, shared a comprehensive summary of radiation research.

In the December [webinar](#), Dr. Gayle E. Woloschak, Fellow of the American Society for Radiation Oncology, Associate Dean for Graduate Student and Postdoctoral Affairs, Professor of Radiation Oncology and Radiology, Northwestern University - Feinberg School of Medicine, Lurie Comprehensive Cancer Center Chicago, provided an overview of the effects of low dose radiation research and long-term animal studies.



### **Promoting CNL's Radiobiology Capabilities at International Conferences**

Researchers in CNL's Isotopes, Radiobiology and Environment Directorate shared their research at two international conferences attended by academic and industry experts and leaders.

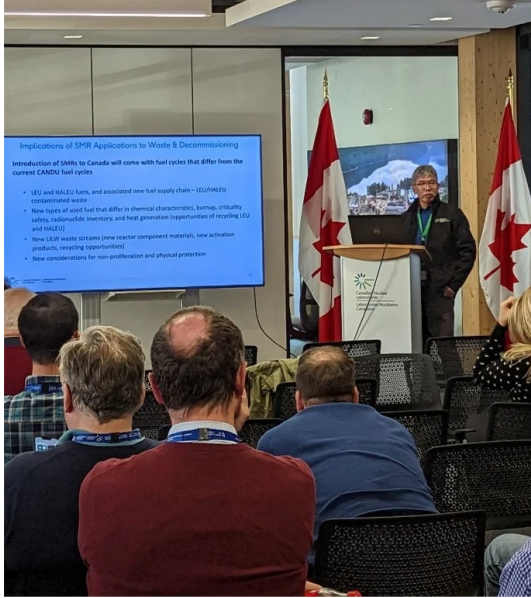
At the Radiation Research Society's Annual General Conference in October 2022, CNL researchers made three presentations:

- *Effects of Low-Dose Ionizing Radiation on Colon Cancer Progression in Genetically-Modified Mouse Model.*
- *Lack of Adverse Health Effects in Rats Chronically Exposed to Natural Uranium in Drinking Water.*
- *Low Dose Gamma Rays Enhances Myogenic Differentiation in Long Term Myoblast Cultures.*

At the 6<sup>th</sup> International Symposium on the System of Radiological Protection organized by the International Commission on Radiological Protection, CNL experts chaired a session on *Emerging Radiation Protection* that included a presentation by CNL on SMR deployment in Canada. In total, researchers delivered eight presentations ranging from low dose radiation research to health impact of exposure to uranium in drinking water and biomarkers of radon exposure. As a key sponsor of the Symposium, CNL also promoted its biological research facility and environmental capabilities.

## **THEME 2: SUPPORTING ENVIRONMENTAL STEWARDSHIP AND RADIOACTIVE WASTE**

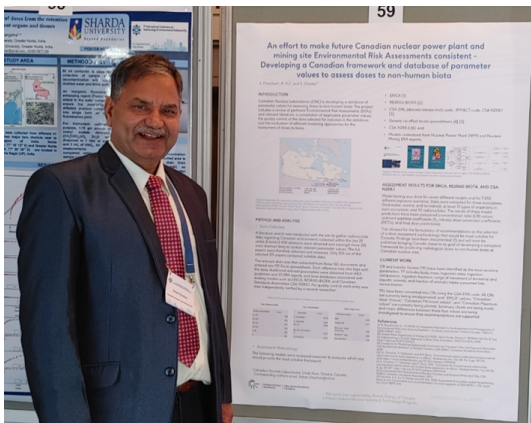
**CNL's S&T Present on SMR Waste and Management Strategies**



As part of a Workshop on the Management of Spent Fuel, Radioactive Waste and Decommissioning in SMRs hosted by the Nuclear Energy Agency and Natural Resources Canada, which took place in Ottawa in November 2022, CNL presented its research on improving the understanding of SMR waste. The presentation focused on research and development conducted for SMR waste management, including methods, models, and capabilities developed to estimate waste volumes and characteristics for low, intermediate, and high-level

radioactive waste from small modular reactors of novel design (including high temperature gas-cooled reactors, molten salt reactors, and liquid metal cooled fast reactors). The presentation touched on current and past spent fuel management technology development at CNL, such as CANDU spent fuel reprocessing, direct use of pressurized water reactor used fuel in CANDU and high-level waste stabilization. The expertise and technology from this work will inform SMR waste management and ultimately help advance the deployment of SMRs.

As part of the workshop, CNL also organized a site tour at Chalk River Laboratories for participants.



