

1. RFEOI Title	Restructuring of AECL Nuclear Laboratories	
2. Lead Organization Responding (legal name)	CREATE (Chalk River Employees <i>Ad-hoc</i> Taskforce for a national laboratory)	
3. Participating Organizations	N/A	
4. Location of interest:	Chalk River Laboratories	
5. Identify one or more of the following areas of interest: e. Other: Ideas for mission and governance	5b. Indicate all facilities of interest: <u>All facilities at CRL.</u>	
6. How would you propose to participate at the Laboratories? CREATE, as a volunteer committee, has no resources to participate in a formal way. Instead, we present ideas for the mission and governance of Chalk River Laboratories (CRL).		
7. Expertise/Capabilities of the Respondent(s) (one paragraph) CREATE is a grass-roots, non-partisan group of volunteers that includes current and former employees at CRL. CREATE was formed in 2009 to develop and propose a vision for the future of CRL, focusing on its mandate and mission. This vision is based on the knowledge and experience of many local individuals and has been endorsed by local municipalities, Renfrew County, and the Eastern Ontario Wardens Caucus. The members of CREATE represent themselves. They do not represent their employers or other institutions with which they may be affiliated.		
8. Summary of Interest (one paragraph) CREATE focuses on the mission of CRL as a national laboratory and we provide some high-level ideas about what such a model may look like. A major purpose for adopting the vision of CREATE for CRL would be to best leverage the existing assets. Thus, our vision for the Chalk River <i>National</i> Laboratory (CRNL) is described in brief here. A national laboratory mission will affect all existing facilities at CRL and will require investment in upgraded and new infrastructure, including notably a new research reactor. It is expected that this transition process would be done in consultation with potential partners and customers. In parallel, detailed planning for a new multi-purpose reactor for research and other applications in the long-term is needed. Such a reactor would assume and expand the functions of the aging NRU reactor.		
9. Benefits expected by Government (one paragraph) The proposed CRNL will be much more outward-looking, collaborating, partnering and impacting at all levels of Canadian society, providing many public good benefits as well as benefits for industry and government directly. We believe that CRNL will be a vehicle to mobilize science and technology (S&T) to Canada's benefit, that is, it will contribute to the vision of Canada's S&T strategy: "to build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life." Specific benefits to AECL and Government, beyond the S&T impacts to Canadian society, include reducing NRC's contributions to AECL for core funding and providing the technical information and foresight needed for public policy decisions that arise from nuclear science. CRNL will be a productive and sustainable national laboratory that provides both near-term and long-term benefits to the Canadian public, with a good return on the investment of public tax dollars and private investment.		
10. If available, would you be interested in a one-on-one session? Yes		

A Vision for the Chalk River National Laboratory:

An Expression of Interest in AECL with respect to the future mission and governance of Chalk River Laboratories

Submitted by

Chalk River Employees Ad-hoc Taskforce for a national laboratory

(CREATE)

With Appendices:

Appendix A: "The CREATE Report" - Chalk River National Laboratory (CRNL):
A Vehicle for Mobilizing Science and Technology (S&T) to Canada's Benefit.
Updated March 2012.

Appendix B: Petitions from individuals collected in support of the establishment of the Chalk River National Laboratory.

1. Respondent Profile

CREATE is a grass-roots, non-partisan group of volunteers that includes current and former employees at Chalk River Laboratories (CRL). The members of CREATE represent themselves. They do not represent their employers or other institutions with which they may be affiliated.

CREATE was formed in the summer of 2009 in response to the announcement of the restructuring of AECL (Atomic Energy of Canada Ltd.), and in response to letters from the Prime Minister to Cheryl Gallant, Member of Parliament for Renfrew-Nipissing-Pembroke, encouraging her to champion the cause of revitalizing CRL. Because this would include advocating for her constituents' views about the restructuring and the investment in a new research reactor, a grass-roots effort was needed to consolidate and communicate a vision for CRL.

CREATE's vision is based on the knowledge and experience of many local individuals gleaned by both focused consultation with expert individuals and broader consultation with the community through public meetings (the process used is described in our report informally known as "The CREATE Report"). Presentations of this vision for CRL to municipalities has led to resolutions being adopted by local municipalities, Renfrew County, and the Eastern Ontario Wardens Caucus calling on the federal government to establish the post-restructuring mission of CRL as a national laboratory. CREATE also presented its vision at the March 25, 2010 meeting of the House of Commons Standing Committee on Natural Resources.

