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1160 Monaghan Road
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Canada

HITACHI GE Hitachi Nuclear Energy Canada

T. Dale Cosh
Sales Manager
Nuclear Services

T 705 748 7946
F 705 748 7338
M 705 930 3681
dale.cosh@ge.com
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Canada

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Nuclear Services

T 705 748 7039
F 705 748 7076
M 705 875 8045
edward.genge@ge.com
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Canada

CNS President's Report

By Adriaan Buijs

Adriaan Buijs

2013 has been a busy and productive year for the Canadian Nuclear Society (CNS). During the year, the CNS carried out all of its key program objectives in hosting conferences and technical courses, and in providing education programs.

For the first time, the CNS has intervened in public hearings: it intervened before the CNSC in a license hearing – the renewal of the operating license for the Pickering NGS – and it made a successful intervention in the joint CEAA-CNSC environmental review of the Bruce DGR project for low- and intermediate-level wastes.

The CNS is an active member of the international community of Nuclear Societies. Domestically, the CNS has worked closely with other nuclear industry associations. Under the leadership of the Canadian Nuclear Association and with the support of its staff, the CNS participated in a number of meetings and workshops in the framework of the Nuclear Leadership Initiative (NLI). The outcomes of the initiative were a 25-year vision and a strategic plan for the industry. Following its mandate and purposes, the CNS has committed itself to three areas of the strategic plan: education and training of (prospective) members of the industry, outreach to the public, and support in matters of nuclear research and development.

Our three focus areas are covered by activities we perform: organization of workshops, courses and conferences, such as Nuclear 101, the CANDU Technology and Safety Course, the Fuel Technology Course; Conferences on steam generators, nuclear-plant maintenance, nuclear science and engineering, small modular reactors and others. The CNS also regularly hosts major international conferences, such as the Pacific Basin Nuclear Conference, the Degradation Conference and others. Our members reach out to schools and other institutions, and participate in science fairs. We wrote a position paper explaining the need for a research reactor in Chalk River. In the spirit of expanding our portfolio of activities, we are currently developing the First Technical Meeting on Fire Safety and Emergency Preparedness.

The CNS has had to make significant changes to its governance and structure during the past year because of the new Canada Not-For-Profit Corporations Act. The new statute required substantial changes to the CNS bylaws, which were drafted and then approved at a special members meeting in November. The CNS has been operating under the new regulations since February 6, 2014. I would like to thank all those involved in making this transition happen; it was a crucial task for the society.

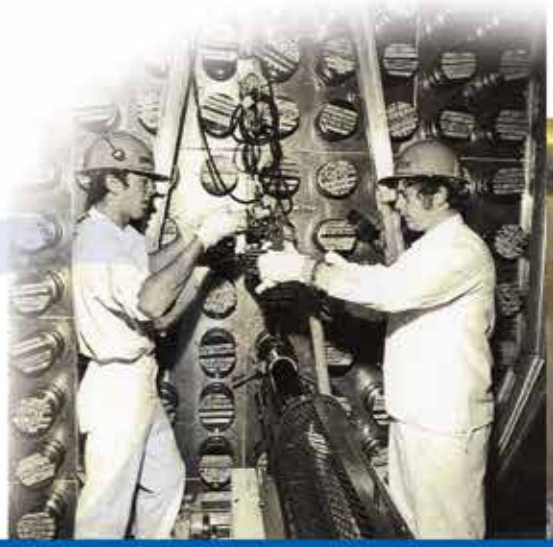
A detailed description of the Canadian nuclear landscape is provided a few pages below in the review of 2013 by the publisher and editor of the Nuclear Canada Yearbook, Colin Hunt. You will also find reviews of the CNS activities by Tracy Pearce, Chair of the CNS Program Committee, Ruxandra Dranga, Chair of the Education and Communications Committee, as well as a number of individual reports by other organisations: The Canadian Nuclear Association (CNA), Women in Nuclear Canada (WiN), the Canadian Nuclear Workers Council (CNWC) and the Organization of Canadian Nuclear Industries (OCI).

The financial support that allows us to stage our many activities comes from several sources: membership fees, industry sponsorship, either through direct support or through registration fees and other modest revenues such as the advertisement in this yearbook and the CNS Bulletin. This shows the need of the CNS for a strong and active membership base. What the CNS in turn offers the membership may not be easy to quantify, but can be summarized in one word: networking. Primarily this comes through the ongoing program of technical conferences, courses and Branch seminars offered by the CNS. This also includes being informed through the CNS Bulletin, the website, and other social media in which we are active. The CNS has a Linked-In.com group that offers great potential. We are working on online forums and blogs.

Just as important as the support from members and the industry is the support the CNS receives from its volunteers. Many of our members volunteer their time on Council, to set the program of the CNS, and on the Executive, to run the day-to-day operations of the Society. There are the chairs and members of the divisions, committees and branches who make up the fabric of the Society. It speaks well for Canada's nuclear industry that its members are so dedicated to what they recognize as a good cause. I salute all those who continue to volunteer their time in support of the CNS. Those who made outstanding contributions to the nuclear industry and R&D, either in person or as part of a team, are honoured as well, with a variety of awards and fellowships, presented at our main conferences.

On a sad note, the past year saw the passing of Ian Wilson on January 6, 2014. Ian was President of the CNS in 2002-3, and he was the Vice President of Technology for the CNA 1985-95. Ian pioneered many of the communication and public contact tools that we use today.

In closing, I would like to thank the Council, Branch-, Committee- and Division-Chairs and -Members, and the CNS Staff for their hard work and dedication during a demanding year. I would also like to thank Frank Doyle for his leadership in organising PBNC-2014 – the premier nuclear event of the year – and Jacques Plourde, incoming President, for organising the CANDU Maintenance Conference, which will showcase Canadian nuclear capabilities, and last but not least, my predecessor John Roberts, under whose watch the new bylaws were drafted, first austerity measures were implemented, and interventions were initiated.



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655 Bay Street, 17th Floor
Toronto, ON M5G 2K4
Tel. (416) 977-7620
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2013 Year in Review

By Colin Hunt, Publisher and Editor, Nuclear Canada Yearbook

Colin Hunt

Introduction

The past year of 2013 has seen some significant successes in the operation of Canada's nuclear facilities. For the first time since 1995, all nuclear reactors in commission across the country were in service and producing electricity. This achievement marks an important milestone in the long work over the past 15 years in restoring a high level of reliability and performance to its nuclear reactors by Canada's operating utilities, Bruce Power, New Brunswick Power and Ontario Power Generation.

Also of great importance during the year was the start of mining operations at Cigar Lake by Cameco Corporation. The commencement of mining operations at Cigar Lake ensures that Canada remains one of the principal sources of commercial uranium for nuclear power generation. With respect to policy development, important decisions were taken with respect to the future of nuclear power in Canada. New reactors will not be built at this time in Ontario, but full refurbishment will proceed with the province's existing reactors at Bruce and Darlington. The federal government is also proceeding with the restructuring of Atomic Energy of Canada Limited. And it has committed to long term policy stability with the re-introduction of the Nuclear Liability Act.

However, perhaps the most important factor for the long term development of Canada's nuclear industry was the coming into force of the Canada-India Nuclear Co-operation Agreement. By ending 40 years of isolation, the NCA allows Canadian businesses in all sectors of Canada's nuclear industry to do business in India and with Indian commercial nuclear enterprises.

For the Canadian Nuclear Society (CNS), these developments have had important short term and long term effects. The CNS intervened in some of these events during the past year. The policy decisions made by the several levels of government and the operating utilities of nuclear reactors will ensure that the CNS will continue to have a stable source of membership and support.

Nuclear Power in Canada

April 12, 2013 is one of the most important dates in the recent history of Canadian nuclear reactor development. On that date, for the first time since 1995, all four reactors of the Bruce A nuclear power station were producing electricity for the Ontario grid. Unit 2 had been indefinitely removed from service on August 8, 1995 as a consequence of lead contamination in its steam generators. At the time, there was no expectation that the unit would return to service. However, the capital investment and hard work by Bruce Power and its contractors has resulted in the full restoration of Bruce A units 1 and 2 to what can be expected to be another 25 years of useful service life.

This was followed on April 22 by electricity generation from all eight Bruce units, again for the first time since 1995. On August 15, with the return of some units from maintenance outages, for the first time since 1996 all operable reactors in Ontario, including those of OPG, were producing electricity simultaneously.

These events mark the full return to service of all eight units in what is now the world's largest nuclear site. As such it ensures that Canada's industrial heartland of Ontario will continue to have a reliable source of base load electricity for the next quarter-century.

The year was also important for New Brunswick's Point Lepreau GS. In November, the reactor achieved full power production at 660 MW for the first time since the completion of its refurbishment outage. This unit too is expected to provide electricity supply to that province for another 25 years. The performance of Canada's nuclear fleet is shown in the CANDU Performance Table found later in this Yearbook.

The CANDU 6 Reactor Fleet

Reactor	In Service	Capacity (MW)	Performance In 2013 (%)	Lifetime Performance (%)
Point Lepreau	1983	680	72.6	70.9
Wolsong 1*	1983	679	0	86.3
Wolsong 2	1987	678	83.7	93.5
Wolsong 3	1998	698	92.6	94.8
Wolsong 4	1999	703	90.2	95.7
Embalse	1983	648	63.3	83.1
Cernavoda 1	1996	707	99.4	90.3
Cernavoda 2	2007	705	89.1	93.9
Qinshan 4	2002	700	92.2	91.2
Qinshan 5	2003	700	102.2	92.3
			78.53	89.2

COG CANDU/PHWR Performance Statistics 2013.
*Wolsong 1 under reconstruction for all or part of 2013.

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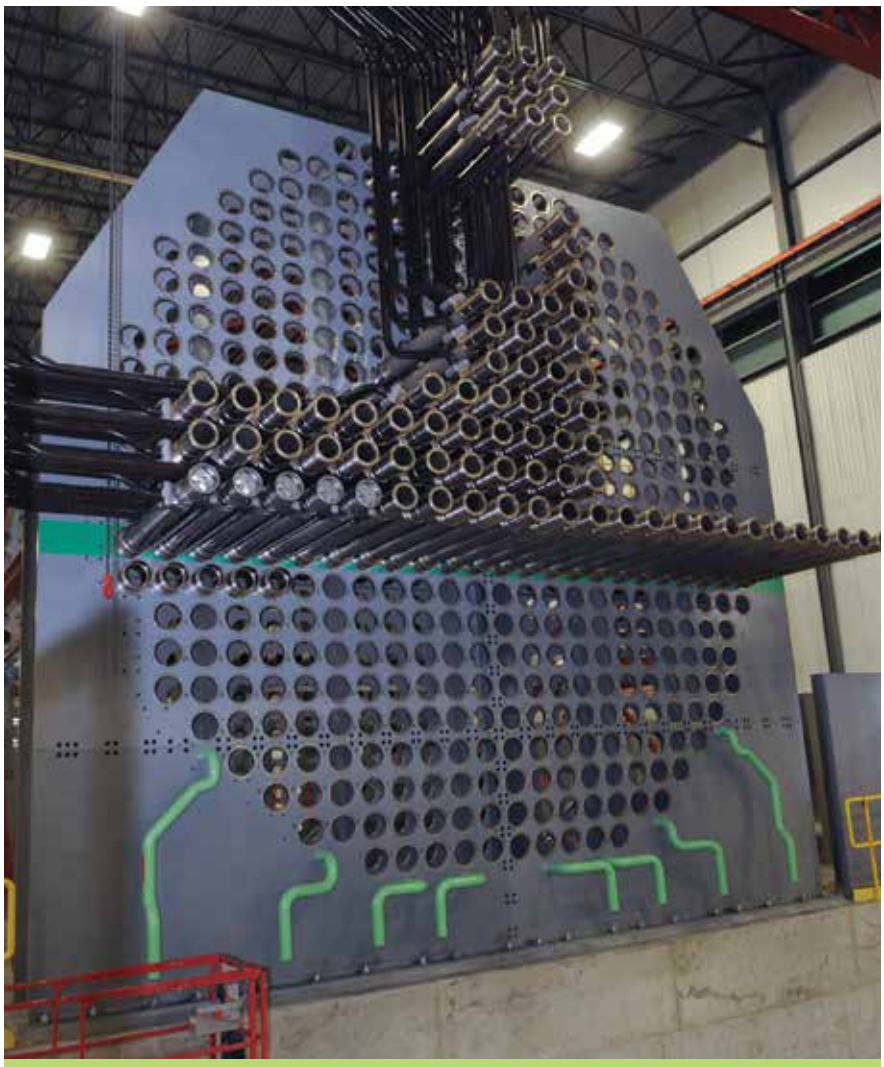

Mock-up reactor face showing lattice openings with fuel channel assemblies and lower feeder pipes. (Photo courtesy of OPG)

Nuclear Co-operation with India

Perhaps the most important long term development for the future of Canada's nuclear industry was the coming into force of the Canada-India Nuclear Co-operation Agreement. This NCA was originally agreed and signed in 2010. It was to come into force with the completion of various administrative requirements such as monitoring and reporting.

The NCA came into force on September 27, 2013. With this agreement, one of the longest and most difficult chapters in the history of Canada's nuclear industry is finally resolved. Canada embargoed all trade in nuclear technology and materials with India after its nuclear explosive test in 1974. India was similarly embargoed by all other nations of the Nuclear Suppliers Group. This was considerably to Canada's disadvantage, as India is the only other large nation in the world which relies on heavy water moderated, fuel channel reactors for its reactor technology. Initially copied from the 220 MW Douglas Point design, the Indian 220 MW PHWRs have evolved into a 500 MW design and most recently a 700 MW version.

In addition to high degrees of compatibility in reactor technology, India also has a chronic shortage of indigenous uranium, one of Canada's principal energy exports. With the coming into force of the NCA, Canada now has opportunities for technical and commercial co-operation in reactor technology and development that did not exist before. It can also provide to India a full range of fuel services for the fuel bundle technology essential for PHWRs along with uranium and fuel services for all other reactor types.

This agreement brings to an end 40 years of nuclear technology isolation of India and opens the door for opportunities for Canadian companies across the reactor and fuel supply chain.

Government Policy and Licensing Activity

During 2013, public hearings were held by the Canadian Nuclear Safety Commission (CNSC) for the renewal of the Pickering NGS operating license. The application by OPG marked a new feature for Pickering; OPG asked the CNSC that Pickering be re-licensed as one operating license, not two, one for Pickering A and one for Pickering B.

This hearing was also important for the CNS. For the first time, the Society intervened in a CNSC public process. Given the success of the CNS intervention, this was the first of what can be expected to be a continuing activity of the Society in the years to come.

The Ontario government made a number of long term policy decisions during the year. These came during the government's policy statement release on October 10. The first was that full refurbishment of the Darlington nuclear reactors should proceed. The first reactor refurbishment is

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- Cernavoda Romania (2 Units)
- Quinshan China (2 Units)
- Wolsong South Korea (4 Units)
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expected to start in 2016. More details on the refurbishment program of OPG can be found later in this Yearbook. Darlington is one of the most important centres of electricity production in Ontario producing about 15 per cent of Ontario's total electricity demand.

However, the Ontario government also decided that it would not proceed with new nuclear construction at the Darlington site. During 2012, it had asked two companies, AECL and Westinghouse, to provide detailed proposals in 2013 for new reactor construction. On October 10, the government canceled its plans for any new construction.

The reason for the cancelation is rooted in Ontario's industrial economy. In the wake of the financial crisis of 2007-8 and the subsequent severe recession, Ontario's demand for electricity dropped by about 25 TWh annually. The overwhelming majority of this loss was industrial load, particularly in key Ontario industrial sectors like automotive.

