



## FEDERAL NUCLEAR SCIENCE & TECHNOLOGY (FNST) WORK PLAN QUARTERLY UPDATE (Q2 2022/23)

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](#).

# UPDATES

### **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)**

With strong support from CNL, the Canadian Nuclear Society (CNS) hosted the 4th International Conference on Generation IV and Small Reactors (G4SR-4) in cooperation with international partners in industry and government. The 4-day conference in Toronto from October 3-6 was a blend of plenary sessions from industry leaders with technical sessions and both full-day and half-day workshops. The conference also included a student team competition inviting OECD NEA NEST students to pitch presentations on deploying an SMR within a university campus community.



### **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.



### **New FNST Test Campaign Measures Fission Product Dispersion during Severe Accidents in the Presence of Simulated Hydrogen**

To support understanding of fission product dispersion during a severe accident, CNL completed a new test campaign under the project "Improving Understanding of Severe Accident Phenomena and Developing Beyond-Design Basis Modelling Capabilities for Advanced Reactors and Small Modular Reactors" to measure aerosol deposition and gas mixing behaviour using the Strong Condensation Containment Apparatus (SCCA) in the Large-Scale Containment Facility (LSCF). The SCCA was originally constructed in 2020 to study fission product aerosol deposition behaviour in a containment volume with a large surface-area-to-volume ratio and significant steam condensation on one wall – conditions

expected inside the small submerged-containment vessel of a water-cooled small modular reactor (SMR). Later modified to include helium injection (as a simulant for hydrogen expected to be released during a severe accident) and incorporate several design improvements, the newest test series measured the effect of the non-condensable helium on the expected fission product aerosol deposition behaviour and the gas thermal stratification inside the containment volume. Once data processing and analysis is complete, the results will be used in a modelling benchmark that includes containment analysis, severe accident, and computational fluid dynamics computer codes.

Work in this area supports enhanced understanding of fission product behaviour in small containments with passive safety systems (prevalent in water cooled SMRs) and ensures simulation codes have the necessary capabilities to analyse the associated phenomena. Ultimately, the goal is to better understand what requirements might be for severe accident management in SMRs, and for informing emergency response requirements like the establishment of emergency planning zones. In fact, this work is also being incorporated into an ongoing coordinated research project “Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment”.



### Identifying New Collaborations in Hydrogen and Clean Fuels Research

On July 20 and 21, a team from CNL and AECL visited the Clean Energy Research Center (CERC) at the University of British Columbia (UBC) – the National Research Council of Canada (NRC)’s Energy, Mines and Environment division in Vancouver, British Columbia. With the purpose to identify potential collaborations with CERC and NRC on hydrogen and clean fuels research, many areas of shared interest were discussed, including complementary capabilities in modeling related to hydrogen embrittlement on pipelines, hydrogen storage technologies, electrolyser development and testing, hydrogen safety assessment, techno-economic and life cycle analyses. Both institutions are looking forward to further discussions on areas of collaboration.



#### UPCOMING EVENTS

- Metallic Fuels Workshop – October 27, 2022
- Low Dose Radiation Webinar Series: “Ionizing Radiation and Health: What do we know, What do we not know, Remaining Questions and Plan for Moving Forward” by Lydia B. Zablotska – November 3, 2022
- CNL Advanced Radiation Detection Techniques (CARDT) course – November 14-18, 2022
- Hydrogen Safety Workshop – November 24-25, 2022
- Workshop: Field Deployable alpha detection techniques for CBRNE threats in support of Emergency Response – November 29, 2022