### CNL Participates in National and International Conferences on Ecotoxicity

CNL researchers delivered six presentations at the Canadian Ecotoxicity Workshop, which took place in Winnipeg in October 2022. Most noteworthy was CNL's presentation of results from the research project entitled Developing a Canadian

framework and database of parameter values to assess doses to non-human biota – an effort to make future Canadian nuclear power plant and mining site Environmental Risk Assessments consistent (this is the second time these results were presented, the first being at the 5th International Conference on Radioecology and Environmental Radioactivity in Oslo, Norway in September 2022). CNL's presentations provided an excellent opportunity to share, promote, and solicit input on work in this area, including the CNL-developed model CSA-ERA (Canadian Standards Association - Environmental Risk Assessment). The supporting database that will be used by all Canadian subject matter experts to perform standardized and accurate environmental risk assessments for the nuclear and mining industry will also allow the Canadian Nuclear Safety Commission to better regulate these industries.

## **THEME 3: ENHANCING NATIONAL AND GLOBAL SECURITY, NUCLEAR PREPAREDNESS AND EMERGENCY RESPONSE**

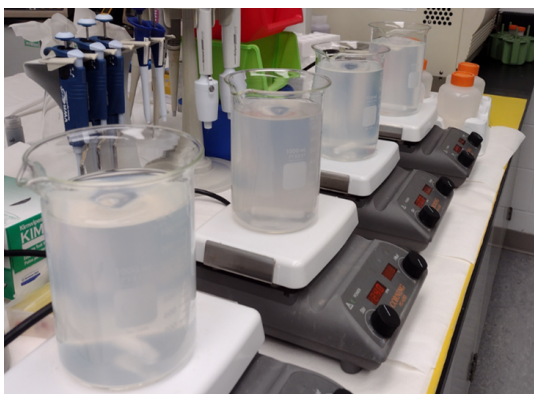


### **First CARDT Course Hosted at Chalk River Laboratories**

**With detection and measurement of radiation essential and vital to nuclear safety and security, the CNL Advanced Radiation Detection Techniques (CARDT) training course welcomed 20 participants from diverse fields who were interested in gaining and**

**developing key skills and technical expertise in nuclear safety and security. The hands-on experience made use of the Chalk River Laboratories' extensive nuclear facilities and detection technologies on site. Lecture topics included the nature of radioactivity, radiation detection instrumentation and measurements, nuclear characterization methods and instruments, and statistics of radioactivity counting, to name a few.**

**As part of the week-long training, participants also attended a public lecture by Dr. Tony Noble, Scientific Director of Queen's University's McDonald Institute, entitled Shedding Light on Dark Matter, Neutrinos, and the Missing Mass in the Universe, jointly sponsored by CNL, the Canadian Nuclear Society, Women in Nuclear Eastern Ontario, and AECL.**



### **Team Develops New Method to Determine Ac-227 in Water Samples**

**The Radiochemistry Analysis Section of CNL's Nuclear Response & Analysis branch published a new method to determine Actinium 227 (Ac-227) in water samples. Ac-227 is considered a very toxic radionuclide because it deposits into the skeleton and liver following ingestion and then decays to a series of**

**short-lived alpha emitters. All the methods previously developed to measure Ac-227 were for trace levels and not suitable for routine monitoring. This new, simple method allows rapid separation of Ac, leading to a more accurate and precise measurement. This method has been the basis for a new international standard, which will be published in the coming months (ISO TC147/SC3).**

# THEME 4: SUPPORTING SAFE, SECURE AND RESPONSIBLE USE AND DEVELOPMENT OF NUCLEAR TECHNOLOGIES



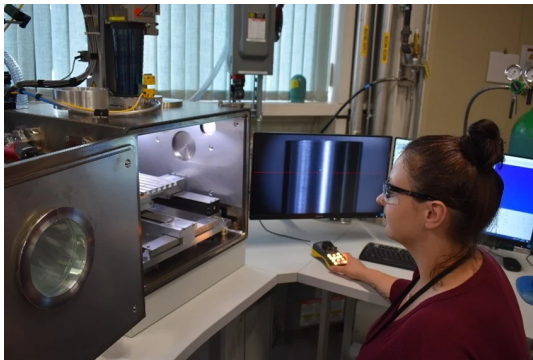
# CEDIR

Clean Energy Demonstration,  
Innovation, and Research

## Advancing Canada's Work in Hybrid Energy Systems

CNL continues to advance its Clean Energy, Demonstration, Research and Innovation (CEDIR) initiative, which is focused on developing hybrid energy systems. In October 2022, a workshop was held with federal departments and agencies to discuss potential applications of hybrid energy systems in Canada, the challenges related to their deployment, and the research and

demonstrations required for these clean hybrid energy systems to realistically support Canada's net zero commitments. The team presented a technical overview on the vision, current R&D, and possible next steps for the CEDIR initiative – inviting feedback on specific areas of interest, activities and potential collaboration opportunities regarding hybrid energy systems within the federal government. The Federal Nuclear Science and Technology Work Plan Steering Committee endorsed the next step for AECL to advance an interdepartmental Memorandum of Understanding with AECL for research, development and demonstration of the CEDIR initiative.