In the years since, Ontario's electricity demand has remained essentially flat. Ontario has continued to lose industrial demand, with a number of high-profile plant closures in the ensuing years. Not confined to automotive, plant closures have extended to significant parts of the food processing industry as well. Ontario is now in a situation of electricity over-supply, particularly given the Province's efforts to stimulate production from various renewable sources. As a result, there is no expectation of demand for additional electricity in Ontario for the foreseeable future.

It should also be noted that 2014 will mark the closure of the last two coal-fired units at the Nanticoke power station on Lake Erie. When shut, this will leave Ontario's electricity supply coming almost entirely from hydraulic and nuclear, with small amounts from natural gas and renewables.

With respect to the federal government, it announced two years ago that it was seeking an alternative business model for its crown corporation AECL. The first step was the sale of the reactor division to SNC Lavalin. The second step was the restructuring of AECL and its Chalk River Laboratories. After an initial round of consultation with stakeholders in 2012, the government announced that it was proposing a government-owned, contractor operated business model similar to that used by US nuclear laboratories owned by the Department of Energy.

The government outlined a deadline date of March 2014 for proposals by contractors. Several consortia have expressed interest and submitted proposals to the government. These proposals must include their capabilities to operate Chalk River Laboratories.

This matter is of great importance to the CNS. Chalk River Laboratories is home to Canada's principal large research reactor, the NRU. At this time, the NRU has an operating license to 2016. At that time, the government previously determined that its mandate to produce Molybdenum-99 will cease, although the reactor can continue to produce other radioisotopes.

However, much of Canada's nuclear research and development community, both academic and commercial, is dependent upon irradiation services provided by NRU. New nuclear technology development is largely dependent upon its availability. It will be up to the new organization operating the Chalk River Laboratories to determine the business case for continued operation of the NRU. The operating license of NRU expires in 2016.

In January 2013, a protocol for the safe long term storage of the Gentilly 2 reactor was signed between Hydro-Quebec and the CNSC. Safe storage is the preliminary step prior to decommissioning. Two days after the signing, fuel removal began from Gentilly 2.

Nuclear Safety and Environment

The CNSC completed its large study on the health of populations living near nuclear sites in Canada. The study was released in May. The study, "Radiation and Incidence of Cancer Around Ontario Nuclear Power Plants from 1990 to 2008 (RADICON), found no evidence of childhood leukemia clusters in the communities within 25 km of Pickering, Darlington or Bruce.

The study confirms earlier work done by the Durham Medical Officer of Health and earlier studies done by the former Atomic Energy Control Board (AECB) during the 1990s.

Also during 2013 the Canadian Environmental Assessment Agency (CEAA) held public hearings regarding the proposal for geologic storage of low and medium level radioactive waste at a proposed site in Kincardine. Public hearings were conducted for approximately two weeks during the late summer.

The hearings were important for the CNS. For the first time, the CNS participated directly in a CEAA environmental assessment review, tabling a submission and addressing the review panel.

The result of the public hearings was a request to OPG to provide further information on specific technical topics.

CANDU Reactor Development

The CNSC completed the third and final pre-licensing vendor design review of the Enhanced CANDU reactor, EC6. The completion of the review means that the EC6 meets or exceeds all Canadian regulatory requirements for design and operation. And it is the only reactor design that has completed such a review.

Completion means that EC6 is now available as a reactor design for deployment as a new installation anywhere in Canada. EC6 builds upon the technology developed for the CANDU 6 reactor already in use in Canada and around the world. It is a 700 MW, heavy water moderated, fuel channel reactor. It is also the first new reactor design in the world to incorporate experience gained from the accident at Fukushima in 2011.

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Prospects for further international CANDU development increased last year with the signing of a letter of intent between Romanian and Chinese companies, Societataea Nationala Nuclearelectrica (SNN) and China General Nuclear Power Group (CGN). The agreement paves the way for the construction of two additional CANDU reactors at Romania's Cernavoda nuclear power plant.

Romania had been seeking support for construction of two additional CANDUs, Cernavoda Units 3 and 4, for a number of years. The inclusion of CGN brings with it financing support for the project. Talks began in Romania with Candu Energy Inc. and CGN late in 2013.

Supporting Candu Energy's proposal for two additional reactors at Cernavoda is the strong continuing performance of the CANDU 6 reactor fleet, as noted in the chart accompanying this article.

Mining Activity in Saskatchewan

The most important event of the past year was the resumption of underground activity at Cameco's Cigar Lake uranium mine. In late 2012, Cameco had dewatered the mine to the point of reaching the main workings. Restoration of the underground works proceeded throughout the past year. Jet boring within the main works formally began on December 17, with commercial uranium production beginning in early 2014.

Cigar Lake received its operating license from the CNSC in June 2013. The operating license is valid from 2013 to 2021.

Cameco continued its expansion of uranium mining activity outside Canada during 2013. It started production from its North Butte uranium mine in May. With initial production of 300,000 pounds, North Butte is expected to produce approximately 700,000 pounds of uranium concentrate annually.

Opportunities for Canadian uranium sales grew last year with the coming into force of the Canada-India Nuclear Co-operation Agreement. Negotiations with India were completed in 2013, and the agreement came into force on September 27.

Also in November was the signing of a nuclear co-operation agreement with Kazakhstan. That country is currently the world's largest producer of uranium, some 15,000 tonnes annually. The agreement will allow Canadian companies to invest in mining and development opportunities in Kazakhstan.

Also important during the past year, Cameco purchased NUKEM GmbH. Nukem is one of the world's largest brokers and traders of nuclear fuel products and services. Cameco closed the purchase for $140 million (US).

International Developments

For the first time in more than three decades, concrete was poured for new nuclear reactors in the United States, starting with Sumner Unit 2 in March. It was followed by pouring of the base mat for Vogtle Unit 3. The reactors, owned respectively by Southern Carolina Electric & Gas and Southern Nuclear, respectively, are the first new units to be started in the US since Watt's Bar in the 1970s. These are the first of two pairs of reactors to be built at the Sumner and Vogtle sites. All are Westinghouse AP1000 PWRs.

These are four of eight such reactors under construction, with four others at Sanmen and Haiyang in China. The two reactors at Sanmen are expected to enter service in 2014, well ahead of the four in the United States.

Regulatory delays played a part in forcing the permanent shutdown of two existing reactors in the US. San Onofre Units 2 and 3 producing a total 2150 MW, about nine per cent of California's electricity supply, were shut down permanently by the owner and operator Southern California

Floor mock-up with upper feeder pipe attachment to feeder cabinet header. (Photo courtesy of OPG)

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Edison (SCE). The reactors had been shut down because of concerns over premature boiler tube wear in their recently replaced steam generators supplied by Mitsubishi. The utility indicated it could not afford to maintain the reactors in a condition to restart because of delays by the US Nuclear Regulatory Commission in granting permission despite three independent reviews confirming the reactors' safety. SCE also indicated that operating license renewal after 2022 would be costly and uncertain.

Also in March, planning permission was given by the British government to Electricite de France (EdF) for the construction of two EPR 1600 reactors at Hinkley Point C in Somerset. These would be the first reactors built in Britain since the start of the Sizewell B reactor in the 1980s, and the largest infrastructure project since the 1950s.

At the same time Horizon Nuclear Power is in discussions with the UK government for the construction of two 1380 MW reactors at the Oldbury station in Gloucestershire and at Wylfa in Wales. These sites were formerly home to British-designed Magnox reactors, now undergoing decommissioning.

Another European nation has adopted nuclear power. Turkey signed an agreement with Mitsubishi Heavy Industries and Areva for the construction of four PWR type nuclear reactors of 1150 MW each at its proposed Sinop nuclear power station on the Black Sea. Construction is to start in 2017 with first power in 2023.

Nuclear power is also coming to the Middle East. Concrete was poured in May for Unit 2 of the Barakah nuclear power plant in the United Arab Emirates. Electricity demand has been growing by about 9 per cent annually. Four nuclear reactors are planned or under construction at the site near Abu Dhabai.

Globally there were four new reactors starting operation in 2013, two in China and two in India. This was matched by the closure of four reactors, Kewaunee, Crystal River, and San Onofre 2 and 3 in the United States. During the year, 10 new reactors started construction, four in the US, three in China, two in the UAE and one in Belarus, representing a total 11,688 MW. At the end of the year, a total of 71 nuclear reactors around the world were under various stages of construction, totaling about 75,000 MW when completed.

International Heath Studies

In May 2013, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) issued its report on the effects of the Fukushima accident in 2011 after more than two years of research and data gathering. It concluded that no detectible health effects were likely to be attributable to radiation releases from the plant. Typical exposures for most of the local population were less than natural background exposures of 2.1 mSv annually. The only exceptions were 146 emergency workers who received doses over 100 mSv during the crisis. The only attributable fatalities from the accident, according to UNSCEAR, was more than 1000 deaths resulting from the stresses of the evacuation.

Another study released in March by the Goddard Institute for Space Studies estimated that the use of nuclear power instead of coal and some natural gas has averted the deaths of 1.84 million people between 1971 and 2009 because of avoided atmospheric emissions.

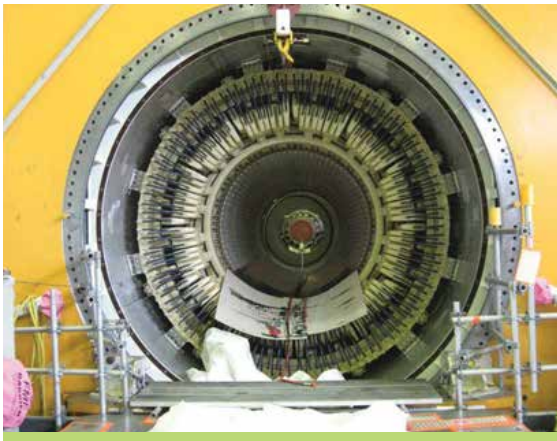
In Closing

2013 was an important year for Canada's nuclear industry. As the performance tables later in this yearbook demonstrate, both Canada's nuclear reactors and its CANDU 6 reactor technology performed well throughout the year. For the first time in nearly two decades, all of Canada's nuclear reactors were operating simultaneously and at full power. This marks an end to the performance and maintenance problems that marked the 1990s and 2000s.

The implementation of the NCA with India offers prospects of further growth in PHWR technology and in particular trade in technology, products and services with a nation which has the second largest nuclear expansion under way in the world. In addition, India has a strong demand for uranium, providing opportunity for growth in Canada's uranium sector.

On a larger scale, it would appear that the shock of the Fukushima accident is wearing off. In July in Japan the pro-nuclear Liberal Democratic Party (LDP) with its coalition partners won control of the upper house of the Diet from the formally antinuclear governing coalition. In particular, the LDP won seats in every constituency in the country with a nuclear power plant. In the Fukushima prefecture, the LDP candidate polled more than twice as much as the antinuclear governing Democratic Party of Japan (DPJ). In Fukui Prefecture, which has the highest concentration of reactors, the LDP candidate polled nearly five times as much as the antinuclear DPJ. These along with the provincial governor races in January would appear to show that the Japanese electorate perceives the need for nuclear power much more than the far more expensive substitutes of fossil fuels and unreliable renewables.

Certainly global trends have remained unchanged by the events at Fukushima in 2011. World statistics, found elsewhere in this yearbook, show 541 reactors under construction, planned or proposed at the end of 2013. Like last year, most of this new construction is in Asia. But with the start of construction beginning in the United States and Britain, there are reasons to accept that nuclear power will undergo a revival around the world, not just in Asia.



Stator after removal from Unit 2 Generator. (Photo courtesy of OPG)

Powering Ontario for the next half-century: Refurbishing Darlington

By Colin Hunt, Publisher and Editor, Nuclear Canada Yearbook

Introduction and Overview

In 2016, Ontario Power Generation (OPG) will commence construction for a project of utmost importance to the future of the province of Ontario: the comprehensive refurbishment of the four CANDU nuclear reactors at it's Darlington Nuclear Generating Station. Over the course of the subsequent ten years, thousands of OPG and contract personnel will carry out a series of complex tasks to replace or renovate thousands of systems and components throughout the station for each of its four reactors.

The importance of Darlington NGS to the economic health of Ontario cannot be understated. Since first production of electricity in 1990 Darlington has produced approximately 560 TWh of electricity. This amount of electricity is equivalent to about one year's total annual consumption of electricity in Canada, or about four and a half years of electricity consumption in the province of Ontario. Each year, Darlington typically produces about 25 to 29 TWh, or about 18-20 per cent of Ontario's total annual electricity demand.

With 934 MW each, the four Darlington reactors are the largest CANDU reactors in the world. Unit 2 entered service in 1990, Unit 1 in 1992, and Units 3 and 4 in 1993.

However, after 25 years of electricity generation, the reactors and their associated systems must be refurbished for continued operation. So starting in 2016 with Unit 2, the reactors will be removed from service in sequence for an outage of approximately three years each. When complete, Darlington will continue electricity production for another thirty years

The total overnight capital cost of the refurbishment project is expected to be less than $10 billion. It should be noted that the refurbishment of Darlington is not the first nuclear station to have units renovated. Bruce Power has just completed its refurbishment of Bruce Units 1 and 2. Point Lepreau

3 x 3 array floor mockup with bellows (intend to remove and reuse). (Photo courtesy of OPG)

in New Brunswick also completed refurbishment and returned to service in 2012. Lessons learned from these refurbishments have been built into OPG's project planning.

Renovation of Darlington also builds upon OPG's own past experience specifically with the refurbishments of Pickering Units 1 and 4 and the early retubing projects of Pickering Units 1-4 from 1985-1992. The pioneer learning experiences at the Pickering station are central to the success of the current refurbishment project of Darlington. What was shown at Pickering was the importance of a dedicated project team and workforce in major project refurbishment work. The first two Pickering units used only station personnel in the 1980s for their retubing, and their return to service was greatly delayed as a result.

However, Pickering 3 retubing completed in 1992 pioneered two key concepts in major nuclear plant renovation work. The first was the need to hire skilled trades from outside the regular station personnel dedicated to the project. The second was the need to build dedicated training facilities to train contract skilled trades workers in techniques for working successfully in the confines of a nuclear power station, in particular the reactor vault. The lessons and successes from Pickering 3's successful retubing have been incorporated in every CANDU refurbishment project ever since.

Lower pressure turbine blades undergoing inspection during routine maintenance outage. (Photo courtesy of OPG)

As a result, there can be confidence that the project will achieve its goals, both financial and technical, because it builds upon more than 30 years of experience with similar projects that have come before it.

Project Scope

The first steps in the Darlington refurbishment began six years ago. It started with inspections of the current state of the station and its equipment, and planning for the outages and the associated work plans. It also included early inclusion of some of its private sector partners in the project, along with securing the needed approvals process from the Canadian Nuclear Safety Commission (CNSC) including an environmental assessment.

As a result of its preliminary inspections, analysis and planning, OPG announced in February 2010 its intentions to proceed with the refurbishment of Darlington.

At this time, some of the remaining steps in refining the project scope include:

- Completing detailed inspections on plant conditions;
- Confirming the regulatory scope of the refurbishments
- Awarding all major contracts with private sector partners.

