AECL R&D's ROLE IN PROMOTING NUCLEAR RESEARCH AND EDUCTION

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Nuclear renaissance has created new opportunities for new technology development and has also brought along the challenge of meeting the growing demand of trained personnel in the nuclear science and engineering. Towards meeting this challenge, AECL R&D organization is actively promoting and supporting the creation of nuclear research capabilities at the universities and also effectively leveraging the R&D at the universities. It has also put in place several new initiatives to attract and develop the talented young people for career in nuclear science and engineering. This paper describes various interactions and collaborations with the universities that supports the nuclear R&D at the universities and develop highly qualified personnel for the future nuclear R&D needs.

1 Introduction

The concerns for climate change and energy security have globally renewed the interest in nuclear energy. In this context, there is increasing recognition by policy makers worldwide that nuclear energy, which is providing 16% of electricity supply today, could significantly increase its contribution in the future [1]. It is expected that in the coming decades, a significant number of new nuclear plants of Generation III and Generation III+ design will be built. Nuclear regulators around the world are demanding improved safety and the new regulations are evolving. Safer, sustainable, economic and proliferation-resistant nuclear systems are being pursued as Generation IV systems worldwide. Such a nuclear renaissance is also on the horizon in Canada and is evident from various recent projects, initiatives and government announcements. Existing CANDU reactors are undergoing refurbishments and new reactors are being planned in Canada. AECL has developed a Generation III+ reactor – the Advanced CANDU Reactor (ACR) - that is being considered for new construction. Canada has joined a twelve-country Generation IV International Forum (GIF) that is developing Generation IV reactor systems as joint international projects. AECL R&D is the lead participant in Canada's Generation IV National Program set up to support Canada's participation in the GIF. All of these activities have created new demands and opportunities for the R&D resources that have been constrained to date due to the stagnation of the nuclear industry over the past decade. AECL R&D has developed successful relationship with the universities to leverage the new R&D opportunities and challenges, and actively supports retention of high quality teaching and research capabilities in the universities. Secondly, AECL R&D is also actively pursuing development of highly qualified personnel for sustainability through its interactions with the educational institutions.

2 Promoting Nuclear Research in the Universities

AECL R&D is the keeper of the basic CANDU technology and has managed to retain the knowledge base over the last 40 years. This knowledge base and the current facilities at Chalk River Lab are critical for providing valuable R&D support to the existing CANDU

plants. More recently, AECL R&D developed technologies that are currently deployed in refurbishment of the reactors. Also in the recent years, AECL R&D played a key role in the development of the ACR technology. Currently, AECL R&D is working towards the development of a Generation IV, CANDU Super Critical Water Reactor (SCWR) under the auspices of the Generation IV National Program, jointly in multilateral collaborations under the GIF umbrella. Thus, AECL's R&D has expanded its role to a National Nuclear Lab beyond its traditional focus of supporting existing CANDU reactors. This increase in AECL R&D's role has created several opportunities and challenges that require development and optimization of the current resources. Towards meeting these challenges, AECL R&D has successfully leveraged its own efforts with the R&D capabilities at the universities and in doing so is creating new nuclear R&D capabilities at the universities.

AECL R&D's interactions with the universities can be grouped into the following broad categories.

- Sponsored research: AECL R&D supports the Collaborative Research and Development (CRD) projects funded through various agencies such as Natural Sciences and Engineering Research Council (NSERC), Ontario Research Fund (ORF) etc. AECL contributes both cash and in-kind for these projects. The in-kind support includes expert advice, reviews, donation of equipment, and making available some of the unique facilities at Chalk River Lab. Support is provided either directly through AECL's base R&D program or indirectly through COG R&D projects, University Network of Excellence in Nuclear Engineering (UNENE) or through Generation IV National Program.
- Support for university applications for capital grants for facilities through Canadian Foundation for Innovation (CFI), Atlantic Innovation Fund (AIF) etc.
- Support for Industrial Research Chairs (IRC) – either directly through AECL's base R&D program or through UNENE. Recently AECL provided financial support for eight IRCs.
- Adjunct professorships: Currently about 15 AECL researchers serve as adjunct professors at various universities.
- Contract research
- Direct support for graduate students – including experimental facilities and joint supervision.

The total number of current collaborations in the above categories is about 50 and is expected to grow significantly as a result of the Generation IV program.

UNENE is an alliance of universities, nuclear power utilities, research and regulatory agencies for the support and development of nuclear education, research and development capability in Canadian universities [2]. UNENE was launched to ensure that the Canadian nuclear industry would continue to have a dependable supply of highly qualified and skilled professionals to meet its current obligations and emerging challenges. To this end, industry is investing significant funds in selected universities and is contributing in-kind to enable the universities to acquire and retain the highest quality

of teaching and research professoriate. The industry is also assisting the universities in developing relevant research programs, attracting bright students, educating and training them to pursue safe and efficient use of nuclear technology. The universities secure additional funds from the Natural Science and Engineering Research Council (NSERC) of Canada, and elsewhere, to match investments made by the nuclear industry. AECL is a voting member of UNENE and contributes funds. AECL R&D plays a key role in UNENE's Research Advisory Committee that decides on the research projects and research chairs. UNENE has so far funded nine CRD projects and seven IRCs.