Given some developments since the original writing of the CREATE report, the report has been updated and revised as of March 2012, and appended to this document.

2. Overview of Areas of Interest

This Expression of Interest focuses on the mission of CRL as a national laboratory. Although the mission must be determined before an appropriate governance model can be developed, CREATE provides some high-level ideas about what such a model may look like.

A national laboratory mission will affect all existing facilities at CRL and will require investment in upgraded and new infrastructure, including notably a new research reactor.

A major purpose for adopting the vision of CREATE for CRL would be to best leverage the existing assets. Thus, our vision for the Chalk River *National* Laboratory (CRNL) is described in brief here. For a fuller discussion, please consult our report in Appendix A.

2.1 Mission of CRNL: What CRNL Will Be

The future CRNL will be Canada's premier laboratory for nuclear and related sciences and technologies. It will be a resource for researchers from across a broad spectrum, from fundamental sciences to industrial applications. It will include research and development (R&D) that supports the nuclear energy sector in Canada, and it will also carry out R&D to support other sectors of industry and topics of concern to the federal government for both the near-term, and the long-term.

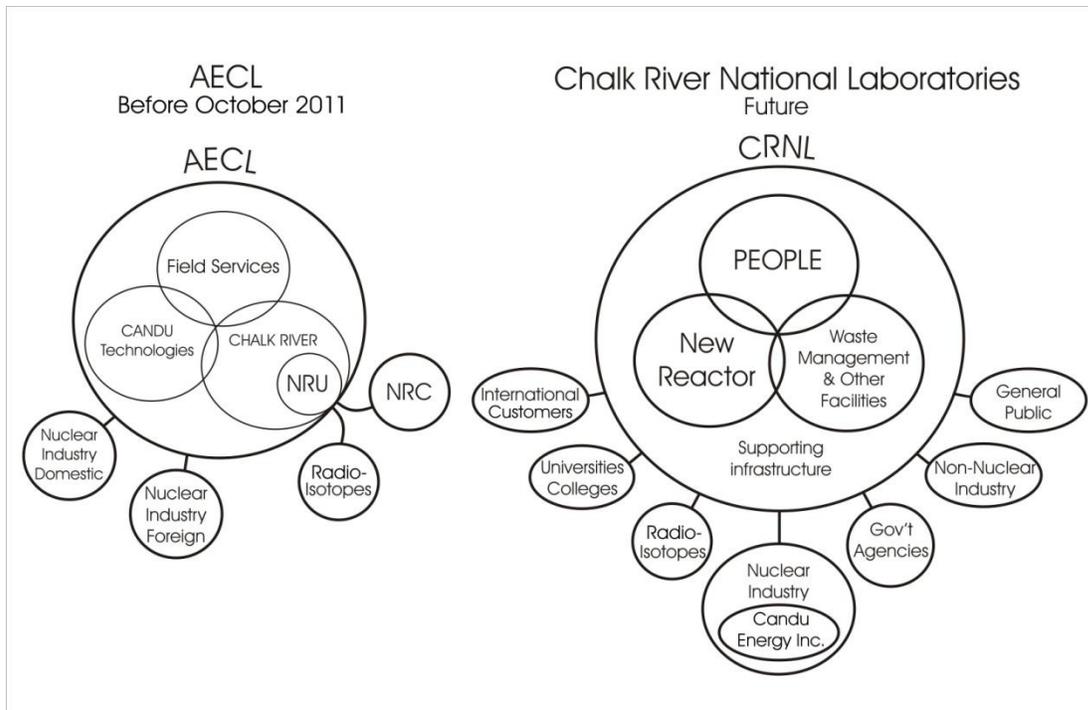
The following key points summarize the differences between a future CRNL and the CRL of the past:

- Up until very recently (2011), Chalk River Laboratories has been a collection of specialized scientific and engineering experts and facilities, mainly focused on a specialized application: CANDU nuclear reactor technology.
- In the future, a Chalk River *National* Laboratory (CRNL) will continue as a collection of specialized experts and facilities in the field of nuclear science and technology, and it will also become a resource for Canada, contributing to a broader range of scientific research and industrial applications.
- Previously, until about 1985, the Chalk River *Nuclear* Laboratories (as it was once named) was a self-contained, mission-focused scientific establishment dedicated mainly to nuclear R&D. In contrast, the national laboratory will actively engage external partners and customers to make impacts beyond nuclear energy technologies. The new outward focus will result in many collaborations with potential partners that were excluded in the past, or whose participation and involvement were minimized.