The result of this will be a fully defined project scope, cost and schedule for execution. Past experience has shown that the success of refurbishment projects is directly dependent on the extent and accuracy of all of these factors. Detailed inspections, for example, minimize or eliminate the possibility of unexpected

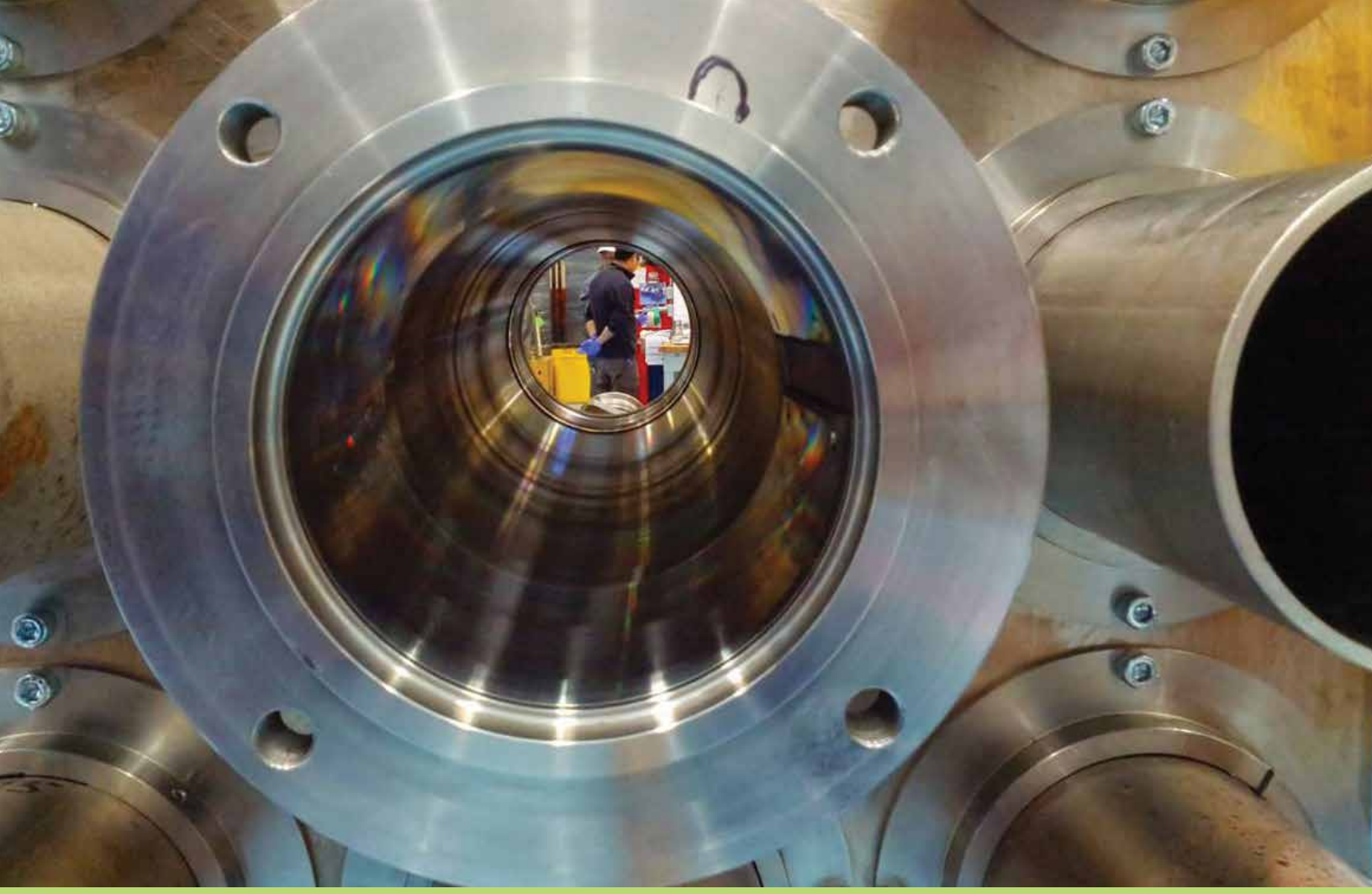
Unit 2 close up low pressure turbine. (Photo courtesy of OPG)

conditions being discovered in plant equipment resulting in possible project delays and increased costs. Also essential is the agreement of the CNSC on the scope of the work. And early involvement and contracting with supplier companies ensures that services, equipment and expertise will be available as required by the project timelines to avoid delays.

The First Steps

OPG has already completed a large number of necessary first steps in its refurbishment project. It has completed the construction of the large training facility, the Darlington Energy Complex or DEC. This is the principal hub of the refurbishment project. It includes a full scale replica of a Darlington reactor and other mockups. It includes a testing facility for the specialized tools required for retubing the reactors. The purpose of these facilities is to ensure that all skilled trades workers contracted for the project will have familiarity with working conditions, procedures and tooling before entering the station. The DEC includes warehousing space for materials and components required for the project. The DEC is also the new home of the Darlington Information Centre.

Training on the mockup is critical. All activity within the reactor vault in retubing will be first done by direct hands-on



DNGS mockup lattice tube inside view. (Photo courtesy of OPG)

Darlington. (Photo courtesy of OPG)

Powering Ontario for the next half-century: Refurbishing Darlington *continued from page 15*

training in the DEC. The facility is designed to accommodate all of the training requirements of workers that will be contracted to carry out the refurbishment work in the years ahead.

OPG is also making other large changes to the plant site. These include:

- Changes to plant services infrastructure
- Changes to electrical power distribution
- A new boiler house for steam heating, and
- Changes to roads and site access.

In addition, OPG is constructing new facilities to store reactor system heavy water during the reactor outages. It is also building a storage facility to accept reactor components after volume reduction. Finally, an additional dry storage warehouse is being built to store previously removed spent fuel removed from the reactors.

Retubing the Darlington Reactors

Replacing the pressure and calandria tubes of the Darlington reactors is a critical timeline in plant refurbishment. Each reactor consists of 480 fuel channels, each containing a pressure tube, which is inside a calandria tube. The pressure tubes contain 13 CANDU fuel bundles each. At each end of each pressure tube are the feeder tubes. These transport heavy water coolant from the reactor calandria to and from the steam generators.

The calandria tubes are separated from the pressure tubes by an annulus gas, carbon dioxide, and a series of springs called garter springs, to maintain separation between the two tubes.

All of these components, pressure tubes, calandria tubes and feeder tubes, must be replaced in the retubing operation. Also to be replaced are the end fittings, including the shield plugs, and the internal components such as the garter springs.

Space can be limited within the reactor vault, and the tooling must be designed for and to accommodate the restrictions in space within it. All of the work must be done at the reactor face in protective suits

Unit 3 low pressure turbine open for inspection during routine maintenance outage. (Photo courtesy of OPG)

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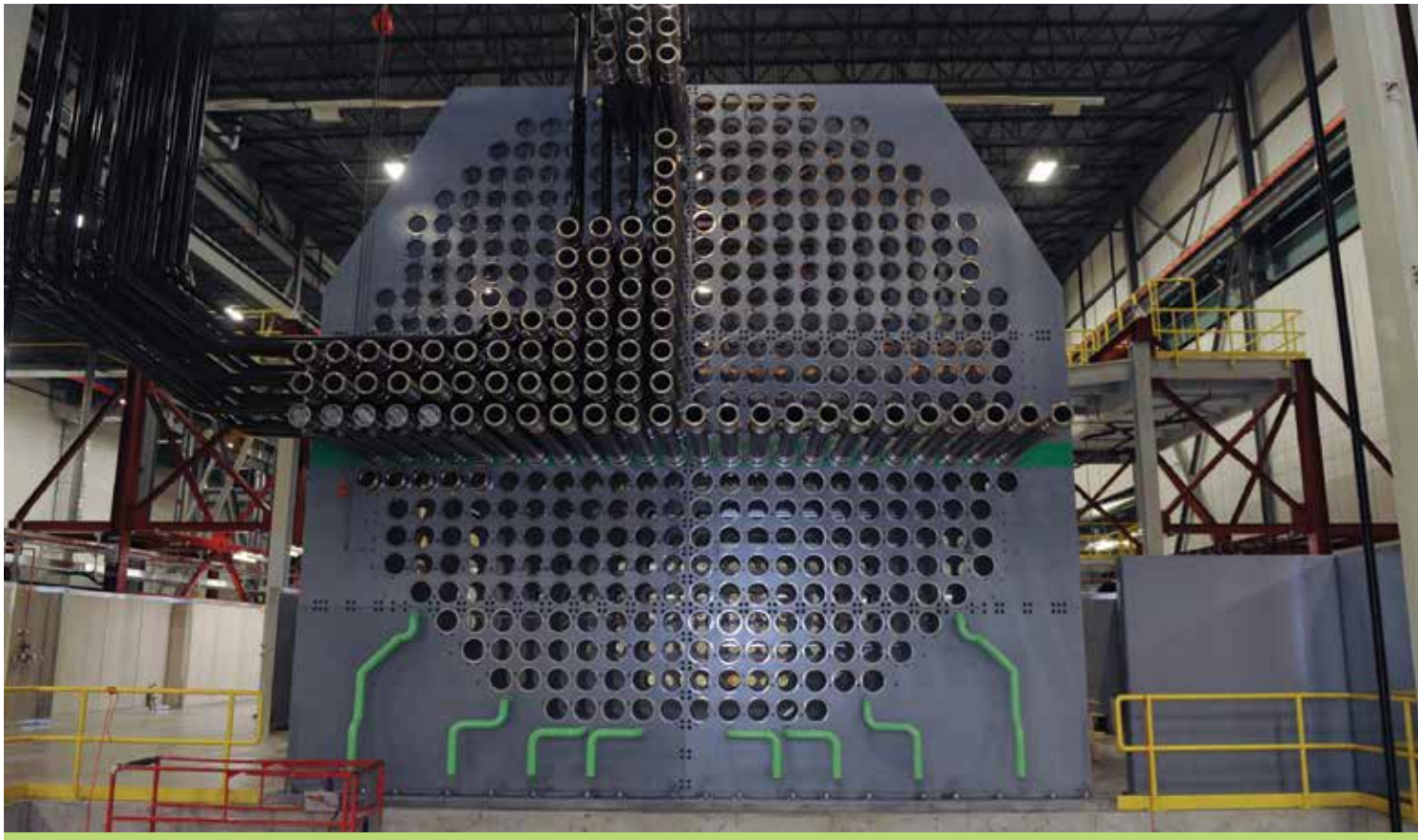
Powering Ontario for the next half-century: Refurbishing Darlington *continued from page 17*



Mockup reactor face with fuel channel assemblies and lower feeder pipes. (Photo courtesy of OPG)

or remotely using automated tools. Thus, the importance of the DEC for hands-on training becomes vital to prepare workers for conditions at the reactor face, both in working with the tools and with the experience of working in protective suits.

Steam Generators and Turbine/Generators

Each Darlington reactor has four steam generators. Receiving coolant from the reactor or primary side, the steam generators produce steam at 265 degrees C under saturation conditions to the secondary side. This steam is in turn transported to the high and low pressure turbines, cooled and condensed, and returned to the inlet secondary side of the steam generators.

After inspection, and due to continuous maintenance during planned outages, it was determined that the steam generators at Darlington would not need replacement and are fit for service for another 30 years. In part this was because of newer, more corrosion-resistant material than found in the steam generators of older reactors. It is also in part due to improvements in maintenance cleaning of the tube sheets and plant chemistry made over the past two decades.

Renovation work to the steam generators will include:

- Water lancing to remove tube sheet deposits;
- Primary side cleaning to remove magnetite accumulation; and
- Installation of access ports to improve inspection capabilities in renewed operation after refurbishment is complete.

With respect to the turbine/generator, a component condition assessment concluded that no replacement of the major components, such as generator rotors, turbine spindles and cylinders was required. The refurbishment work here will primarily consist of:

- Inspection, repair and replacement of turbine components and auxiliaries;
- Inspection, repair and replacement of generator components and auxiliaries (including replacement/rewind of two generator stators);
- Inspection, repair and replacement of moisture separator reheater internals and auxiliaries; and

Floor mock-up 6 x 9 array with fuel channel tubes, end fittings and lower feeder pipes. (Photo courtesy of OPG)

Powering Ontario for the next half-century: Refurbishing Darlington *continued from page 19*

- Complete replacement of the analog turbine control systems and excitation control with digital systems (including hydraulic components).

The original steam generators were built by Babcock & Wilcox, while the turbine/generator sets were built by BBC (Brown Boveri) now Alstom.

The Path Forward

Some work remains to be done to prepare Darlington for commencement of refurbishment and the first reactor outage. These tasks include:

- Completing detailed plant inspections to confirm plant conditions and refine the scope of the project;
- Confirming the regulatory scope of the project with the CNSC;
- Awarding all major contracting arrangements with contractors and suppliers to ensure availability;
- Completing the detailed engineering; and
- Establishing in detail the critical path of the entire outage including replacing the fuel channels and feeder tubes.

At this time, OPG has completed contracting arrangements with a number of large companies based in Ontario for various parts of the refurbishment project. These companies include:

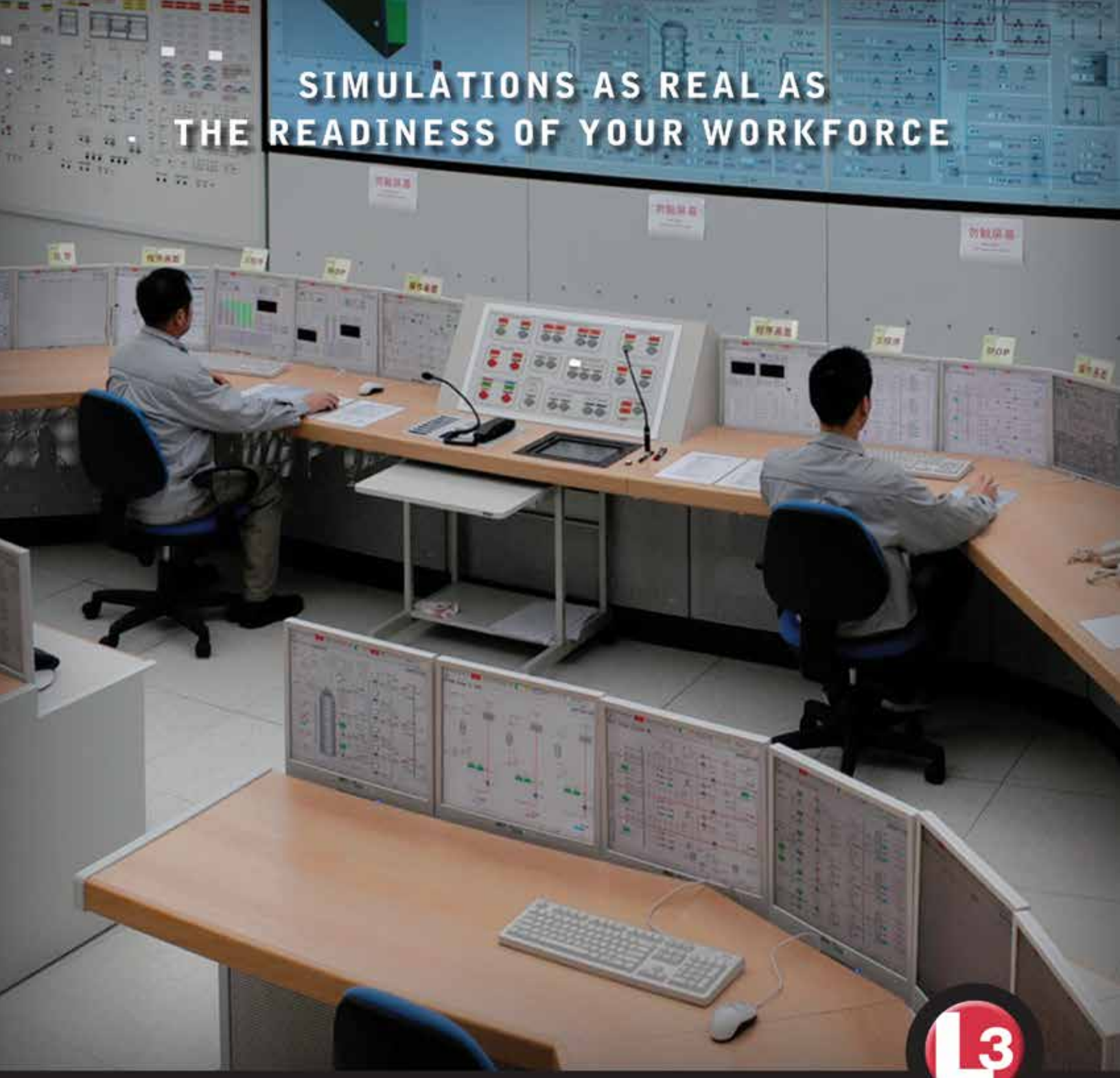
- Aecon Construction Group Inc.
- Alstom Power & Transport Canada Inc.
- AMEC NSS
- Babcock and Wilcox Canada Ltd.
- Black & McDonald
- Candu Energy Inc.
- E.S. Fox Ltd.
- GE Hitachi Nuclear Energy Canada
- SNC Lavalin Nuclear Inc.
- Worley Parsons

In 2015, OPG will complete and release the detailed cost estimates for execution of the refurbishment outages. It will also release the detailed project schedule and its timelines.