AECL's R&D program is structured into eight distinct technology areas. The university collaborations in seven of the eight technology areas are listed in Table 1.

Table 1: University Collaborations in AECL R&D Technology Programs

	Technology Group	Universities
1	Reactor Chemistry and Components	Alberta, Carleton, Guelph, McMaster, Toronto, Western Ontario, Waterloo
2	Safety Technology	Carleton, McMaster, Ottawa, Toronto, Western Ontario
3	Physics and Fuel	Ecol e Polytechnique, Manitoba, Royal Military College (RMC), Ryreson, University of Ontario Institute of Technology (UOIT), McMaster
4	Environmental Emissions and Health Physics	Calgary, Laurentian, McMaster, RMC, UOIT, Western Ontario, Waterloo
5	Fuel Channel	Queens, Toronto, Western Ontario, Waterloo
6	Control and Information	Western Ontario
7	Hydrogen and Heavy Water Technology	UOIT

An important component of the eighth area, namely the Generation IV program, is the trilateral NRCan/NSERC/AECL program for the Generation IV related R&D projects at the universities. This program was conceived to both to leverage the existing expertise available in the Canadian universities and to develop the capabilities for Generation IV R&D in Canadian universities. It is a three-year program with a total funding of about $2M/year from NRCan and NSERC. AECL, as an industrial sponsor, ensures that the proposed projects are relevant to the CANDU SCWR development and provides in-kind support. The program is currently focused on two main technical areas, namely, the SCWR materials and SCWR thermalhydraulics and safety. Universities all across Canada were encouraged to participate and the response has been very good, with a total of 34?? proposals from 22 universities. The results of the competition will be known in early 2009 [3]. This is yet another initiative where AECL R&D is actively supporting and promoting nuclear research capabilities at the universities. AECL also supported a recent multi-university proposal led by McMaster University for ORF grant for research

ranging from addressing the issues with the current generation reactors to the Generation IV reactor systems including advanced fuel cycles.

3 Developing Personnel for Future R&D Needs

One of the enabling objectives of the AECL R&D Strategic Plan is to develop highly qualified personnel for sustaining the nuclear energy option for Canada. To encourage talented students to pursue careers in nuclear science and engineering, AECL's R&D has undertaken several initiatives. AECL R&D representatives continue to visit the university campuses and make presentations on the nuclear R&D challenges and opportunities to the students and the academics. Emphasis is also placed on participation in the campus career fairs.

As one of the three contributing members of the UNENE, AECL actively participates in its Education Advisory Committee to identify the training requirements and provide inputs to the university curricula for training the students for nuclear industry. The main purpose of UNENE is to assure a sustainable supply of qualified nuclear engineers and scientists to meet the current and future needs of the Canadian nuclear industry through university education, university-based training and by encouraging young people to choose nuclear careers. UNENE organizes and delivers through member universities educational programs appropriate to students planning to enter the nuclear industry and to those already employed. Several professional development courses are also available for those wanting to advance their knowledge in a particular field of nuclear science or engineering. UNENE-sponsored postgraduate studies leading to a masters degree are also available for the advancement of the current employees of nuclear industry. AECL encourages and supports employees' participation in the distant-learning of nuclear engineering courses offered by McMaster University through video conferencing towards the diploma or masters studies in nuclear engineering.

AECL also employs several co-op students and the summer students across the organization. In R&D alone, the number of university students average about 20-30 per year. These students are strategically chosen to match their interest with the future employment needs. The students get a first hand experience of a career in nuclear R&D and some return to AECL to pursue their career in nuclear R&D.

AECL R&D supports the summer science-camp program of the Deep River Science Academy (DRSA), a not-for-profit organization whose mission is to encourage talented high school students to pursue careers in science and engineering. The high school students work in the Chalk River Lab, in pairs of two assisted by a university student, on research projects and contribute to the research itself. This provides the high school students an opportunity to "test-drive" a career in nuclear science and engineering. The program also provides the university students an opportunity for career development through dual roles as tutors for the high school students and as research assistants at the host laboratory [4].

AECL also supports the World Nuclear University and provides opportunities for young and talented personnel for career development. AECL R&D encourages and supports

employee participation in the WNU Summer Institute, which is an intensive six-week program of lectures, tours and tutorials presented by some of the world's foremost authorities on nuclear technology and development. AECL played a key role in organizing and hosting the WNU Summer Institute in July-August 2008 in Ottawa in collaboration with Canadian nuclear industry.

4 Summary

As AECL's R&D role expands beyond its current focus on existing reactors, to a National Nuclear Lab, AECL is promoting new nuclear research capabilities at the universities and also undertaking initiatives to develop personnel for the future needs. The relationships with the universities involve providing cash and in-kind support for the sponsored research projects and research chairs, and research infrastructure funded by federal and provincial agencies, in addition to encouraging AECL researchers to be adjunct professors. These relationships with the universities are effectively leveraging AECL's R&D efforts to maintain existing and create new research capabilities, to ensure sustainability in the longer term. AECL is also playing key role in this endeavour through its participation in UNENE and Gen IV National Program. Development of personnel for the future needs is now an enabling objective for implementation of R&D strategic plan and several initiatives are in place to attract new talent to attain this objective.

5 References

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