2.2 Mission of CRNL: What CRNL Will Do

The mission of CRNL will be to lead the fields of nuclear and related sciences and technologies to produce maximum benefit for Canada, by:

- Providing national infrastructure for science and industry, including a multi-purpose reactor for research and radioisotope production.
- Leading high-priority research in materials science, energy, health, the environment and other sciences and technologies, while innovating in key areas such as reactor safety, nuclear safeguards, waste management, and radioisotopes (please refer to "Disclaimer on isotope production" in section 2.4).
- Collaborating with Canadian and international scientists from various industries, other government agencies, and universities who need access to CRNL's unique facilities, equipment and expertise.
- Transferring knowledge, commercializing research, and training highly qualified personnel to support Canada's strategic needs.
- Fostering a culture of scientific intelligence, creativity and innovation through public education and outreach.
- Supporting Canada's representation in international organizations, such as the International Atomic Energy Agency.
- Providing objective technical advice on issues that affect the public.



The differences between the past CRL and the future CRNL are illustrated in the above functional diagram, illustrating the following key points:

- In the past, CRL served AECL alone as a company laboratory, with just a few notable exceptions. In the future picture, CRNL will serve Canada, proactively seeking collaborations and partnerships with universities and industries, including customers in the domestic and international nuclear and non-nuclear industries, while supporting government and the public.
- Expert people at CRNL are directly accessible to customers to streamline the flow of knowledge and innovation to customers.
- A new multi-purpose research reactor is an essential component of the new CRNL to support its missions.
- Waste Management and other facilities at CRNL will also serve Canada. CRNL can lead Canada in nuclear waste management R&D, potentially leading to a very large source of revenue.

2.3 A New Multipurpose Research Reactor

A new multi-purpose research reactor is an essential component of the new CRNL, with capabilities surpassing the current NRU reactor for its three missions:

- (1) Nuclear R&D, including energy.
- (2) Advanced materials research using neutron beams.
- (3) Isotope production for applications in industry and medicine (see 2.4 Disclaimer on Isotope Production below).

A new research reactor must be based on a business case for supporting the two science and technology (S&T) missions, namely, nuclear R&D and neutron beams. However, there is great added value in including a *capability* to produce radioisotopes in the original design, rather than implementing expensive modifications to the facility after it is built.

The new reactor will not merely be a replacement for NRU. It should be a world-class facility that places Canada at the leading-edge in these areas of S&T.

An engineering design and cost assessment for a new multi-purpose reactor is needed. Such a study should have input from all stakeholders, including Canadian scientists and industries, to better determine Canada's long-term needs. The new reactor should, at a minimum, duplicate the capabilities of the existing NRU reactor, but it should also include new capabilities, for example, the capacity to perform R&D for the next generation of nuclear power technology.

It would be expected that all key stakeholders and customers (e.g., federal government, provincial governments, various universities, utilities and private companies) would contribute to the development of this business case.

2.4 Disclaimer on Isotope Production

CREATE recognizes that AECL produces isotopes as a matter of public policy, not to make money. We welcome the government's intention to place Canadian production of Tc-99m¹ on a sound commercial footing without government support. Achieving more clarity in this complex policy landscape was a step forward when this intention was announced in March 2010. Tc-99m was not a reason for building the NRU reactor,² and it should not be the major reason for a new multi-purpose research reactor.

Without seeking to detract from this positive policy direction, isotopes continue to be mentioned here for the following reasons:

- Alternative methods of producing Mo-99 or its daughter product Tc-99m are being investigated to determine their technical and economic feasibility. However, current policy may need to be re-evaluated if these other options do not meet requirements. For example, current estimates place the cost to hospitals of the Tc-99m produced by accelerator-based methods at ten times today's price.³
- If reactor-based production of Mo-99/Tc-99m is to be considered in the future, the goal of achieving a sound commercial footing without government support would still be needed. In such a case, CREATE fully supports the implementation of a full-cost

¹ Tc-99m is the most commonly used medical isotope and is the daughter-product of Mo-99, which is produced in the NRU reactor in Chalk River.

² Nuclear medicine was still in its infancy when the NRU reactor was completed in 1957.

