TRIUMF

Canada's national laboratory for particle and nuclear physics and accelerator-based science
Laboratoire national canadien de physique des particules, de physique nucléaire et de science fondée sur les accélérateurs

Protecting Canada's Global Leadership in Nuclear Innovation and Technology

2016 Submission to the House of Commons Standing Committee on Natural Resources (RNNR)

December 1, 2016

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Summary

Canada is a world leader in nuclear technologies. The nation enjoys a strong competitive advantage in areas with transformative potential. To maintain this leadership position, the Government of Canada must assume active stewardship of this strategic sector. Targeted investment in upstream research and development would dramatically bolster Canada's capacity to innovate and deliver substantial economic and societal benefit to Canadians.

Beginning with TRIUMF's founding in 1968, Canada has cultivated world-leading expertise in particle accelerator and detector technologies. Initially developed for fundamental research, the technologies have proven their worth in a variety of industrial sectors, ranging from material sterilization to cancer treatment.

Applications for Canada's expertise are wide-reaching, and include:

- The development of accelerator-driven systems to drive sub-critical energy reactors
- The use of accelerators for the transmutation and treatment of nuclear waste
- The application of detector technologies to natural resource exploration and homeland security
- The development of radioisotopes for the diagnostic and therapeutic treatment of disease

While TRIUMF has expertise in all of these areas, in this brief we will focus on the last. Building on more than two decades of experience in life sciences and nuclear medicine, TRIUMF is at the centre of a nation-wide cluster of excellence focused on the accelerator-based production of medical isotopes. With 19 member universities from Victoria to Halifax, TRIUMF's technologies have the potential to deliver benefits to all Canadians.

Canada is well positioned as a global leader in nuclear medicine, but this competitive advantage is threatened by ageing infrastructure. For example, TRIUMF's life-sciences facilities need essential upgrades to enable cyclotron-based production of technetium-99m (Tc-99m) – a critical medical isotope whose supply is at risk now that the National Research Universal (NRU) reactor in Chalk River, Ontario has stopped production. Without modern facilities, Canada's competitiveness in the research, development, and commercialization of medical isotopes is at risk.

This reality is what underlies TRIUMF's proposal to construct the Institute for Advanced Medical Isotopes (IAMI). This facility will not only strengthen TRIUMF's nuclear medicine program, but also allow the development of new isotopes that hold the potential to dramatically improve the health and well-being of Canadians. IAMI represents a commitment to Canada's global leadership in nuclear medicine, and federal support for this institute would send a clear and unequivocal message to international competitors that we intend to keep our competitive advantage.

TRIUMF – A National Resource

TRIUMF is Canada's national laboratory for particle and nuclear physics and accelerator-based science, and also a prime example of the opportunity and capacity available within Canada's large-scale research facilities. The laboratory is an international centre for discovery and innovation, advancing fundamental, applied, and interdisciplinary research for science, medicine, and business. Owned and operated by a consortium of 19 universities that span from coast to coast, TRIUMF is an important pillar in Canada's innovation ecosystem, and also a central conduit for our integration into the global scientific community.

TRIUMF is home to over 500 staff and students, who together support core programs in the areas of particle and nuclear physics, accelerator research, materials science, and nuclear medicine. This scope provides the laboratory with capabilities that are beyond the reach of any single Canadian institution. TRIUMF's contributions to the discovery of the Higgs particle at CERN and to the detection of neutrino oscillations at the SNO Experiment in Sudbury, ON – both Nobel Prize-winning achievements – are but two examples of the roles that laboratories like TRIUMF play in advancing fundamental science. The laboratory is equally proud of its many accomplishments in the commercial sector, especially its long-standing partnership with Nordion, which produces over 2 million doses of life-saving isotopes each year on our campus.

TRIUMF's track record of excellence, both in fundamental and applied research, is a product of long-term investments in the core infrastructure of the laboratory. Supported by a combination of federal and provincial sources, this infrastructure is the foundation upon which our competitive advantage is built. Leveraging this, TRIUMF has earned a reputation as a global leader in translating this technology to the health and life sciences sectors. This puts Canada at the leading edge of a rapidly growing market; but without leadership and support from the federal government, Canada's advantage is at risk.