Closing Notes

The scope of work to be done in the Darlington refurbishment project means that it will be one of the largest

CV inspection – vented sheild plug. (Photo courtesy of OPG)



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Powering Ontario for the next half-century: Refurbishing Darlington *continued from page 21*

3 x 6 array floor mockup with some end fittings installed. (Photo courtesy of OPG)

construction projects in Canada for more than a decade. Normally, OPG has about 2,600 people working at the site. Carrying out the refurbishment work will require at peak up to an additional 2,000 workers, primarily in skilled trades. The impact on employment in the demand for skilled trades workers will therefore be significant.

For more than 30 years, nuclear power has been the backbone of the electricity system in the province of Ontario. At this time, it accounts for well over half of all the electricity generated in the province. Of that, nearly one-third is produced by the Darlington CANDU reactors.

One of the great advantages that nuclear energy has provided Ontario over these years has been both the low cost and the price stability of its electricity supply. Unlike fossil fuels, the cost of electricity from nuclear power does not vary significantly over time, as the bulk of the cost of nuclear-generated electricity comes largely from capital construction costs and ongoing maintenance and operating costs, all of which are generally constant over time. Because fuel is such a small portion of the total lifetime operating cost, nuclear power is not affected by the considerable variations in fuel costs to which fossil fuel sources are subject.

It is also not subject to the great variations in output, either hour by hour or day by day, which is experienced by renewable sources such as wind or solar generation.

By committing to the full refurbishment of the Darlington NGS, OPG is helping to ensure that reliable nuclear power will remain the cornerstone of Ontario's electricity system well into the second half of the 21st century.

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2013 – Program Committee Chair Report

By Tracy Pearce, Chair Program Committee

In 2013, the CNS continued to successfully organize conferences and courses. The following highlights the events held during the past year:

CANDU Reactor Safety Course/ CANDU Reactor Technology and Safety Course

Safety is a primary consideration in the design and operation of nuclear reactors. The CNS takes an active role in promoting the outstanding safety features of CANDU reactors. To address the safety-training needs of the Canadian nuclear industry, the CNS offered the CANDU Reactor Safety Course on March 25 to 27 at the Courtyard by Marriott Downtown Toronto.

The CANDU Reactor Safety Course is one of the most popular courses organized by the CNS. It has been offered at least once a year (and sometimes twice a year) since 1996. The course addresses a broad set of topics on reactor safety, and attendees always find that this allows them to get a better understanding of the way in which different disciplines impact reactor safety. The offering of this course in March 2013 received very positive feedback, as usual.

In October 2013, a new course combining various Technology and Safety topics relating to CANDU reactors was developed.

This new CNS CANDU Reactor Technology and Safety Course was offered on October 28-30 in Toronto. It attracted a large number of participants (45), who appreciated the breadth of topics presented.

Nuclear-101

Nuclear-101 was offered twice in 2013: May 13-14 at McMaster University and December 9-10 in Ottawa. These were the third and fourth offerings of this two-day course. Nuclear 101 is specifically designed for those working in the nuclear industry (with or without a technical background), who are interacting with the public. The course provides a good understanding of nuclear fundamentals, helps the participants understand how the industry works, and provides the tools to explain to others in simple, factual terms how nuclear science and technology works.

The course includes three half-day modules, together with a workshop session which also incorporates demonstrations, and where available, tours. The modules discuss the Nuclear Fuel Cycle, the History of Canadian Nuclear Science, including a discussion of Nuclear Myths and Reality, and a module on Radiation and Risk. A fifth offering of Nuclear-101 is scheduled for May 5-6, 2014 in Hamilton.

34th CNS Annual Conference and 37th Annual CNS-CNA Student Conference

The CNS Annual Conference gathers together scientists, engineers, technologists, senior management, government officials, and students. It is open to all those interested in nuclear science, engineering and technology from across Canada and from abroad. The central objective of this conference is to exchange views on how nuclear science and technology can best serve the needs of humanity, now and in the future.

The Conference attracted close to 400 participants, who enjoyed a Plenary Session and several Technical Sessions each day. There was also a very successful Student Program, with students at the Bachelor's, Master's and Ph.D. levels presenting their research at a Student Poster Session and Wine-&-Cheese Reception. The NA-YGN Professional Development Seminar surpassed all expectations, attracting almost 80 attendees on Sunday. The Fun Night was held at the unequalled Toronto venue, Casa Loma, where everyone had a terrific dinner and social evening.

Canadian Workshop on Fusion Energy Science and Technology

The first Canadian Workshop on Fusion Energy Science and Technology (CWFEST 2013) was held on August 30, 2013, on the campus of the University of Ontario Institute of Technology (UOIT), and was co-organized and co-sponsored by the Toronto Chapter of the IEEE. CWFEST-2013 was held as an embedded event with the Smart Energy Grid Engineering Conference (SEGE'13). Blair Bromley (AECL) and Prof. Hossam Gaber (UOIT) co-organized the workshop. There were 8 speakers from across Canada and one speaker from the USA. There were over 50 attendees, representing academia, industry, government, and government departments and institutions. The workshop was considered a great success by all who participated. An article about CWFEST-2013 was published in the September 2013 edition of the CNS Bulletin.

12th International Conference on CANDU Fuel

The 12th International Conference on CANDU Fuel – "CANDU Fuel: Safe, Reliable & Flexible" was organized by the Canadian Nuclear Society and the Royal Military College of Canada with the contribution of Mr. Mark Floyd of AECL. This Conference was held in Kingston, Ontario, on September 15-18, 2013, and was chaired by Dr. Paul K. Chan of RMC, and. The venue of the conference was at the Holiday Inn Waterfront Hotel in downtown Kingston, Ontario. It gathered some 130 participants (106 registered delegates) from 8 countries and 14 organizations. A total of 55 presentations were made in the plenary session and the 10 technical sessions. There was also a luncheon presentation by Maj. Paul Hungler on the neutron tomography installation at the SLOWPOKE-2 Nuclear Reactor Facility at the Royal Military College of Canada. Other activities of the conference included a welcoming reception on the Sunday evening with speeches by the Mayor of Kingston, Mr. Mark Gerretsen, the Federal Member of Parliament for Kingston and the Islands, the Honourable Dr. Ted Hsu, and the Member of the Provincial Parliament and Minister of Justice, the Honourable Mr. John Gerretsen. The reception was enlightened by bagpipes-and-drums music and a very colourful demonstration of Highland dances by Officer-Cadets of the Royal Military College.

continued on page 27...

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2013 – Education and Communications Committee Report

By Ruxandra Dranga, Chair Education and Communications Committee

In 2013, the Education and Communications Committee (ECC) continued to be a key contributor towards the CNS's core objectives, via a number of activities and programs that encourage education in, and knowledge about nuclear science and technology, increase members involvement in public educational programs, and facilitate the exchange of information between CNS members and the general public.

Geiger kits to schools

The Geiger Program, one of the main activities overseen by the ECC, continued to provide high-quality Geiger Kits to high schools throughout Canada. The kits include a Geiger detector and computer interface, teaching material and Naturally Occurring Radioactive Materials (NORM) for measurement and demonstration. In 2013/2014, the program was possible due to the sponsorships provided by the Canadian Nuclear Association (CNA) and Atomic Energy of Canada Limited (AECL). In Early 2013, the CNA has sponsored the acquisition of 17 Geiger Kits, while AECL has sponsored the acquisition of an additional 14 kits in early 2014. Thanks to this financial support, a total of 179 high schools have received Geiger Kits; however, more than 100 high school are still awaiting to receive a kit. All 31 kits were assembled and tested by Acsion Industries.

An additional important component of the Geiger Program is the Ionising Radiation Workshop offered to teachers, to demonstrate the use of the detector in a classroom setting. In 2013, two workshops were held, one at the Association of Science Teachers Conference in Halifax, and one at the Science Teacher's Association of Ontario in Toronto. Furthermore, to add to the training component of the Geiger Program, the ECC has commenced recording a series of YouTube videos on various the Geiger demonstrations. The first video titled "Hot Balloons" is available for open access on the CNS website!

NEO Workshops

A fourth Nuclear Education and Outreach (NEO) workshop was planned in August 2013. However, due to lack of registration, the workshop had to be cancelled. In 2014, the NEO subcommittee is focusing its efforts on identifying the needs of the corporate communication and outreach community and redesigning the NEO workshop to address their requirements and interests.

"Nuclear 101" Course

2013 was a highly successful year for the "Nuclear 101" course, with two organized courses, one offered in Hamilton in May and one offered in Ottawa in December. The next offering of the course is planned for May 5-6, 2014, in Hamilton. This course was specifically design for individuals with or without a technical background who are part of the nuclear science and technology community and who find themselves interacting with the public. Although still in its early years, this new CNS course has been very popular amongst individuals in the nuclear community and received excellent reviews from all participants. The initial course format, containing three main modules taught by leading Canadian nuclear educators, followed by a Q&A session, has been reshaped based on the participants comments to include a workshop session which encourages all course attendees to participate in group discussions and ask the instructors specific questions. The new format, first implemented during the December session, worked very well, and was commended by those in attendance.

Public Advocacy

The CNS increased its participation to public hearings and other advocacy activities in 2013, including the Pickering license renewal hearings in June, the Quebec energy review in September, and the Bruce Deep Geologic Repository hearings in September. In addition the CNS renewed its support for a new Canadian multipurpose research reactor. Copies of this report and other submission are available on the CNS website.

Further Information

For further information on the CNS' activities in Education and Communication, contact Ruxandra Dranga (Chair, CNS Education and Communication Committee) at **ECC@cns-snc.ca**.

...2013 – Program Committee Chair Report *continued from page 25*

The plenary session on Monday morning was co-chaired by Dr. Hugues W. Bonin (Professor, Royal Military College) and by Mr. Michael Montgomery (Consultant, Ceramic Tubular Products LLC). The conference participants were offered an overall view of the activities around the CANDU fuel, first around the world with presentations by Mr. Luis Alvarez (Argentina), Dr. Dionysius (Dé) Groeneveld (Canada), Mr. Nudurupati Saibaba (India) and Dr. Uddharan Basak (IAEA). Following the coffee break, the spotlight was focused on the Canadian activities, with presentations by Dr. Bill Kupferschmidt (Vice-President, Research & Development, AECL), Dr. Harley Hughes (Ontario Power Generation), Dr. Michel Couture (Director, Canadian Nuclear Safety Council) and Dr. Catherine Cottrell (Engineering Manager, CANDU Energy Inc.).

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Canadian Nuclear Association (CNA) President's Report

By John Barrett, PhD

As the public affairs advocate for the nuclear industry, the Canadian Nuclear Association (CNA) works to shape a more favourable operating environment for our members. We are seeking to build a better understanding of the nuclear industry among decision-makers and opinion leaders, whether they be pro-nuclear, sceptical, or have no view. Our activities include public relations, government relations, and support to our members in their regulatory processes.

The industry's innovative nature lies at the heart of our operations. From the earliest days of Canada's nuclear program, our scientists and engineers have developed solution after solution to the challenges of harnessing nuclear energy for peaceful purposes. Throughout, our advances in nuclear science and technology have been spectacular. Consider our innovative reactor designs that drove world-leading performance in electrical generation; our approaches to uranium mining, processing and fuel fabrication; our development of a safety culture and regulatory regime that has protected our employees, the public and the environment for decades.

Today Canada stands in the top tier of nations whose nuclear capabilities fully span the fuel cycle. We enjoy a significant competitive advantage in that we can provide abundant low-carbon electricity, and innovative applications in industries such as health care and advanced manufacturing.

Our role at the CNA is to help Canadians see, appreciate, and support the nuclear industry's contributions to our knowledge economy and our high quality of life. You will find us talking with government about laws and regulations, including a current federal proposal to increase reactor operators' liability for accidents, and a proposal to ratify an international treaty that could create more foreign opportunities for Canadian nuclear firms.

We are also working with the Canadian Nuclear Safety Commission, our industry's regulator, to defend current regulatory limits for emissions and releases. Canadian nuclear operators regularly outperform limits by a significant margin, prompting some critics and observers to advocate for even tighter restrictions without first establishing through science that such a need exists.

Our external communications program reinforces our approach to governmental decision-makers by providing key influencers with accurate information about the industry's capabilities and strategic vision. From business leaders to environmental activists, from health-care organizations to municipal leaders and entrepreneurs, the CNA regularly makes the case for sustained investment in nuclear innovation, commercialization, and application. The recently completed refurbishment of the Point Lepreau reactor, coupled with the forthcoming refurbishment of ten reactors in Ontario, provide us with an excellent opportunity to demonstrate our industry's expertise, its economic contribution and its environmental advantage.

Our policy and research agenda includes further analysis of the Ontario electrical supply mix, as the provincial government steps up the frequency at which it reviews its Long-Term Energy Plan. Our advocacy last year helped the Ontario government to confirm its support for reactor refurbishment, and to retain an option to build new reactors when they become justified by economic growth.

In addition, we continue to develop and share industry knowledge through special events such as workshops. I look forward to our forthcoming session on nuclear reactor technology and innovation, planned for this fall in Saskatchewan. The CNA is also contributing to an independent Canadian study of life-cycle greenhouse-gas emissions from the nuclear, gas and wind-based electrical generation. We aim to convince Canadians that nuclear technology offers real hope in countering the harmful consequences of climate change.

The CNA is also equipping Canadian educators to provide students with accurate, timely information on nuclear science and the Canadian industry. As well, we are helping students to see paths into rewarding nuclear careers. In this way we help to ensure the availability of a workforce that can transform vision into reality, just as we have been doing since the first days of Canadian nuclear innovation.

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Canadian Nuclear Workers Council (CNWC)

By David Shier, President, Canadian Nuclear Workers Council (CNWC)

The Canadian Nuclear Workers Council (CNWC) is an umbrella organization of Unions representing workers in all sectors of the Canadian nuclear industry. Founded in 1993, it represents sectors including electric power utilities, uranium mining and processing, radioisotope production for medical and industrial purposes, and nuclear research.

CNWC activities are focused on the following objectives:

- Ensure that the interests and perspectives of nuclear workers are heard by decision-makers;
- Strengthen the collective role of nuclear workers as a partner in their industry;
- Enhance public knowledge and understanding of nuclear issues by providing factual information, and;
- Build support for the nuclear industry and its future potential.

During 2014, several presentations and briefs were made on behalf of the membership. On April, 29th, the CNWC made a presentation to the Canadian Nuclear Safety Commission [CNSC] in support of Ontario Power Generation's application to renew and merge the Pickering A and B (Pickering NGS) Nuclear Power Reactor Operating Licenses. In September the CNWC made a presentation to the Joint Review Panel's Public Hearing in support of OPG's Deep Geological Repository Project and application for a license to prepare the site. The CNWC also submitted comments to Ontario's Ministry of Energy regarding the province's Long-Term Energy Plan Review. Written and oral presentations were also made to the CNSC in support of Cameco's McArthur River Uranium Mine and the Key Lake Uranium Mill in partnership with USW Local 8914. In December, a written submission was filed and an oral presentation made on the CNSC's Report on the Performance of Uranium Fuel Cycle and Processing Facilities, 2012.