³ Terrence D. Ruddy, Director of Nuclear Cardiology at the University of Ottawa Heart Institute, speaking at the 2012 Canadian Nuclear Association conference (February 2012).

recovery model for access to any facilities at CRNL by radioisotope producers. A recent study by the OECD Nuclear Energy Agency indicates that such a model is feasible and global progress is being made toward recovering costs of isotope production.⁴

- Many other isotopes besides Mo-99/Tc-99m for industrial or other medical purposes can be produced only using a reactor. Examples include neutron doping of silicon for the electronics industry, isotopes for nuclear batteries and high-specific activity Co-60 for cancer therapy.

3. Ideas for Governance and Management

CREATE is focused mainly on establishing the best the mandate and mission for CRL. This mission should ensure that CRNL provides the best value proposition for Canada. Ideally, the best governance model should follow logically and sensibly from the mission. In practice, it is possible that there may be more than one workable governance model. Thus, while we can provide some high-level ideas and suggestions on governance, we always remain open to variations.

3.1 What is a National Laboratory?

A national laboratory is a major research and development (R&D) facility with a national scope and is owned and funded significantly by government. The phrase "national scope" denotes that its research mandate is determined by the needs of the country as a whole, usually including both strategic and fundamental research. A national laboratory is accessible by external researchers from across the country. As a major R&D site, a national laboratory has unique facilities such that its operations go beyond those available in the private or academic sectors for reasons of size, expense, technical stringency, long-term liabilities, or special security requirements.

Thus, a national laboratory is a major hub that serves industrial, academic, and other government R&D programs. It is a catalyst and a facilitator in transferring and transforming new knowledge and innovations from universities and other institutions to industry and private start-up companies. These components, when interfaced well, help to drive the knowledge-based segment of an economy. A national laboratory can also serve important roles as both an incubator and a nursery for numerous entrepreneurs and small businesses that need R&D assistance in developing new products and technologies.

The Chalk River National Laboratory (CRNL), as proposed, might be the first of its kind in Canada according to this definition of a national laboratory. In the international community, there exist many "national" laboratories that bear similarities to the CRNL concept. Examples include

⁴ OECD Nuclear Energy Agency. The Supply of Medical Radio-isotopes. An Economic Study of the Molybdenum-99 Supply Chain. 2010.

This study indicates that the price increases needed to achieve sustainability through full cost-recovery are would result in about a 50% increase in the price at the hospital, while producing several times more revenue for the reactor operator.

Oak Ridge National Laboratory (ORNL) in the United States, the Paul Scherrer Institute (PSI) in Switzerland, the VTT Technical Research Centre of Finland, and the Korean Atomic Energy Research Institute (KAERI) in South Korea.

3.2 Federal Leadership

A national laboratory such as CRNL cannot perform its mission without strong support by the federal government, despite involvement from other stakeholders. The role of the federal government is to set the mission and models for funding and management that will facilitate access to CRNL by all stakeholders, and then to provide on-going oversight.

Due consideration is needed for the appropriate federal ministry that is best suited to oversee the new mission of CRNL, which will go far beyond the scope of energy, the realm of Natural Resources Canada, and more broadly influence the whole of science and industry, the realm of Industry Canada.

A transfer of responsibility for the new CRNL to Industry Canada (or to one of the S&T agencies reporting to Industry Canada) would strongly reflect a broad S&T mission, and facilitate decision-making about CRNL in the context of Canada's other major investments in S&T. In addition, having CRNL and the Canadian Nuclear Safety Commission (CNSC) report to different Ministerial portfolios might reduce potential conflicts of interest, whether real or perceived.

Further, it might not be necessary to transfer the responsibility for nuclear legacy liabilities along with the rest of CRNL to Industry Canada. Natural Resources Canada could continue to award funds for clean up activities, whether to CRNL or to a contractor. Such an arrangement would allow each federal agency to focus on its respective areas of experience.

3.3 Size & Funding

In our report, CREATE presents a high-level picture of CRNL's potential size and funding model, noting that a much more rigorous analysis is needed. We suggest that sustainable operations of CRNL would require approximately 900 frontline R&D staff (scientists, engineers, and supporting technical staff), plus a full range of support staff. The total baseline employment would be at least 2,700, but could grow as new R&D initiatives and new customers and funding sources develop. These numbers do not include spin-off employment in S&T firms that could be co-located at CRNL or at a proposed nearby technology park.

The funding model is envisioned to be approximately 60% baseline funding from the federal government, plus 40% from various partners and customers. The 60% baseline funding includes overhead costs and should allow management of fluctuations in partner funding, while the 40% revenue from partners and customers will enable the laboratory to be maintained in a truly competitive state of readiness to meet the needs of Canadian stakeholders, and to provide international leadership in science and technology.