## Invited Workshop: Understanding the Future of Metallic Fuel

CNL led a workshop organized by AECL to present many aspects of the history and current development of metallic fuel with members of the federal family. The workshop, held in October 2022, was attended by 22 representatives from the federal family including

Natural Resources Canada, Environment and Climate Change Canada, and the Canadian Nuclear Safety Commission. Participants expressed interest in learning more about the future areas of development being envisioned, particularly in terms of environmental/waste impact and the non-proliferation/safeguards aspects of metallic fuel. It was noted that UMo-Mg fuel (a high density alloy fuel composed of uranium-molybdenum and magnesium suitable for use in research reactors to replace higher enrichment legacy fuels) is already quite well developed, although it may need additional work to make it suitable for a wide application. The workshop provided CNL the opportunity to explain its plans under the Federal Nuclear Science and Technology Work Plan, linkages to CNL's work in advancing fuel development

and manufacturing processes for [ARC Clean Technology's SMR](#), and to answer questions related to supply chain, required equipment, and collaborations. This is an important first step as metallic fuels are likely to be a key component of advanced reactors in Canada and CNL is well positioned to inform government stakeholders on regulatory and policy decisions related to this technology.



## **Taking a Leading Role in Hydrogen Safety with Two-Day Workshop**

On November 24, 2022, CNL, in collaboration with AECL, hosted a Hydrogen Safety workshop in Ottawa. The goal was to better understand the issues and gaps affecting hydrogen deployment and the opportunities for current and future development. The 68 targeted attendees of the facilitated

workshop discussed safety challenges in production, materials-related safety issues, safety infrastructure and test facilities, nuclear hydrogen initiatives and stakeholder engagement. Presentations were also given by Stuart Hawksworth, Head of UK's Centre of Energy, and Daryl Wilson, Executive Director of the Hydrogen Council. The following day, 27 participants were given a tailored tour of the Chalk River Laboratories to showcase CNL's hydrogen labs and materials characterization capabilities. This type of meeting is essential as the team begins to explore CNL's role in bringing together the various stakeholders on hydrogen, allowing for discussions with many participants on potential collaborations.



## **Highlighting ZED-2, Chalk River's Zero Power Research Reactor**

Since 1960, Chalk River Laboratories has been home to the ZED-2 (Zero Energy Deuterium) research reactor, which continues to be a unique facility contributing to the execution of the FNST Work Plan. Fiscal Year 22/23 is no exception. In the project "ZED-2 Experimental and Computational Studies of Plutonium-Bearing Fuels in Support of CANDU Physics", experimenters and facility staff are planning an extensive campaign using

mixed-oxide fuels to generate high quality data for code validation. These experiments, to be executed next fiscal year, will be the most representative of the reactor physics of the CANDU system of any experiment conducted in the history of ZED-2.

Looking to the future of nuclear in “Experimental and Modelling Supported Evaluations of ZED-2 for SMR Physics”, researchers are studying how ZED-2 can be used to support the design, licensing, and operation of SMR reactors. The effort is multipronged, and includes extensive computational studies of experimental SMR zones in ZED-2, SMR fuel surrogate development, measurements of the dynamic reactor behaviour, and conceptual design of assemblies for high temperature measurements. These two projects exemplify the contributions of ZED-2 to science and technology to date: an essential component of the design, licensing, and operation of the CANDU reactor, while also making contributions to other next generation nuclear technology.

ZED-2’s value extends past reactor physics, where researchers use it as a source of mixed neutron and gamma radiation to develop and calibrate instrumentation, or perform novel radiobiological studies. Researchers have irradiated blood samples in ZED-2 to help understand the biological effect of irradiation by neutrons of varying energies.

ZED-2 also contributes to CNL’s outreach activities in education and training. This has included multiple offerings of the “ZED-2 Reactor Safety & Instrumentation School” over the last decade. These schools were funded by prior FNST programs, providing for a unique, week-long workshop attended by federal stakeholders, university students, and nuclear industry employees. Today, ZED-2 researchers continue to actively engage these stakeholders, exploring their education needs, and providing mentorship to university students.

## Upcoming Events

- **Tritium and the Future of Fusion: Tritium Extraction Technologies from Molten Breeder Blankets**  
Webinar – 11:00 to 12:00 pm, February 9, Register here <http://ow.ly/YzYo50MF0jY>
- **Aquatic Dispersion Workshop** – February 23, 2023
- **Low Dose Radiation Webinar Series: “Twins & Telomeres - in Space!”** by Dr. Susan M. Bailey – 12:00 – 1:00 pm, February 23, 2023, to register for this event email [communications@cnl.ca](mailto:communications@cnl.ca)
- **Advanced Algorithms for Radioisotopes Identification Workshop** – March 23, 2023
- **Upcoming Fall 2023 – Ottawa, ON, FNST Workshop**, stay tuned for details!

Visit our website

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