The CNWC's 2013 education and outreach activities included: attendance at the Canadian Nuclear Association's 2013 Annual Conference, CUPE National Convention, and OFL Convention; and meetings with the President and staff of the CNSC, and the International Nuclear Workers' Union Network (INWUN). Public communications included four newsletters issued each quarter during the year.

In 2014, CNWC education and outreach activities will focus on: expanding the membership with a focus on nuclear supply chain companies and local labour councils (the Society of Energy Professionals have re-affiliated and the CAW (now Unifor) locals at GE Hitachi have affiliated); support for Bruce Power's and OPG's refurbishment projects, OPG's DGR facility and the restructuring process for AECL's Chalk River Laboratories; continuing efforts to develop a national nuclear strategy in collaboration with other groups in the sector; and, implementing a tour program for labour leaders. Leadership changes in these groups create the need for the new leadership to be updated about current and emerging nuclear industry issues and opportunities.

The CNWC will publish four editions of the Nuclear Worker, update its information booklets and website and continue with its display booth activities in 2014. The CNWC will represent its membership at several conventions/ conferences – the Canadian Labour Congress Convention (Montreal May 4-9), Provincial Federation of Labour Conventions, and the Annual INWUN 2014 meeting (location TBA) etc. As well, the CNWC will participate along with member Unions in the annual meeting with the CNSC. The CNWC's annual meeting is planned for Winnipeg, Manitoba.

CNWC Member Unions:

- Canadian Union of Public Employees – Locals 1500, 2000 & 267
- UNIFOR – Local 599-O & Local 48-S
- International Association of Firefighters
- International Association of Machinist & Aerospace Workers – Local 608
- International Brotherhood of Electrical Workers Local 37
- Power Workers' Union
- Professional Institute of the Public Service of Canada (PIPS) – CRPEG & WRPEG
- Society of Energy Professionals
- United Steel Workers – Locals 8914, 7806, 14193, 13713, 1568, 4096
- Society of Professional Engineers & Associates (CANDU Inc)
- Society of Professional Engineers & Associates (CANDU Inc.)
- Hydro Quebec Professional Engineers Union
- Grey Bruce Labour Council
- Durham & Region Labour Council
- Northumberland District Labour Council

What CANDU Can Do

Canada's CANDU nuclear reactor technology is a proven success:

- Supports a $6 billion a year, 60,000 job industry
- One of Canada's few high-technology exports
- 1000 reactor years of safe operation worldwide
- Enhanced energy security
- Provides over half of Ontario's electricity
- Avoids 89 million tonnes of GHG emissions/year in Canada
- Ontario's only good alternative to fossil fuel base-load electricity generation

The planned mid-life refurbishments of Ontario's nuclear reactors will produce abundant low-cost electricity and create tens of thousands of jobs for decades to come.

Plus, secure a strong foundation for the future of Ontario's nuclear sector paving the way for:

- New reactors to replace the 3,000 megawatt Pickering Nuclear Station, scheduled to close in 2020;
- Canada's ability to compete in the trillion dollar global nuclear marketplace;
- Powering "Made-in-Ontario" zero-emission vehicles with GHG emission-free electricity; and
- Exporting low-carbon electricity to our fossil fuel dependent neighbours.

For more information please go to www.pwu.ca

FROM THE PEOPLE WHO HELP KEEP THE LIGHTS ON.

POWER WORKERS' UNION

Organization of CANDU Industries (OCI) President's Report

By Ron Oberth, President, Organization of CANDU Industries (OCI)

OCI is an industry association that has grown over the last year to now include more than 180 leading Canadian suppliers to the nuclear industries in Canada and offshore. OCI member companies employ collectively more than 30,000 highly skilled and specialized individuals, many of whom are dedicated to manufacturing equipment and components and providing engineering services and support to the 19 operating CANDU nuclear power plants in Canada as well as to CANDU and LWR reactors in offshore markets.

OCI also offers a variety of services and support to its member companies to help them become the suppliers of choice in the domestic nuclear market and to bring them opportunities in offshore CANDU markets and targeted LWR markets by organizing trade missions and market specific seminars.

In the last year OCI organized three very successful "Supplier Day" events with Ontario Power Generation, AECL Nuclear Laboratories and Candu Energy Inc. We are starting this year with a Supplier Day at the Bruce Site in at the beginning of May. These focused trade shows, with between 60 to 80 exhibitor booths, enable member companies to showcase and discuss their products and services with engineers and procurement specialists in our key domestic customer organizations. Our Supplier Days also create networking opportunities among member companies often leading to collaboration on specific project opportunities.

In the last year OCI also hosted numerous workshops. These were at the Ajax Convention Centre on "Targeting the US Market, for the Canadian Supply Chain" and at Hilton Garden on "Understanding the market for Small Modular Reactors". We also had the pleasure to host a private screening of Pandora's Promise for our members and politicians which included a conversation with the film maker, Robert Stone. The movie had a very large impact on all who watched it and proved to be well worth the effort to bring it to Canada.

Other notable events from the year were attending PowerGen in Orlando, to represent the Canadian nuclear supply chain at the event. During this year, OCI also provided constructive input to Ontario's updated Long Term Energy Plan, that input was based on the findings of a detailed comparative evaluation of electricity supply options performed by Strapolec Inc for OCI and the PWU.

We have been very happy with the support the nuclear supply chain has received from the federal government through their Global Opportunities for Associations (GOA) program. In 2013, OCI received $142,000 as part of this program and we have been successful in securing almost $90,000 in co-founding for the period April 1, 2014 to March 31. This generous funding will support OCI and OCI member companies on planned trade missions over the next 12 months.

Over the past year OCI also led successful trade missions to Washington in February 2014, to India in November 2013 and in China April 10 to 18, 2014 on a trade mission. The mission to China has the support of Minister of Energy Bob Chiarelli, and OCI is happy to have Minister of Research and Innovation Reza Moridi, and Assistant Deputy Minister at Ontario Ministry of Energy and Infrastructure Rick Jennings with us in China. Also joining OCI in China from the Federal Government is David Anderson, Parliamentary Secretary to the Minister of Foreign Affairs. In total, OCI had 11 member companies, 4 industry partners, and both Federal and Provincial representation on this China Trade Mission.

OCI has also worked to improve our communications this year and now have active social media spaces on LinkedIn, Twitter, Facebook, and Google+. Also during 2013, OCI co-funded a radio campaign aimed at informing listeners about nuclear.

OCI was invited to participate in several events at our members facilities at which successful project completions were celebrated in the presence of both provincial and local political leaders and local media. OCI is planning to organize more events and media tours at member facilities across Ontario in the coming year.

Finally OCI was pleased to continue to contribute at workshops with Canadian nuclear industry leaders. We are focused on working with our members, and the broader industry to ensure our collective vision of Canada as a "Tier one nuclear nation".

April 11, 2014

Contacts:
Dr. Ron Oberth, President (ron.oberth@oci-aic.org or 905-839-0073)
Ms. Marina Oeyangen, Manager Member Services (marina.oeyangen@oci-aic.org or 905-839-0073)

ENERGYSOLUTIONS
Canada

Bruce Power, Ontario Canada
Energy*Solutions* has performed work on various projects at Bruce Power

Delivering integrated solutions to the global nuclear industry

Energy*Solutions* Bear Creek Facility
Beneficial re-use of contaminated material

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Energy*Solutions* is an international nuclear services company with operations around the world.

Our portfolio spans the entire nuclear lifecycle from new build, operations, engineering and technology, facility decontamination and decommissioning, defueling, reactor dismantling, transportation, waste processing and recycling to complete site restoration.

Energy*Solutions* Canada, an ISO 9001 registered company, provides comprehensive, integrated services and solutions to the Canadian nuclear industry. We operate a Canadian Nuclear Safety Commission licensed facility where we safely and cost-effectively manage waste, perform decommissioning projects and meet the significant fuel cycle and waste management challenges faced by our Canadian government and commercial customers. Energy*Solutions* Canada's 130,000 ft² licensed facility can be utilized to support current and future CANDU reactor refurbishment, decontamination and waste processing projects.

You can depend on Energy*Solutions* to deliver innovative waste management approaches. We have been managing Canadian radioactive waste since 1978.

Tel: 1-800-665-7736
www.energysolutions.com
canada@energysolutions.com

Women in Nuclear (WiN) Canada President's Report

By Colleen Sidford, President, WiN-Canada

As we reflect on all we have accomplished since Women in Nuclear (WiN) Canada was established a decade ago, it is truly amazing how we have grown to over 1,300 members in six chapters across Canada. In 2013, WiN was invited to a number of tables where industry policy decisions were being made. This is a great achievement for an organization that is still considered to be very young within the industry.

WiN-Canada is proud of the many accomplishments achieved through the dedication of our members and the generosity of our many industry sponsors. This report highlights how our WiNners achieved some of WiN-Canada's goals through a wide variety of activities.

Promoting the industry and women in nuclear-related occupations

WiN-Canada has always taken a leadership role in WiN-Global and I would like to begin by saying congratulations to WiN-Canada past president, Susan Brissette, who was named the 1st recipient the WiN-Global Honourary Award at the WiN-Global conference in South Africa.

Closer to home, WiN participated in a number of industry initiatives and committees including the Canadian Nuclear Leadership Forum, the CNA Communications Working Group, the CNS Nuclear 101 Committee, the CNS Education and Communications Committee and participated in the innovative N6 Industry Leaders strategic initiative.

As a result of our participation in the Electricity Human Resources Canada (EHRC) Bridging the Gap project, WiN member, Lori Brown, a female operator at OPG was the focus of a video that will be seen throughout Canada by many students making career decisions.

In addition to boasting a very diverse attendance of 165 delegates at our conference, hosted by WiN-Eastern Ontario in Pembroke, ON, we were able to connect with a number of WiNners and recruit new members at booth space generously provide to us at the CNA and CNS conferences.

Our newest chapter, WiN-Saskatchewan and Women in Mining hosted "Mine Your Potential," an inaugural development event for 102 women, in or interested in the natural resources sector.

WIN's role in increasing public awareness

WiN was honoured to be invited to participate in an Economic Consultation Meeting with Canada's Prime Minister and Minister of Finance to discuss the current state of the economy, thoughts on the 2013 budget and where the economy is headed.

Adding their voice to the public hearing process, WiN provided a positive intervention at the CNSC hearing for the OPG Pickering relicensing hearing and provided a written submission for the positive intervention at OPG's DGR hearing with the Joint Review Panel. We also prepared a written submission on Ontario's Long Term Energy Policy Stakeholder Roundtable and encouraged our members to participate in the on-line survey.

Promoting nuclear careers for women and young people

In 2013, WiN chapters participated in a number of activities mentoring young people:

- 5 Skills Work! For Women Networking dinners
- OYAP Try the Trades Day at Bruce Power
- Skills Canada-Ontario Young Women's Conference
- Skills Canada-Ontario Technological Skills competition
- GIRLS Science Club (summer camps, March break program and PD Days)

One of the biggest changes in 2013 was the retirement of WiN-Canada's Executive Director Cheryl Cottrill. Since 2004, Cheryl was instrumental in designing and nourishing the current leadership role of WiN-Canada in the industry and her guiding presence will be missed by all.

Welcome aboard to Joy Shikaze who stepped into the role of our new Executive Director. We look forward to her continuing WiN-Canada's leadership role across the country and around the globe.

While it is always interesting to look back on the many WiN-Canada accomplishments over the past year, it is more exciting to look forward to 2014 with anticipation for bigger and better things to come.

You can visit us online at:
www.wincanada.org
https://www.facebook.com/womeninnuclear.canada
https://twitter.com/win_canada

Canadian Nuclear Society
Société Nucléaire Canadienne

1st Technical Meeting on Fire Safety and Emergency Preparedness for the Nuclear Industry

Delta Meadowvale Hotel & Conference Centre
Mississauga, ON, 2015 May 03 – 06

The 1st International Meeting on Fire Safety and Emergency Preparedness will provide a forum for nuclear professionals to network and communicate changes presently impacting the industry. It is an opportune time as the new standard, CSA N393 Fire Protection for Facilities that Process, Handle or Store Nuclear Material is approved for use. This standard may affect facility licenses as early as 2014. It is expected that CSA N393 will be included in a broader range of facility licences and will replace NFPA 801 Standard for Fire Protection for Facilities Handling Radioactive Materials in existing licences.

Emergency Preparedness is at the forefront of the nuclear industry since the 9.0 magnitude earthquake and tsunami 2011 that resulted in the Fukushima nuclear incident. The CNSC has introduced REGDOC 2.10.1 Nuclear Preparedness and Response to clarify emergency preparedness requirements. This document is now in draft form and has been issued for comments.

The conference is intended to attract participants from various sectors of the nuclear industry relating to power reactors, research reactors, nuclear laboratories, mines, processing, storage and handling facilities, decommissioned nuclear facilities, nuclear medicine and transportation of nuclear materials.

FSEP 2015 – Call for Abstracts

The Technical Program Committee invites the submission of abstracts for proposed presentations pertaining to the topic areas within each of the four conference themes. Abstracts are to be no more than 300 words in length and the deadline for submission of abstracts is **September 19, 2014**. Details are on the conference website www.cns-snc.ca.

Get engaged: plan to participate as a Speaker, Session Chair or member of the Organizing Team.

Technical Focus

Business Performance and Governance	Human Performance	Technology	Processes and Programs
Regulatory Affairs	Succession Planning	Communication	Nuclear Safety
Codes & Standards	Instructional Systems Development/Training	Event Simulation	Integrating Services
License and Laws	Personnel Safety	EME	Fire Prevention
Organizational Design/Alignment	Human Resources	Fukushima	Engineering Change Control
Management Oversight	Leadership	Emerging Technologies	Business Continuity
Visions of the Future	Ethics	Analytical Tools	Risk Management
Strategies	Human Factors	Fire Protection Systems	OPEX
Business Metrics	Management of Performance Systems	Emergency Response Equipment	Analysis, Evaluation and Measurement

Conference Chair:
Tracy L. Pearce
Atomic Energy of Canada Ltd
Chalk River Laboratories

1-800-377-5995 x 44084
pearcetl@aecl.ca

Technical Chair:
Rudy Cronk
Professional Loss Control
3413 Wolfedale Road, Suite 6, Mississauga, ON

1-800-675-2755
rcronk@plcfire.com

2014 Conference Schedule

This programme lists events which are organized or co-sponsored by the Canadian Nuclear Society or considered to be of interest to its members.