Federal & Provincial Research Funds

Other large S&T laboratories in Canada (e.g., TRIUMF, Canadian Light Source) do receive substantial funding from federal S&T funding agencies such as the Canada Foundation for Innovation (CFI) for capital projects or the CFI Major Science Initiatives Fund and the Natural Sciences and Engineering Research Council (NSERC) Major Resource Support program for operating costs. As a federal crown corporation, AECL may be ineligible to receive funds from these federal sources toward construction or operation of a research reactor or other facilities. Therefore, due consideration should be given to possible governance models that would allow CRNL, or perhaps specific facilities at CRNL, to receive funds directly from these agencies.

Indirect routes for funding from the S&T funding agencies may also be available. For example, NSERC provides funding to support academic access to major resources as well as the activities of the University Network of Excellence for Nuclear Engineering. The CFI also funds new infrastructure that will be used by academic researchers. Thus, CRNL's efforts to collaborate broadly with academic research and to pursue formal integration with university programs of research and education may result in partnership income from these sources.

Provinces have S&T funding bodies similar to their federal counterparts to meet federal requirements for matching funds. The host province of any major S&T facility will likely accrue more spin-off benefits from S&T activities than other provinces. Thus, Ontario has a significant potential role in supporting CRNL as a junior partner with S&T funds.

Industry Funds

Several major sources of revenue could collectively provide 40% of CRNL's non-baseline funding. Candu Energy and the CANDU Owners Group will require significant R&D to continue to support the existing CANDU fleet. Candu Energy will also need R&D to support new reactor construction and operation (e.g., the Enhanced CANDU-6), and to develop the next generation of reactors, fuels, and fuel cycles for the future. A significant portion of the research required by Candu Energy can be done economically and reliably at CRNL. Revenue from this one source alone could eventually be greater than \$100 M per year.

Waste management has significant potential for revenue, given that there are few facilities globally that are able to accept radioactive waste. Although there are uncertainties, CREATE is confident the income potential from waste management would be an important revenue source for CRNL. Waste from hospitals and universities will be a small but steady portion of this of income.

Revenue from isotope production would increase significantly if a full-cost recovery model is implemented (but see section 2.4 "Disclaimer on Isotope Production"), and if other radioisotopes of commercial interest are produced.

Further revenues can be generated from other industries requiring access to key facilities by simple fee-for-service arrangements based on a full cost recovery model. For example, these services could include the following: proprietary R&D for industry, which could include testing materials in a reactor core for other nuclear companies (including foreign reactor vendors), and non-destructive characterization or assessment of automotive or aerospace components.

3.4 Operating CRNL

In addition to considering the appropriate federal department or agency to oversee CRNL (described in section 3.2 above), the choice of operator is also important. First, CRNL could be operated as a stand-alone federal agency for nuclear S&T, similar to the Canadian Space Agency for space S&T. Second, CRNL could become part of the National Research Council (NRC) in order to leverage the existing expertise at NRC in operating S&T facilities. Third, operations could be contracted out to a consortium of parties, somewhat similar to what is done with several national laboratories in the USA, sometimes called a "GOCO model." Fourth, CRNL could become a public-private partnership, governed by a board of directors with representatives from government and private industry.

Whatever model is chosen, the following key principles must be included in the model:

- CRNL must remain open to access by all, and therefore no private company should have exclusive access to its capabilities.
- The operator must be responsive to the needs of all stakeholders and be able to protect the broad interests of Canada in the facility, not just the vested interests of a few companies.
- If the operator is a federal S&T agency with a suitable mission, it should be able to protect the broad interests of Canada, but formal mechanisms for the stakeholders to be included in decision-making about the facilities are needed to ensure responsiveness to their needs.
- If the operator is, for example, a university-industry consortium or public-private partnership, the board of directors must have strong representation from the external S&T communities that require access to facilities (including especially the neutron beam users and nuclear engineering users) to ensure that the concerns of these communities are not overwhelmed by commercial activities. Thus, a private consortium primarily interested in waste management and decommissioning activities or isotope production should not be granted a contract to operate the whole laboratory.
- To further enforce the mission of CRNL as an S&T facility, the operator should be accountable to S&T users of the facilities for envelopes of funding that are tied to their access. For an example of such a model, the NRC Canadian Neutron Beam Centre (CNBC) relies on its user community, represented by the Canadian Institute for Neutron Scattering (CINS), to obtain an NSERC Major Resource Support grant. CINS oversees the use of the funds at the CNBC and reports to NSERC on its evaluation of CNBC's state of readiness for user access.
- The operator's value proposition should include the external expertise needed to reflect the change in mission and enhance the existing capabilities, such as experience in operating other S&T facilities. This consideration argues against implementing a stand-alone S&T agency in the short term.

