



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

QUARTERLY UPDATE Q2 2022/2023

Federal Nuclear Science and Technology Work Plan (FNST) serves the collective interests of 14 federal departments and agencies in the areas of health, nuclear safety and security, energy and the environment. Through the FNST Work Plan, federal departments and agencies are able to leverage the vast experience and expertise at the Chalk River Laboratories – Canada’s largest science and technology complex – to contribute to the government’s health, science, innovation and climate change objectives. 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



Low Dose Research International Webinar Series Kicks Off with Presentation by Dr. Antone Brooks

As the nuclear industry globally looks to reduce the uncertainties in low dose health risk assessment, CNL’s Isotopes, Radiobiology and Environment Directorate, with the support of AECL,

Health Canada and the Canadian Nuclear Safety Commission, is helping to build a community of practice in the sharing of research amongst the Low Dose Radiation (LDR) research community. In September, CNL hosted the first in a series of international webinars featuring some of the world’s leading researchers in LDR.

CNL was pleased to welcome Dr. Antone Brooks, Professor Emeritus for Washington State University Tri-Cities, and his presentation, “Low Dose Radiation Research: Past, Present and Future.” A recording of the webinar is available [here](#) to watch. Stay tune for more information on the webinar series.

THEME 2: SUPPORTING ENVIRONMENTAL STEWARDSHIP AND RADIOACTIVE WASTE



CNL Researchers Collaborate with Clearwater Dënë First Nation on Sampling Project

CNL’s Isotopes, Radiobiology and Environment Directorate includes dedicated teams of researchers who are playing an important role in studying the fate and transport of naturally occurring radioactive material in different Canadian environments, including regions associated with uranium mining development. In close consultation with the Clearwater Dënë First Nation, a team was able to conduct a large-scale sampling campaign in Saskatchewan’s uranium-rich regions.

The aim of the research is to better understand the fate, transport and biological uptake of polonium-210 (Po-210) and lead-210 (Pb-210) – naturally occurring radioisotopes associated with the uranium-238 decay series that exist at very low levels in the natural environment, including aquatic foodwebs, and may be elevated in uranium ore and tailings produced by uranium mining and milling operations. Community feedback drove the preparation of the sampling plan, and lake systems were chosen based on their traditional value expressed by locals.

Beyond community engagement, the partnership included employing staff members and four students (aged 13-15) from the local Clearwater River Dënë School to assist in the week-long sampling campaign. CNL researchers certainly appreciated the learning that came with interacting with the community.

This work is funded under the project " Biogeochemical and Foodweb Processes Controlling the Fate and Transport of Pb-210 and Po-210 in Aquatic Ecosystems in the Uranium Mining Region of Saskatchewan".

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

CNL’s New National Innovation Center for Cyber Security Hosts Incident Response Exercise



CNL hosted a successful three-day hands-on cyber security incident response exercise with participation from Ontario Power Generation, Bruce Power, NB Power, Cernavoda Nuclear Power, Canadian Nuclear Safety Commission (CNSC), Canadian Centre for Cyber Security, Idaho National Laboratories (INL), Sandia National Laboratories (SNL), and the National

Nuclear Security Administration (NNSA) Office of International Nuclear Security. Feedback from the observers was unanimous and complimentary including: the dynamic, real-time hands-on experience with hardware in the loop is very effective for evaluating and improving incident response capabilities, and CNL's new facility in Fredericton's Cyber Centre is well suited for creating "realism" in the experience.

This work is funded under the project "Cyber Security Incident Response Exercise for Canadian Industrial Control Systems".



New Canadian Safety and Security Program Projects Announced

The Canadian Safety and Security Program, managed by Defence Research and Development Canada, has approved five projects this fiscal. These projects include:

- 3D Printing System for Making Gamma and Neutron Radiation Sources and Multiform Scintillators for Nuclear Security Applications;
- A Superconducting Quantum Interference Device (SQUID) for enhancing Chemical, Biological, Radiological, Nuclear, and high yield Explosives detection;
- Exploring applicability of active interrogation techniques for nuclear disarmament verification;
- Testing Lithium-6 Based Neutron Detectors as Helium-3 Detector Alternative; and
- Development of Low Burden Shielding Material with Melanocytes.

Evaluation experiments of Radiation Signature Training Devices (RSTDs) carried out at Oak Ridge National Laboratory (ORNL)

After an extended delay due to COVID-19 restrictions, evaluation experiments of Radiation Signature Training Devices (RSTDs) have been carried out at Oak Ridge National Laboratory (ORNL). Carried out under an FNST Project titled, "Advancing nuclear science and technologies for monitoring, tracking, and characterizing radioactive and nuclear materials", these experiments focused on the function of the devices and to determine if there are unexpected radiation dose rates to the



user. RSTDs use a small amount of Special Nuclear Material (SNM) configured in a geometry to simulate a large amount of SNM during passive gamma and neutron measurements. They are also easily modifiable to simulate a variety of source strengths and geometries. They have the potential to make detector development, testing, and evaluation

significantly more efficient, as it reduces criticality control requirements.

Acquisition of such devices will also be evaluated as a component of potential commercial detector test and evaluation services.

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



Industry Gathers for the 4th International Conference on Generation IV and Small Reactors (G4SR-4)

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).



33rd Gen-IV International Forum – Industry Forum Joins Up with 4th International G4SR Conference

Held in conjunction with the G4SR conference for the first time in Toronto (October 3-6), the Generation IV International Forum (GIF) - Industry Forum was designed to help

strengthen GIF's links with industry partners seeking to deploy advanced nuclear energy systems. Canadian Nuclear Laboratories has had the special privilege of representing Canada on GIF since its inception, and has expanded its involvement in

the collaborative beyond supercritical water-cooled reactors to include participation in both molten salt reactors and very high-temperature reactors.

In advance of the forum, CNL was pleased to host the Very High Temperature Reactor (VHTR) System Steering Committee (SSC) at Chalk River Laboratories to review technical progress in member countries



Chalk River Laboratories Hosts Tour of International Experts for 20th Annual Symposium on Zirconium

The ASTM 20th International Symposium on Zirconium, hosted in Ottawa this summer, brought together over 90 experts from across the globe entrenched in research on zirconium-based materials used in the nuclear sector. As a world leader in zirconium-related research, CNL was pleased to serve as the local host sponsor for the

symposium. This included hosting an international group of material scientists at Chalk River Laboratories to showcase the innovative zirconium projects CNL is currently working on from corrosion loops, CNL's shielded facilities, the bi-axial burst testing rig, surface science capabilities and inspection techniques.



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
- **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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