The current listing of events is posted on the CNS website at **www.cns-snc.ca**

2014

2014 April 27 – April 30
Canada-China Conference on Advanced Reactor Development
Niagara Falls Marriott Fallsview Hotel and Spa
Organized by: CNS
Website: www.cns.snc.ca/events/cccard

2014 May 04 – May 06
Nuclear 101
Organized by: CNS Education and Communication Committee
Sheraton Hotel, Hamilton, ON
Organized by: CNS
Website: www.cns-snc.ca/events/nuclear-101-2014/

2014 May 12 – May 14
The 3rd International Conference on Physics and Technology of Reactors and Applications (PHYTRA3)
University Abdelmalek Essaadi, Tetouan, Morocco
Co-sponsored by CNS
Website: www.gmtr-association.com/phytra3/

2014 May 25 – May 27
The 10th International Conference on CANDU Maintenance (CMC 2014)
Metro Toronto Conference Centre
Organized by: CNS NOM Division
Website: http://cmc2014.org/cmc2014html/cmc2014_home.html

2014 June 09 – 11
CANDU Technology and Safety Course
Courtyard by Marriott Toronto Downtown Hotel
Organized by: CNS NSE Division
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2014 June 23 – June 26
PHWR Safety 2014 / CANSAS-2014
Organized by: CNSC, AECL in collaboration with IAEA and CANSAS
Co-sponsored by CNS
Website: www.nuclearsafety.gc.ca/eng/stay-connected/get-involved/session-workshop/phwr-safety.cfm

2014 August 24 – August 29
8th International Conference on Isotopes and Expo
Hyatt Regency Chicago
Co-sponsored by CNS
Website: http://www.8ici.org/

2014 August 24 – August 28
19th Pacific Basin Nuclear Conference (PBNC-2014)
Hyatt Regency Vancouver Hotel
Organized by: CNS, CNA, NRCan, in collaboration with IAEA
Website: http://pbnc2014.org/home.html

2014 September 28 – October 03
PHYSOR 2014
The Westin Miyako, Kyoto, Japan
Co-sponsored by CNS
Website: http://www.physor2014.org

2014 Fall
CANDU Fuel Technology Course
Organized by: CNS FT Division
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2014 October 26 – October 31
Nuclear Plant Chemistry Conference 2014
Royton Sapporo Hotel, Japan
Co-sponsored by CNS
Website: http://www.npc2014.net

2014 November 05 – November 07
3rd International Technical Meeting on Small Reactors
Ottawa Marriott Hotel
Organized by: AECL and CNS
Website: www.cns-snc.ca/events/3tm/

2015

2015 Spring
CNS CANDU Technology and Safety Course
Organized by: CNS NSE Division
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2015 Spring
Nuclear 101
Organized by: CNS Education and Communication Committee
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2015 May 03 – May 06
1st International Meeting on Fire Safety and Emergency Preparedness for the Nuclear Industry
Organized by: CNS NOM Division
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2015 May 25 – 27
4th Climate Change Technology Conference
Montréal, QC
Co-sponsored by CNS
Website: www.eic-ici.ca/index_e.html

2015 May 31 – June 03
36th CNS Annual Conference And 39th Student Conference
Saint John, NB
Organized by: CNS
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

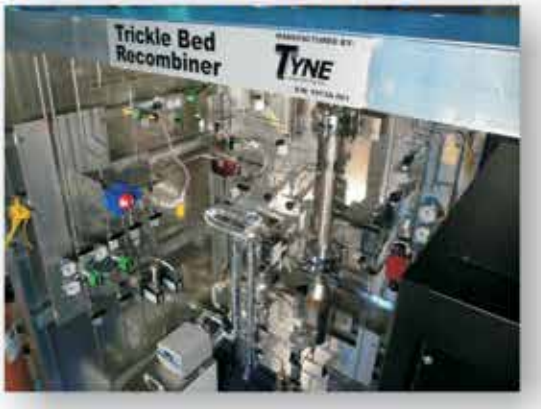
2015 August 09 – August 13
17th International Conference on Environmental Degradation of Materials in Nuclear Power Systems
Ottawa, ON
Organized by CNS E&WM Division
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2015 Fall
CNS CANDU Reactor Physics Course
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

2015 November 01 – November 04
Delta Meadowvale Hotel, Mississauga, ON
8th International Steam Generators, Heat Exchanger, and Reactor Components Conference (ENCC-2015)
Organized by: CNS DM Division
Contact: Canadian Nuclear Society Office
Tel: 416-977-7620
E-mail: cns-snc@on.aibn.com
Website: www.cns-snc.ca

TYNE engineering inc.

Reactor Gas Handling Systems



Quality Assurance

- CSA-N286.2 (CANPAC)
- CSA-Z299.1 (CANPAC)
- EPRI-NP-5625CGD/CANPAC
- ISO9001
- N285.0/ASME III,
- B51/ASMEVIII,B31.3,B31.1

Reactor Control Software

- Reverse-Engineering
- Full Process Documentation
- Testing and Commissioning

Skid-Mounted Process Systems

- Tritium, Oxygen, Hydrogen Systems
- Failed Fuel Location System
- Off Gas Management
- Radiation Monitoring Systems
- Hydrogen Monitoring System
- Heavy Water Upgrading
- Tritium Removal
- Gaseous Waste Monitors
- Heavy Water Leak Detection

Safety-Related Nuclear Components

- Electronic Modules
- In-core amplifier
- Shutdown System Power Supplies
- Relays and Timers
- Instrumentation Panels
- Tritium Monitors
- Neutron detectors
- Commercial Grade Dedication

Design & Engineering

Tritium Lights Rig

Nuclear Instrumentation

Fixed Area Tritum & Gamma Monitor

Portable Tritum Monitor

Manufacture & Test

Failed Fuel Location / Delayed Neutron Detection System

Reactor Safety Components

In-Core Amplifier / Trip Unit

Commercial Grade Dedication

Mercury Relays

Panel Meters

Burlington - Oakville - Deep River
Tel: 289-288-0490 Email: info2@tyne-engineering.com
www.tyne-engineering.com

The Top 25

World Reactor Performance

Top 25 units for 2013 by capacity factor, December 31, 2013

Rank	Country	Plant	Type	Capacity (MW)	Capacity (%)
1	India	Rajasthan 5	PHWR	220	106.15
2	Russia	Balakovo 1	PWR	1000	104.61
3	US	Calvert Cliffs 1	PWR	890	104.35
4	Russia	Kalinin 2	PWR	1000	103.27
5	Russia	Volgodonsk 1	PWR	1000	103.03
6	South Africa	Koeberg 2	PWR	940	102.97
7	US	Dresden 3	BWR	920	102.14
8	US	Surry 2	PWR	890	101.83
9	US	Comanche Peak 2	PWR	1241	101.13
10	US	Three Mile Island 1	PWR	890	100.46
11	US	Peach Bottom 2	BWR	1182	100.45
12	Spain	Asco 1	PWR	1032	100.12
13	Korea	Kori 3	PWR	1043	100.09
14	India	Rajasthan 3	PHWR	220	100.08
15	Korea	Hanul 3*	PWR	1050	100.01
16	Taiwan	Chinshan 2	BWR	636	99.88
17	US	Byron 1	PWR	1242	99.87
18	Korea	Hanbit 6*	PWR	1052	99.82
19	**Romania**	**Cernavoda 1**	**PHWR**	**706**	**99.66**
20	Sweden	Forsmark 2	BWR	1034	99.56
21	US	Ginna	PWR	597	99.54
22	Czech Rep.	Dukovany 4	PWR	498	99.33
23	US	Duane Arnold	BWR	647	99.25
24	Taiwan	Maanshaan 2	BWR	980	99.04
25	US	Surry 1	PWR	861	98.70

All figures taken from Nucleonics Week, 02/14/14. All numbers have been rounded.
No monthly results reported from Great Britain, Ukraine, Slovakia, Bruce Power-Canada
*Hanbit, formerly known as Yonggwang. Hanul, formerly known as Ulchin.

Darlington NGS. (Photo courtesy of OPG)

Nuclear Power and Uranium Resources

CANDU Nuclear Reactor Performance

December 2013 Reactor	In Service	Capacity (MW)	Performance In 2013 (%)	Lifetime Performance (%)
Point Lepreau	1983	680	72.6	70.9
Wolsong 1*	1983	679	0	86.3
Wolsong 2	1987	678	83.7	93.5
Wolsong 3	1998	698	92.6	94.8
Wolsong 4	1999	703	90.2	95.7
Embalse	1983	648	63.3	83.1
Cernavoda 1	1996	707	99.4	90.3
Cernavoda 2	2007	705	89.1	93.9
Qinshan 4	2002	700	92.2	91.2
Qinshan 5	2003	700	102.2	92.3
Pickering 1	1971	542	46.2	63.7
Pickering 4	1973	542	86.2	66.3
Pickering 5	1983	540	58.1	73.5
Pickering 6	1984	540	67.6	78.2
Pickering 7	1985	540	95.1	78.5
Pickering 8	1986	540	86.4	76.8
Bruce 1	1977	825	82.1	75.5
Bruce 2	1978	825	87.7	87.1
Bruce 3	1978	825	86.6	64.6
Bruce 4	1979	825	65.1	64.4
Bruce 5	1985	872	89.7	84.6
Bruce 6	1984	872	79.5	81.4
Bruce 7	1986	872	97.9	85
Bruce 8	1987	872	79	82.5
Darlington 1	1992	934	97.3	85.6
Darlington 2	1990	934	67.2	78.8
Darlington 3	1993	934	95.8	87
Darlington 4	1993	934	68.4	85.9
Total/Average		**20 666**	**79.3**	**81.8**

COG CANDU/PHWR Performance Statistics, 2013.
*These reactors were under reconstruction during part or all of 2013.

World Uranium Production – 2012

Country or area	Production (tU) 2009	2010	2011	2012
Australia	7 982	5 900	5 983	6991
Brazil	345	148	265	231
Canada	10 173	9 783	9 145	8999
China*	750	827	1599	1500
Czech Rep	258	254	229	228
France	8	7	6	3
Germany	-	-	52	50
India*	290	400	400	385
Kazakhstan	14 020	17 803	19 451	21 317
Malawi	104	670	846	1101
Namibia	4 626	4 496	3 259	4495
Niger	3 234	4 198	4 351	4667
Pakistan*	50	45	45	45
Romania*	75	77	77	90
Russia	3 564	3 562	2 993	2872
South Africa	563	583	582	465
Ukraine*	840	850	890	960
USA	1 453	1 660	1 537	1596
Uzbekistan	2 429	2 400	3000	2400
Other	112			
Total	**50 772**	**52 993**	**54 610**	**58 394**

* UI estimate
All figures taken from the World Nuclear Association

World Reactor Capacity

February 2014

Country	Operating		Planned or Under Construction		Electricity Generation (2012)	
	No	MW	No	MW	%	TWh
Argentina	2	935	1	745	4.7	5.9
Armenia	1	376	1	1060	26.6	2.1
Bangladesh			2	2000		
Belarus			4	4800		
Belgium	7	6943			51	38.5
Brazil	2	1901	5	5405	3.1	15.2
Bulgaria	2	1905	1	950	31.6	14.9
Canada	19	13553			89.1	15.3
Chile			4	4400		
China	20	17042	204	216270	2	92.7
Czech Rep.	6	3766	3	3600	35.3	28.6
Egypt			2	2000		
Finland	4	2741	3	4400	32.6	22.1
France	58	63130	3	5530	74.8	407.4
Germany	9	12003			16.1	94.1
Hungary	4	1889	2	2400	45.9	14.8
India	21	5302	63	64400	3.6	29.7
Indonesia			5	4030		
Iran	1	915	2	1300	0.6	1.3
Israel			1	1200		
Italy			10	17000		
Japan	48	42569	15	20128	2.1	17.2
Jordan			1	1000		
Kazakhstan			4	1200		
Korea (N)			1	950		
Korea (S)	23	20656	11	15600	30.4	143.5
Lithuania			1	1350		
Malaysia			2	2000		
Mexico	2	1600	2	2000	4.7	8.4
Netherlands	1	485	1	1000	4.4	3.7
Pakistan	3	725	4	2680	5.3	5.3
Poland			6	6000		
Romania	2	1310	3	1965	19.4	10.6
Russia	33	24253	59	57941	17.8	166.3
Saudi Arabia			16	17000		
Slovakia	4	1816	3	2142	53.8	14.4
Slovenia	1	696	1	1000	53.8	5.2
South Africa	2	1830	6	9600	5.1	12.4
Spain	7	8002			20.5	58.7
Sweden	10	9508			38.1	61.5
Switzerland	5	3252	3	4000	35.9	24.4
Thailand			5	5000		
Turkey			8	9300		
Ukraine	15	13168	13	13900	46.2	84.9
UAE			12	17200		
UK	16	10038	11	14600	18.1	64
USA	100	99098	27	38481	19	770.7
Vietnam			10	10700		
World	**434**	**374335**	**541**	**598227**		**2233.8**

Notes
All figures taken from the World Nuclear Association

CNS Council and Staff

CNS Executive

Adriaan Buijs
President

Jacques Plourde
1st Vice-President

Vinod Chugh
2nd Vice-President

John Roberts
Past President

Mohamed Younis
Treasurer

Colin Hunt
Secretary

Benjamin Rouben
Executive Director

Ken Smith
Financial Administrator

The Canadian Nuclear Society

The Canadian Nuclear Society (CNS) was established in 1979 as an organization of individual members, paying membership dues. It was established as an independent section of the Canadian Nuclear Association in order to benefit from the office support structure of the CNA. In 1997, after twenty years of operation in this mode, and after building its own asset base, the CNS obtained a federal charter as an independent not-for-profit organization. The CNS, through its base of individual members, promotes the exchange of information on all aspects of nuclear science and technology – including uranium mining and refining, electricity generation by nuclear power, medical and industrial uses of radionuclides, management of radioactive wastes, and various associated research and development activities.

The activities of the CNS are managed by a Council that is elected by the CNS members at the Annual General Meeting, normally held in June. The Council term of office is one year. A group photo of Council Members at a recent meeting is provided on the next page. The elected Council consists of six Executive Officers plus up to nineteen Members-at-Large – all volunteers. Various members of Council are appointed to Chair Committees that look after specific issues. A list of Committee Chairs appears on the next page. The Council is supported by a full time Office Manager, and by other part-time specialists.

Elected Executive for June 2013 to June 2014:

Adriaan Buijs	Jacques Plourde	Vinod Chugh	Colin Hunt	Mohamed Younis	John Roberts
President	1st V-P	2nd V-P	Secretary	Treasurer	Past President

Part-time Specialists and Office Staff:

Ben Rouben	Ken Smith	Brian Blosser	Amanda Blosser	Denise Rouben	Bob O'Sullivan
Executive Director	Financial Administrator	Accountant	Bookkeeper	Office Manager	Office Assistant

The CNS is organized into Branches and Technical Divisions, both directed towards involvement of the individual member. Branches are established on a geographical basis, and hold local meetings on issues of interest. Technical Divisions are established for specific technical areas of interest – and are responsible for organizing topical conferences, courses, and seminars.

The Chairs of the various Branches and Division are listed on the next page.

An outline of the activities of the CNS, including a list of upcoming conferences and courses, is provided elsewhere in this Yearbook.