3.5 Summary Recommendations toward a Governance Model for CRL

- Adopt or adapt the CRNL concept to optimize the future mission of CRL for the benefit of all Canadians and Canadian industry.

- Identify a federal agency with broad science and industry experience to lead detailed planning in consultation with all stakeholders and to assist in the transformation of CRL into CRNL.
- To expedite implementation of this vision, initiate simultaneously:
 - Detailed planning for CRNL's future governance and business model;
 - Detailed planning of a new multi-purpose reactor for research that can take over and expand the functions of the aging NRU reactor over the long term.

4. Participation and Investment in the Laboratories

N/A

5. Benefits to AECL and Government

CREATE has presented its vision for CRL as a national laboratory (CRNL); the proposed CRNL will be much more outward-looking, collaborating, partnering and impacting at all levels of Canadian society. That outward focus includes several new functions: leading diverse research programs beyond nuclear energy; collaborating and partnering broadly with universities, industries and government; as well as assisting with the commercialization of research knowledge.

This vision contributes toward the policy goal in the federal S&T strategy: "to build a sustainable national competitive advantage based on science and technology and the skilled workers whose aspirations, ambitions, and talents bring innovations to life." A full discussion of how CRNL is aligned with the four core principles, and three S&T advantages in the strategy is provided in section 6 of Appendix A (the CREATE report).

A summary of expanded areas of R&D including nuclear energy R&D and advanced materials research as well as potential growth areas for R&D at CRNL are provided in section 5.5 of Appendix A (the CREATE report). The benefits include increased knowledge to support safe and economic operations of the existing fleet of reactors and to develop the next generation of nuclear energy technology which can provide a sustainable supply of energy with little-to-no greenhouse gas emissions; improved materials that enables advances in many industry sectors, including energy, automotive, aerospace, information and communications, health, and nanotechnologies; the study of the environmental impacts of nuclear technologies; as well as the development of mitigation methods and nuclear safeguards to enhance security.

More specific benefits to AECL and Government, beyond the S&T impacts to Canadian society include:

- By partnering to increase revenue generation and by recovering costs for services, NRC's contributions to AECL for core funding can be reduced and isotope subsidies could be eliminated, meeting the government's goal of achieving a sustainable model for isotope production (see 2.4 Disclaimer on Isotope Production above).

- By establishing CRNL as a dispassionate and objective advisor to the government, it will be a resource for the technical information and foresight needed for public policy decisions that arise from nuclear science, in such areas as, energy, security, reactor safety, and isotopes for medical and other applications. Such policy advice could be provided to bodies such as the Science, Technology and Innovation Council, the Canadian Nuclear Safety Commission, and other federal and provincial agencies, as considered appropriate.

The opportunity has arrived to begin transitioning CRL into CRNL by establishing a future direction, supported by an appropriate business model. If implemented in cooperation and in partnership with the Government of Ontario, and major stakeholders from Canadian industry and academia, the proposed changes to CRL will lead to a productive and sustainable national laboratory that provides both near-term and long-term benefits to the Canadian public, with a good return on the investment of public tax dollars and private investment.

These investments will lead to science and technology research, development, innovation and implementation that will improve the health, security, and prosperity of all Canadians.

6. Implementation Timeline

Decision-making must be well-informed. The future governance model for CRNL needs to be implemented as soon as reasonably possible. However, an evaluation of costs and benefits of a new multi-purpose research reactor must be done in parallel with the evaluation of the future mission and mandate of CRL.

A new research reactor is vital to any major S&T-oriented mission for CRL. Ongoing uncertainty about the continued presence of such a major facility at CRL would render implementation of such a mission nearly impossible. Complete up-front knowledge of the proposed costs, benefits, and revenues for a new reactor will enable more informed decision-making about how to proceed with such a mission.

A conceptual design and cost estimate of a new reactor may take up to two years. This timeframe fits well with the CNSC's request in October 2011 for AECL to present a plan for the future of the NRU reactor in 2014, provided that this analysis is commissioned in the next few months.

7. Risk Management

N/A

8. Future Procurement Processes

N/A