Canada's Advantage in Nuclear Medicine

As with any enterprise, large-scale science facilities must be periodically renewed to ensure their continued effectiveness. Having endured extended periods of budgetary stagnation, many of Canada's research facilities have experienced significant erosion of their critical infrastructure. In a climate of fierce global competition, this has had a real and demonstrated impact on Canada's ability to innovate. Of particular note, TRIUMF's ageing infrastructure is threatening its world-renowned nuclear medicine program.

TRIUMF's nuclear medicine program has a track record of excellence in innovation and research. The program is responsible for a number of major advances in Canadian health care, including pioneering neurological positron emission tomography (PET) imaging in Canada and hosting the nation's only proton therapy cancer treatment centre. Most recently, TRIUMF's nuclear medicine program was recognized with the 2015 NSERC Brockhouse Prize for Interdisciplinary Research in Science and Engineering for leading a breakthrough effort to develop and commercialize a new method for producing technetium-99m (Tc-99m) – a critical medical isotope whose supply is at risk now that the National Research Universal (NRU) reactor in Chalk River, Ontario has stopped production. This TRIUMF-led

technology provides national supply security for Tc-99m, and if implemented, would safeguard against a repeat of the 2007 and 2009 crises that saw isotope shortages compromising patient care across the country.

TRIUMF's nuclear medicine program is facing an uncertain future because of its ageing infrastructure. Powered by a twenty-five-year-old medical accelerator, TRIUMF's nuclear medicine program needs essential upgrades to allow it to continue to serve Canadians and the wider scientific community. This is the basis for TRIUMF's proposal to construct the Institute for Advanced Medical Isotopes (IAMI) – a facility that would strengthen TRIUMF's nuclear medicine program and significantly increase its impact.

The Institute for Advanced Medical Isotopes

Envisioned as the future home of TRIUMF's life sciences program, the Institute for Advanced Medical Isotopes (IAMI) will provide the infrastructure necessary to keep the laboratory – and by extension Canada – at the cutting edge of innovation in nuclear medicine. Leveraging $11.0M in committed support, TRIUMF and its regional research partners – which include the University of British Columbia, the BC Cancer Agency, and Simon Fraser University – are requesting $12.25M each from the federal and provincial governments for the capital construction of the facility. Ultimately, IAMI will serve as the hub for Canada's growth and development in nuclear medicine, the benefits of which will spread across Canada through TRIUMF's network of 19 member universities and dozens of other research partners and collaborators.

Located at TRIUMF, the proposed facility will fulfil two core purposes: 1) provide clinical partners with a secure supply of Tc-99m and other short-lived isotopes, and 2) enable cutting-edge research into next-generation radiopharmaceuticals for both diagnostic and therapeutic use. To enable this dual mandate, the facility will include a new cyclotron particle accelerator, an underground vault to house the machine, multiple isotope target stations, and a suite of medical-grade laboratories suitable for both research and production.

Once complete, IAMI will offer unparalleled technical expertise and state-of-the-art facilities, uniting a cluster of stakeholders from across academia, industry, and government to deliver world-class breakthroughs in science and medicine. Building on the existing assets of the TRIUMF program, IAMI will enable the development and production of isotopes for cancer and other critical illnesses, facilitate closer collaboration with industry to commercialize new technologies, and deliver societal impact through the education and training of future generations of talent.

IAMI stands to serve as an enduring example of the Government of Canada's commitment to research and development in Canada's nuclear sector. Investment in Canada's accelerator infrastructure will have an immediate and lasting impact on the outlook and promise of nuclear medicine.

If Canada is to maintain its standing as a leading force in global science – and enjoy the concomitant economic and societal benefits – the nation must invest in its infrastructure. IAMI offers tremendous opportunity and benefit to Canada in a critical field. Conversely, without IAMI, Canada will lose significant capacity and talent in an area where it is enjoys a significant competitive advantage.