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Scientists raise alarm over future of neutron beam research capacity

Canadian researchers whose work relies on access to a neutron beam source have issued an urgent appeal to the federal government for stop-gap funding to offset the looming impact from the March 2018 closure of the National Research Universal (NRU) reactor at Chalk River ON. The Canadian Neutron Initiative (CNI) is requesting $24 million over the next three years and $19 million a year between 2021 and 2029 to buy beam time at foreign facilities and to upgrade the small, medium-flux nuclear reactor at McMaster Univ.

The funding, say CNI organizers, is essential to avoid a severe brain drain of researchers pursuing leading-edge materials research. They compare the potential loss of neutron beams to a construction industry without hammers and drills. The goal is to establish an organizational framework for a Canadian program for neutron beam-based materials research and secure sufficient baseline funding to implement it. The group also plans to negotiate alternative beam sources both domestically and internationally, including the McMaster reactor.

In its August 3rd submission to the House of Commons Finance Committee, CNI's working group says the funding request is far less than the price tag for maintaining the NRU, which has exceeded $100-million annually in recent years. CNI says its aim is to "prevent the loss of an irreplaceable tool for materials research" that benefits Canada's push for clean energy, advanced manufacturing, health and food security and safety and security.

Research access to the 60-year-old NRU at Chalk River — the world's oldest operating research reactor — is coordinated by the Canadian Neutron Beam Centre (CNBC) which has operated on site for decades. It's estimated that 200 users annually currently access the NRU, and more than 800 Canadian and international users have worked at the site over the past five years. Although the shutdown date is March/18, the NRU is licensed by the Canadian Nuclear Safety Commission until 2021.

Canadian researchers are already using foreign neutron beam sources, including France's Institut Laue-Langevin in Grenoble, the NIST Center for Neutron Research near Washington DC and the Spallation Neutron Source at Oak Ridge. The latter is the focus of an access agreement with McMaster and funded by the Canada Foundation for Innovation (CFI). But that agreement is set to expire March/18 – the same time the NRU is permanently shut down.

"We're approaching it holistically and creating an academic, institutional voice to speak up for neutron beam materials research. This is an emergency request to get something established by March 2018. We all agree Canada needs something like the multi-purpose NRU research reactor until the government responds more fully," says Dr John Root, executive director of the Canadian Centre for Nuclear Innovation at the Univ of Saskatchewan and head of the CNBC. "The neutron beam community doubled between the 1990s and now … and reached its height between 2008 and 2012. Then things started to fall apart."

The shifting fortunes of the neutron beam research community were precipitated by the previous government's decisions to convert AECL into a government-owned, contractor-operated (GoCo) facility, get out of the medical isotopes business and wind down the NRU. That was exacerbated by the re-direction of the National Research Council under former president John McDougall which included pulling away from its role of managing national research facilities for use by the academic community.

The CNBC was transferred to the NRC in 1987; in 2012 it was transferred back to Atomic Energy of Canada Ltd. When Canadian Nuclear Laboratories was established in 2015 as the new operator of the Chalk River facility, CNBC was bounced back to AECL on secondment, with the employees and equipment remaining with the NRC.

"The changes in NRC and AECL have created a lot of the stress on the neutron beam community in terms of morale and engagement," says Root.

The McMaster reactor could meet some of the demand but needs upgrading. Even if the facility ran at full power 24/7, Root says it still wouldn't be able to serve the whole research community. That's where access to foreign neutron beam sources comes in, allowing researchers to pursue their work in a timely way by utilizing specialized sources in various countries.

"Our reactor is working fine but the facility is very crammed. There's no room," says Dr Rob Baker, McMaster's VP research and a member of CNI's working group. "We'd like to hire more nuclear scientists and technicians to allow it to run 24/7. That would require capital funding to expand the space used for chemistry and other things."

Baker says members of the CNI working group have met with both CFI president Dr Gilles Patry and Lawrence Hanson, former assistant DM of the science and research sector at the department of Innovation, Science and Economic Development (now ADM policy at Transport Canada). And while there's an understanding and sympathy with the crisis facing the neutron beam user community, a satisfactory solution has yet to emerge, prompting CNI to go public with its concerns.

"We received some feedback about our proposal and shared it with the working group, who agreed that reasonable next steps were to prepare a submission for the federal pre-budget consultation, and attempt to raise ministers' awareness of the issue," says Root, who travelled with Baker and others to Ottawa for the discussions.

Baker also describes the current situation as "extremely urgent" and characterizes the end of the 10-year facility access agreement and closure of the NRU as "a perfect storm" that could create a neutron beam gap at a time of increasing utility for both the academic community and industry.

"The need for neutron beams is growing because of the new types of materials that are being developed. There's been an incredible proliferation of new materials and we need to understand their characteristics. Industry is asking for them," he says. "We're all in on helping industry develop. McMaster does a huge number of industry contracts and a lack of neutron beams will limit our ability to do these."

A new national research reactor?

For the research community, the Holy Grail would be a new, world-class, domestic neutron source for applications across all sectors to replace the NRU. Given the complexity of such a project, however, even if the federal government approves such an initiative, it would likely not go online until around 2030 and have a lifespan of 40 years.

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