CNS Members at Large


Parva Alavi


John Barrett
President and
CEO, CNA


Fred Boyd


Emily Corcoran


Ruxandra Dranga


Dan Gammage


V.S. (Krish) Krishnan


Laurence Leung


Kris Mohan


E.M (Dorin) Nichita


Peter Ozemoyah


Tracy Pearce


Jad Popovic


Nick Sion


Aman Usmani


Jeremy Whitlock


Alex Wolf


Syed Zaidi

CNS Staff


Denise Rouben
CNS Office Manager


Fred Boyd
Publisher
CNS Bulletin


Ric Fluke, Editor
CNS Bulletin


Brian Blosser
Accountant


Amanda Blosser
Bookkeeper

International Nuclear Organizations

ARGENTINA

Autoridad Regulatoria Nuclear (ARN)
Av. Del Libertador 8250
(1429) Buenos Aries
Tel: 54-1 704 1218
Fax: 54-1 703 2845

Comision Nacional de Energia Atomica (CNEA)
Avenida del Libertador 8250
Buenos Aires 1429
Tel: +54 1 70 7711

AUSTRIA

International Atomic Energy Agency (IAEA)
Wagramerstrasse 5
P.O. Box 100
A-1400 Vienna, Austria
Tel: +43 12600-0

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)
P.O. Box 500
A-1400 Vienna, Austria
Tel: +43 1 211 31, ext. 4330

AUSTRALIA

Australian Nuclear Science and Technology Organization
Lucas Heights Res. Labs.
New Illawarra Road
Lucas Heights
Private Mail Bag 1,
Menai 2234
N.S.W.
Tel: +61 2 9717 3111
Fax: +61 2 9543 5097

Uranium Information Centre Ltd.
GPO Box 1649N
Melbourne, 3001
Tel: 03 9629 7744
Fax: 03 9629 7207

BANGLADESH

Bangladesh Atomic Energy Commission
G.P.O. Box 158, 4 Kazi Nazrul
Islam Avenue, Dhaka-1000
Tel: +880 2 502 600
Fax: +880 2 861 3051

BELGIUM

Commission of the European Communities Nuclear Safety Research Directorate
200, rue de la Loi
B-1049 Brussels, Belgium
Tel: +32 2 2299 11 11

FORATOM – European Atomic Forum
Rue Belliard, 15-17
1040 Brussels, Belgium
Tel: +32 2 502 4595
Fax: +32 2 502 3902

Forum Nucléaire Belge (ASBL)
Avenue Ariane 7
B-1200 Bruxelles
Tel: +32 2 773 93 79
Fax: +32 2 773 98 00

Institute for Reference Materials and Measurements (IRMM)
European Commission
Joint Research Centre
Retieseweg, B-2440 Geel
Belgium
Tel: +32 14 57 12 11
Fax: +32 014 58 4273

Joint Research Centre (JRC) Commission of the European Communities
Rue de la Loi 200
B-1049 Brussels, Belgium
Tel: +32 2 299 11 11

Ministere des Affaires Economiques Administration de L'Energie
Service des applications
Nucléaires
North Gate III, boul. du Roi
Albert 11, 16
1000 Bruxelles
Tel: 02 206 42 58
Fax: 02 206 57 11

Union of the Electricity Industry EURELECTRIC
Bd de l'Impératrice 66
1000 Brussels
Tel: +32 2 515 1000
Fax: +32 2 515 1010

BRAZIL

Comissao Nacional de Energia Nuclear (CNEN)
22294 Rua General
Severiano 90
Rio de Janeiro, R.J.
Tel: (021) 546-2320
Fax: (021) 546-2282

CANADA

North American Young Generation in Nuclear
c/o PO Box 1268
Fredericton NB E3B 5C8
Tel: (877) 526-2946

TRIUMF
4004 Westbrook Mall
Vancouver BC V6T 2A3
Tel: (604) 222-1047

CHINA

Beijing Institute of Nuclear Engineering (BINE)
P.O. Box 840
100840, Beijing
Tel: 86-10-8802-2213
Fax: 86-10-6841-5067

Chinese Nuclear Society
P.O. Box 2125
100822, Beijing
Tel: +86 1 801 2211
Fax: +86 1 867 188

National Nuclear Safety Administration (NNSA)
P.O. Box 8088
Beijing 100088, PRC
Tel: 86-10 6225 8583
Fax: 86-10 6225 7804

CZECH REPUBLIC

State Office for Nuclear Safety (SUJB)
Senovazne namesti 9
110 00 Prague 1
Tel: 420-2 323 185
Fax: 420-2 242 20200
Denmark
Danish Energy Agency
Amaliegade 44
DK-1256 Copenhagen K.
Tel: +45 3392 6700

EGYPT

Arab Republic of Egypt Atomic Energy Authority
101 Kasr El-Eini St.
Cairo, Egypt
Tel: +20 2 355 8269
Fax: +20 2 354 0982

FINLAND

Advisory Committee on Nuclear Energy, Ministry of Trade and Industry
Energy Department
Pohjoinen Makasiinikatu 6
P.O. Box 32
00023 GOVERNMENT
SF-000130 Helsinki 13
Tel: +358 9 1601

Centre for Radiation and Nuclear Safety (STUK)
Laippatie 4/P.O. Box 14
00880 Helsinki, Finland
Tel: 358 9 759 811
Fax: 358 9 759 88 500

Finnish Nuclear Society
C/o VTT Energy,
Nuclear Energy
P.O. Box 1604, FIN-02044
VTT, Finland
Tel: 358 94 561
Fax: 358 9 456 5000

FRANCE

Direction de la Sureté des Installations Nucléaires (DSIN)
99, rue de Grenelle
75353 Paris 07 SP
Tel: 33-1 43 19 70 87
Fax: 33-1 43 19 70 69

Electricité de France
2, rue Louis Murat
75384 Paris Cedex 08
Tel: +33 1 40 42 22 22

Forum Atomique Francais
48, rue de la Procession
F-75015 Paris
Tel: +33 1 45 76 07 70

Institut Laue-Langevin
6, rue Jules Horowitz
BP 156-38042
Grenoble Cedex 9 – France
Tel: +33 4 76 20 71 11
Fax: +33 4 76 48 39 06

International Energy Agency (IEA)
9, rue de la Fédération
75739 Paris, Cedex 15, France
Tel: +33 140 5765
Fax: +33 140 57 6559

International Radiation Protection Association (IRPA)
Route du Panorama
BP48-F92263
Fontenay-aux-Roses Cedex
France
Tel: +33 1 46 547 476
Fax: +33 1 40 849 034

OECD Nuclear Energy Agency (NEA)
Le Seine Saint-Germain
12, boulevard des les
F-92130 Issy-les-Moulineaux
France
Tel: +33 (1) 45 24 82 00
Fax: +33 (1) 45 24 11 10

Societé Francaise d'énergie Nucléaire (SFEN)
67, rue Blomet
75015, Paris
Tel: 01 53 58 3214
Fax: 01 53 58 32 11

GERMANY

Bundesministerium fur Umwelt, Naturschutz und Reaktorsicherheit (BMU/GRS)
Alexanderplatz 6
10178 Berlin
Tel: +49 1888/305-0
Fax: +49 1888/305 4375

Bundesministerium für Wirtschaft und Arbeit (BMWA)
Scharnhorststr. 34-37
10115 Berlin
Tel: +49 1888-615-0
Fax: +49 1888-615-7010

Deutsches Atomforum e. V. (DAtF)
Robert-Koch-Platz 4
10115 Berlin
Tel: +49 30 498555-0
Fax: +49 30 498555-19

German Nuclear Society Kerntechnische Gesellschaft (KTG)
Robert-Koch-Platz4
10115 Berlin
Tel: +49 30 498555-10

HUNGARY

Hungarian Atomic Energy Authority (HAEA)
H-1539 Budapest 114
P.O. Box 676
Tel: 36-1 375 3586
Fax: 36-1 375 7402

INDIA

Department of Atomic Energy
Government of India
Anushakti Bhavan
Chatrapathi Shivaji Maharaj Marg
Mumbai- 400001, India
Tel: +91-22-2202 6823

INDONESIA

Badan Pengawas Tenaga Nuklir (BAPETEN)
MCA Bldg., 6th fl., JL. M. H. Thamrin no. 55
Jakarta Pusat
Tel: 62-21 513 694
Fax: 62-21 525 1110

ISRAEL

Israel Atomic Energy Commission
26 Chaim Levanon St.
P.O. Box 7061
Tel-Aviv 61070
Tel: +972 646 2922

ITALY

Comitato Nazionale per la Ricera e per lo Sviluppo dell'Energia Nucleare e dell Energia Alternative (ENEA)
Lungotevere Thaon di Revel
76 – 00196 Roma
Tel: +39 6-36271
Fax: +39 6-36272591/2777

Ispra-Joint Research Centre
1-21020 Ispra (Varese), Italy
Tel: +39 332 789 743
Fax: +39 332 789 903

JAPAN

Japan Atomic Industrial Forum Inc. (JAIF)
6th Floor, Toshin Building
1-13, 1-chome Shimbashi
Minato-Ku
Tokyo 105-8605
Tel: +81 3 508 2411

Atomic Energy Society of Japan (AESJ)
1-1-13 Shimbashi,
Minato-Ku
Tokyo 105-0004
Tel: +81 3 3508 1261

KOREA

Ministry of Science and Technology (MOST)
Government Complex-Gwacheon Gwacheon City
Kyunggi-Do 427-760
Tel: 82-2 503 7645
Fax: 82-2 503 7673

Koreal Atomic Industrial Forum (KAIF)
21 Youido-doug
Yongdungpo-ku
Seoul 150-875
Tel: +82 2 785 2570

NETHERLANDS

Nederlands Atoomforum
P.O. Box 1
NL-1775 ZG Petten
Tel: +31 2246 4082

Nederlands Nuclear Society
c/o Kema NV
Utrechtsweg 310
NL-6812 AR Arnhem
Tel: +31 85 56 2491

NORWAY

OECD Halden Reactor Project
P.O. Box 173
N-1751 Halden, Norway
Tel: +47 69 21 22 00
Fax: +47 69 21 22 01

PAKISTAN

Pakistan Atomic Energy Commission
P.O. Box 1114
Islamabad
Tel: +92 51 9204276

PERU

Instituto Peruano de Energia Nuclear (IPEN)
Av. Canada 1470-San Borja
Lima 41-Peru
Tel: 511226-0030/ 511226-0038
Fax: 511224-8991

POLAND

National Atomic Energy Agency
36 Krucza Str.
00-921 Warsaw
Tel: +48 2 628 27 22

ROMANIA

National Commission for Nuclear Activities Control (CNCAN)
14 Libertatii Blvd.
Bucharest – 5, Romania
Tel: 401 410 27-54
Fax: 401 411 14 36

SOUTH AFRICA

National Nuclear Regulator (NNR)
PO Box 7106
CENTURION 0046
Tel: 27 12 663 5500
Fax: 27 12 663 5513

SPAIN

Cosejo de Seguridad Nuclear (CSN)
c/o Justo Dorado,
11 – 28040 Madrid
Tel: 34-913 460105
Fax 34-913 460103

Foro de la industria nuclear espanola
Boix y Morer 6 – 28003 Madrid
Tel: +34 1 553 63 03
Fax: +34 1 535 08
Email: correo@foronuclear.org

Sociedad Nuclear Espanola (SNE)
Campoamor 17
E-28004 Madrid
Tel: +34 1 308 63 18

SWEDEN

International Commission on Radiological Protection (ICRP)
SE-171 16 Stockholm, Sweden
Tel: +46 8 729 727 5
Fax: +46 8 729 729 8

Statens Karnkraftinspektion (Swedish Nuclear Power Inspectorate)
Klarabergsviadukten 90
SE-106 58 Stockholm
Tel: 468 698 8400
Fax: 468 661 9086

International Nuclear Organizations *continued from page 45*

Stockholm International Peace Research Institute (SIPRI)
Signalistgatan 9
SE-16970, Solna, Sweden
Tel: +46 8 655 9700
Fax: +46 8 655 9733

Swedish Atomic Forum
C/o Energiforum AB
Allhegonavagen 25
S-61135 Nykoping
Tel: 46 155 281070

SWITZERLAND

CERN European Laboratory for Particle Physics
CH-1211 Geneva 23
Switzerland
Tel: +41 22 767 61 11

European Nuclear Society
Belpstrasse 23
P.O. Box 5032
CH-3001 Berne, Switzerland
Tel: +41 31 320 6111

Hauptabteilung fur die Sicherheit der Kernanlagen (HSK)
CH-5232 Villigen – HSK
Tel: 41 56 310 39 36
Fax: 41 56 310 49 36

Schweizerische Vereinigung fur Atomenergie (SVA)
(Swiss Association for Atomic Energy)
Postfach 5032
Ch-3001 Bern
Tel: +41 31 32 065 25

TAIWAN

Atomic Energy Council
No, 67, Lane 144, Sec. 4,
Keelung Rd.
Taipei, Taiwan, R.O.
Tel: 886 2 2363 4180

TURKEY

Turkish Atomic Energy Authority (TAEK)
Eskisehir Yolu 9. km
Lodumlu, 06530 ANKARA
Tel: 90-312 287 1529
Fax: 90-312 285 1537

UNITED KINGDOM

British Nuclear Energy Society (BNES)
1-7 Great George Street
London SW1P 3AA
Tel: +44 20 7222-7722

British Nuclear Industry Forum (BNIF)
First Fl., Whitehall House
41 Whitehall
London, SW1A 2BY
Tel: +44 20 7766 6640
Fax: +44 20 7839 4695

British Nuclear Fuels PLC (BNFL)
Risley Warrington
Cheshire WA3 6AS
Tel: +44 925 832 000

CNSC-H&SE/NII
Railway Inspectorate
2nd floor SW, Rose Court
2 Southwark Bridge
London SE1 9HS
Tel: 44-171 717 6887
Fax: 44-171 717 6095

JET Joint Undertaking
Abingdon, Oxfordshire
United Kingdom OX14 3EA
Tel: +44 235 528 822
Fax: +44 235 464 755

Scottish Power (Head Office)
Cathcart House, Spean St.
Glasgow, Scotland G44 4BE
Tel: +44 41 637 7177

United Kingdom Atomic Energy Authority (UKAEA)
Marshall Bldg.
521 Downs Way
Harwell, Didcot, Oxfordshire
OX11 ORA
Tel: +44 1235 820 220

Women in Nuclear Global (WiN)
c/o World Nuclear Association
Carlton House
22a St. James' Square
London SW1Y 4JH
United Kingdom
Tel: +44 (0)207 451-1520
Fax: +44 (0)207 839-1501

World Association of Nuclear Operators (WANO)
King's Buildings,
16 Smith Square
London. United Kingdom
SW1P 3HQ
Tel: +44 71 828 2111
Fax: +44 71 828 6691

World Energy Council (WEC)
5th Floor, Regency House
1-4 Warwick St.
London, United Kingdom
SW1B 5LT
Tel: +44 20 7734 5996
Fax: +44 20 7734 5926

World Nuclear Association
22a St James's Square
London, United Kingdom
SW1Y 4JH
Tel: +44 (0)20 7451 1520
Fax: +44 (0)20 7839 1501

UNITED STATES

American Nuclear Society (ANS)
555 North Kensington Ave.
La Grange Park, Illinois 60526
Tel: (708) 352-6611

Argonne National Laboratory (East)
9700 South Cass Ave.
Argonne, Illinois 60439
Tel: (630) 252-2000

Argonne National Laboratory (West)
P.O. Box 2528
Idaho Falls, Idaho
83403-2528
Tel: (208) 533-7341

Brookhaven National Laboratory (BNL)
Upton, NY 11973-5000
Tel: (631) 344-8000

CNSC-USNRC Office of Public Affairs (OPA)
Washington, D.C. 20555
Tel: 301-415 0317
Fax: 301-415 2395

Edison Electric Institute (EEI)
701 Pennsylvania Ave. NW
Washington, D.C.
20004-2696
Tel: (202) 508-5000

Electric Power Research Institute (EPRI)
3412 Hillview Ave.
P.O. Box 10412
Palo Alto, California 94303
Tel: (415) 855-2000

Environmental Protection Agency (EPA)
1200 Pennsylvania Ave., NW
Washington, D.C. 20460
Tel: (202) 260-2090

Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, CA 94551-0808
Tel: (925) 422-1100

Los Alamos National Laboratory (LANL)
P.O. Box 1663
Los Alamos, N.M. 87545
Tel: (505) 667-7000

National Council on Radiation Protection and Measurements (NCRP)
7910 Woodmont Ave.
Suite 800
Bethesda, Maryland
20814-3095
Tel: (301) 657-2652

Nuclear Energy Institute
1776 I Street, NW, Suite 400
Washington, D.C.
20006-3708
Tel: 202.739.8000
Fax: 202.785.4019

Nuclear Regulatory Commission (NRC)
Mail Stop TA-13
Washington, D.C. 20555
Tel: (301) 415-8200

Oak Ridge National Laboratory (ORNL)
P.O. Box 2008
Oak Ridge, Tennessee 37831
Tel: (615) 574-4160

Sandia National Laboratories
Albuquerque, N.M
87185-5800
Tel: (505) 844-5678

U.S. Department of Energy (DOE)
1000 Independence Ave., S.W.
Washington, D.C. 20585
Tel: (202) 586-5000

Yugoslavia Federal Secretariat for Energy and Industry
Bulevar AVNOJ-A 104 11070
Novi Beograd
Tel: (38-11) 195 244

Guide to Nuclear-Related Organizations

FEDERAL GOVERNMENT

Atomic Energy of Canada Limited (AECL)
Place de Ville, Tower B112 Kent St., Suite 501
Ottawa ON K1P 5P2
Tel: (613) 237-3270

AECL Chalk River Laboratories
Chalk River ON K0J 1J0
Tel: (613) 584-3311

AECL Low-level Radioactive Waste Management National Office
Suite 200
1900 City Park Drive
Ottawa ON K1J 1A3
Tel: (613) 998-9442

AECL Whiteshell Laboratories
P.O. Box 550
Pinawa MB R0E 1L0
Tel: (204) 753-2051

Canadian Nuclear Safety Commission
P.O. Box 1046
280 Slater Street
Ottawa ON K1P 5S9
Tel: (613) 995-5894

Department of Foreign Affairs and International Trade (DFAIT)
Lester B Pearson Bldg.
125 Sussex Dr.
Ottawa ON K1A 0G2
Tel: (613) 996-9134

DFAIT – Global Partnership Program (GPX)
Outreach and Communication
Department of Foreign Affairs and International Trade
125 Sussex Drive
Ottawa ON K1A 0G2
Tel: (613) 944-2536

Environment Canada
351 Joseph Blvd.
Hull QC K1A 0H3
Tel: (613) 997-2800

Health and Welfare Canada
A.L. 0900C2
Ottawa ON K1A 0K9
Tel: (613) 957-2991

Mine Environmental Neutral Drainage Program Canada Centre for Mineral & Energy Technology
Natural Resources Canada
555 Booth Street
Ottawa ON K1A 0G1
Tel: (613) 992-8736

National Energy Board
444 Seventh Ave. SW
Calgary AB T2P 0X8
Tel: (403) 292 4800

National Research Council
Canada Institute for Scientific and Technical Information (CISTI)
Bldg. M55, Room 148
Montreal Rd. Campus
Ottawa ON K1A 0S2
Tel: (613) 993-1600

Natural Resources Canada (Uranium, Nuclear Energy & Waste Management)
580 Booth Street
Ottawa ON K1A 0E4
Tel: (613) 995-0947

Natural Sciences and Engineering Research Council of Canada (NSERC)
350 Albert St., Tower 2
Ottawa ON K1A 1H5
Tel: (613) 995-5992

Nuclear Waste Management Organization (NWMO)
49 Jackes Avenue,
First Floor
Toronto ON M4T 1E2
Tel: 416-934-9814

PROVINCIAL ORGANIZATIONS

Hydro-Québec
75 René-Lévesque Blvd., West
Montréal QC H2Z 1A4
Tel: 514 289-2211

Hydro-Québec Gentilly 2 Nuclear Power Station
4900 Becancour Blvd.
Gentilly QC G0X 1G0
Tel: (819) 298-2943

New Brunswick Power
515 King Street
P.O. Box 2000
Fredericton NB E3B 4X1
Tel: 1-800-663-6272

New Brunswick Point Lepreau Generating Station
P.O. Box 600
Lepreau NB E5J 2S6
Tel: (506) 659-2220

Ontario Power Generation (OPG)
700 University Ave.
Toronto ON M5G 1X6
Tel: (416) 592-5111

Ontario Power Generation Darlington Generation Station
Information Centre
P.O. Box 4000
Bowmanville ON L1C 3Z8
Tel: (905) 623-7122

Ontario Power Generation Pickering Generating Station
Information Centre
1675 Montgomery Park Rd.
Pickering ON L1V 2R5
Tel: (905) 839-0465

ASSOCIATIONS

Association of Consulting Engineers of Canada
130 Albert St., Suite 616
Ottawa ON K1P 5G4
Tel: (613) 236-0569

Association of Major Power Consumers of Ontario (AMPCO)
P.O. Box 69, 595 Bay St.
Suite 1201
Toronto ON M5G 2C2
Tel: (416) 260-0225

Canadian Association of Medical Radiation Technologists
130 Albert St., Suite 1501
Ottawa ON K1P 5G4
Tel: (613) 234-0012

Canadian Association of Radiologists
1740 Cote Vertu Blvd.
Saint-Laurent QC H4L 2A4
Tel: (514) 738-3111

Canadian Electricity Association
66 Slater Street, Suite 1210
Ottawa ON K1P 5H1
Tel: (613) 230-9263

Canadian Standards Association (CSA)
178 Rexdale Blvd.
Rexdale ON M9W 1R3
Tel: (416) 747-4000

Engineering Institute of Canada
1295 Hwy 2 East
Kingston ON K7L 4V1
Tel: (613) 547-5989

Electricity Distributors Association
20 Eglinton Ave. W.
Suite 500
P.O. Box 2004
Toronto ON M4R 1K8
Tel: (416) 483-7739

Guide to Nuclear-Related Organizations *continued from page 47*

Institute de Recherche d'Hydro-Québec (IREQ)
1800, boul. Lionel-Boulet
Varennes QC J3X 1S1
Tel: (514) 652-1321

Radiation Safety Institute of Canada
1120 Finch Avenue W.
Suite 607
Toronto ON M3J 3H7
Tel: (416) 650 9090

UNIVERSITY/ EDUCATION

Association of Universities and Colleges of Canada
350 Albert St., Suite 600
Ottawa ON K1R 1B1
Tel: (613) 563-1236

Carleton University
1125 Colonel By Drive
Ottawa ON K1S 5B6
Tel: (613) 788-7400

Dalhousie University
1459 Oxford St.
Halifax NS B3H 4R2
Tel: (902) 494-2211

École Polytechnique
C.P. 6079 Centre-Ville
Montréal QC H3C 3A7
Tel: (514) 340-4711

Institut Armand-Frappier
531, boulevard des Prairies
C.P. 100
Laval QC H7V 1B7

Institut National de la Recherche Scientifique (INRS)
2600, boulevard Laurier
C.P. 7500
Ste-Foy QC G1V 4C7
Tel: (418) 654-2500

McGill University
845 Sherbrooke St. W.
Montréal QC H3A 2T5
Tel: (514) 398-4455

McMaster University
1280 Main St. W.
Hamilton ON L8S 4L8
Tel: (905) 525-9140

Queen's University
99 University Ave.
Kingston ON K7L 3N6
(613) 533-2000

Royal Military College of Canada
Station "Forces"
P.O. Box 17000
Kingston ON K7K 7B4
Tel: (613) 541-6000

Trent University
1600 West Bank Dr.
Peterborough ON K9J 7B8
Tel: (705) 748-1011

University of Alberta
114 Street – 89 Ave.
Edmonton AB T6G 2M7
Tel: (708) 492-3111

University of British Columbia
2329 West Mall
Vancouver BC V6T 1Z4
Tel: (604) 822-2211

University of Manitoba Department of Physics and Astronomy
Winnipeg MB R3T 2N2
Tel: (204) 474-8880

Université de Montréal
C.P. 6128, Succursale A
Montreal QC H3C 3J7
Tel: (514) 343-6111

University of New Brunswick
3 Bailey Dr.
P.O. Box 4400
Fredericton NB E3B 5A3
Tel: (506) 453-4864

University of Ontario Institute of Technology
2000 Simcoe Street North
Oshawa ON L1H 7L7
Tel: (905) 721-3190

University of Ottawa
550 Cumberland
P.O. Box, 450 Stn. A
Ottawa ON K1N 6N5
Tel: (613) 562-5700

University of Saskatchewan
Physics Department
116 Science Place
Saskatoon SK S7N 5E2
Tel: (306) 966-4343

University of Toronto – Centre for Nuclear Engineering
Contact: Brian C.
Wallberg Bldg.
184 College Street
Toronto ON M5S 3E5
Tel: (416) 978-2127

University of Victoria
Faculty of Engineering
PO Box 3055, EOW 248
Victoria BC V8W 3P6
Tel: (250) 721-8677

University of Western Ontario
1151 Richmond Street
Suite 2
London ON N6A 5B8

University Network of Excellence in Nuclear Engineering (UNENE)
For more information
please contact your local UNENE
representative

World Nuclear University (WNU)
Atoms for Sustainable
Development
For more information
please visit their website
at www.world-nuclear-
university.org

Nuclear Power Plant Operators
Bruce Power Inc.
P.O. Box 1540, B32
Tiverton ON N0G 2T0
Tel: (519) 361-7777

Hydro-Québec Gentilly 2 Nuclear Power Station
4900 Becancour Blvd.
Gentilly QC G0X 1G0
Tel: (819) 298-2943

New Brunswick Point Lepreau
Generating Station
P.O. Box 600
Lepreau NB E5J 2S6
Tel: (506) 659-2220

Ontario Power Generation Darlington Generation Station
Information Centre
P.O. Box 4000
Bowmanville ON L1C 3Z8
Tel: (905) 623-7122

Ontario Power Generation Pickering Generating Station
Information Centre
1675 Montgomery Park Rd.
Pickering ON L1V 2R5
Tel: (905) 839-0465

National Organizations

Canadian Nuclear Association
130 Albert Street
Suite 1610
Ottawa ON K1P 5G4
Tel: (613) 237-4262

Canadian Nuclear Society (CNS)
480 University Avenue
Suite 200
Toronto ON M5G 1V2
Tel: (416) 977-7620

Canadian Nuclear Workers Council
244 Eglinton Ave. E.
Toronto ON M4P 1K2
Tel: (416) 484-4491

CANDU Owners Group
480 University Ave.
Suite 200
Toronto ON M5G 1V2
Tel: (416) 595-1888

The Canadian Centre for Energy Information
201, 322 – 11 Avenue, SW
Calgary AB T2R 0C5
Tel: (403) 263-7722

Organization of CANDU Industries (OCI)
1 Yonge St., Suite 1801
Toronto ON M5W 1W7
Tel: (416) 363-7845

INTERNATIONAL ORGANIZATIONS

Commission of the European Communities Nuclear Safety Research Directorate
200, rue de la Loi
B-1049 Brussels, Belgium
Tel: +32 2 2299 11 11

European Nuclear Society
Rue Belliard, 15-17
1040 Brussels, Belgium
Tel: +32 2 505 30 50
Fax: +32 2 502 3902

FORATOM – European Atomic Forum
Rue Belliard, 15-17
1040 Brussels, Belgium
Tel: +32 2 502 4595
Fax: +32 2 502 3902

International Atomic Energy Agency (IAEA)
Wagramerstrasse 5
P.O. Box 100
A-1400 Vienna, Austria
Tel: +43 12600-0

International Energy Agency (IEA)
9, rue de la Fédération
75739 Paris, Cedex 15 France
Tel: +33 140 5765
Fax: +33 140 57 6559

International Radiation Protection Association (IRPA)
Route du Panorama
BP48-F92263
Fontenay-aux-Roses Cedex
France
Tel: +33 1 46 547 476
Fax: +33 1 40 849 034

(OECD) Organisation for Economic Cooperation and Development Nuclear Energy Agency (NEA)
Le Seine Saint-Germain
12, boulevard des les
F-92130 Issy-les-Moulineaux, France
Tel: +33 (1) 45 24 82 00
Fax: +33 (1) 45 24 11 10

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)
P.O. Box 500
A-1400 Vienna, Austria
Tel: +43 1 211 31, ext. 4330

World Association of Nuclear Operators (WANO)
King's Buildings
16 Smith Square
London, United Kingdom SW1P 3HQ
Tel: +44 71 828 2111
Fax: +44 71 828 6691

World Council of Nuclear Workers
49 rue Lauriston
75116 Paris, France
Tel: +33 (0)1 53 70 88 99
Fax: +33 (0)1 53 70 01 08

World Energy Council (WEC)
5th Floor, Regency House
1-4 Warwick St.
London, United Kingdom SW1B 5LT
Tel: +44 20 7734 5996
Fax: +44 20 7734 5926

World Nuclear Association
12 Floor, Bowater House W.
114 Knightsbridge, London
SW1X 7LJ, UK
Tel: +44 20 7225 0303
Fax: +44 20 7225 0308

World Nuclear Transport Institute
Remo House
310-312 Regent Street
London, W1B 3AX
Tel: +44 (0) 207 580 1144
Fax: +44 (0) 207 580 5365
www.wnti.co.uk

Canada's Nuclear Facilities

This list contains, by licence type, power reactors, uranium mine/mill facilities, uranium refineries and fuel fabrication facilities, radioisotope management facilities, research reactors, particle accelerators and radioisotope uses licensed by the Canadian Nuclear Safety Commission in Canada.

Information is based upon Canadian Nuclear Safety Commission licensing information in 2013.

Power Reactor Licences

Facility and Location	Type and Number of Units/Capacity	Startup	Status
Pickering Nuclear Generating Station A Pickering, Ontario (Ontario Power Generation)	CANDU-PHW 2 x 500 MW(e)	1971	Operating
Pickering Nuclear Generating Station A Pickering, Ontario (Ontario Power Generation)	CANDU-PHW 2 x 500 MW(e)	1971	Shutdown To be decommissioned
Pickering Nuclear Generating Station B Pickering, Ontario (Ontario Power Generation)	CANDU-PHW 4 x 500 MW(e)	1983	Operating
Darlington Nuclear Generating Station Bowmanville, Ontario (Ontario Power Generation)	CANDU-PHW 4 x 850 MW(e)	1989	Operating
Bruce Nuclear Generating Station A Tiverton, Ontario (Bruce Power)	CANDU-PHW 4 x 750 MW(e)	1976	Operating
Bruce Nuclear Generating Station B Tiverton, Ontario (Bruce Power)	CANDU-PHW 4 x 840 MW(e)	1984	Operating
Gentilly-2 Nuclear Generating Station Gentilly, Québec (Hydro-Québec)	CANDU-PHW 1 x 600 MW(e)	1983	Shutdown To be decommissioned
Point Lepreau Generating Station Lepreau, New Brunswick (New Brunswick Power Corp.)	CANDU-PHW 1 x 600 MW(e)	1982	Operating

Non-Power Reactor Licences

Unit	Type	In Service	Status
University of Toronto, Toronto, Ontario	Subcritical Assembly	1958	Decommissioned
McMaster University, Hamilton, Ontario	Pool-Type 5 MW(T)	1959	Operating
École polytechnique, Montréal, Québec	Subcritical Assembly	1974	Operating
University of Toronto, Toronto, Ontario	SLOWPOKE-2 20 kW(t)	1976	Decommissioned
École polytechnique, Montréal, Québec	SLOWPOKE-2 20 kW(t)	1976	Operating
Dalhousie University, Halifax, Nova Scotia	SLOWPOKE-2 20 kW(t)	1976	Decommissioned
University of Alberta, Edmonton, Alberta	SLOWPOKE-2 20 kW(t)	1977	Operating
Saskatchewan Research Council, Saskatoon, Saskatchewan	SLOWPOKE-2 20 kW(t)	1981	Operating
Royal Military College, Kingston, Ontario	SLOWPOKE-2 20 kW(t)	1985	Operating
Atomic Energy of Canada Ltd., Chalk River, Ontario	Maple 1 & 2 Reactors 10 MW(t)		Shutdown pending decommissioning

Nuclear Research and Test Establishment Licences

Unit	Type	Status
Chalk River Laboratories (AECL)		
NRX Reactor	42 MW(t)	Decommissioning
NRU Reactor	135 MW(t)	Operating
Recycle Fuel Fabrication Laboratories	Manufacture of small quantities of mixed oxide fuel for research and demonstration	Operating
PTR Reactor	100 W(t)	Decommissioned and released
ZED-2 Reactor	200 W(t)	Operating

Nuclear Research and Test Establishment Licences (cont'd)

Unit	Type	Status
Universal Cells	3 isolation cells for examining radioactive material	Operating
Molybdenum-99 Production Facility	Production of Mo-99 and Xe-133	Operating
Health Physics Neutron Generator	Electrostatic accelerator 150 KeV	Operating
Gamma Beam Irradiator GC60	Irradiation Facility	Operating
Gamma Beam 150 C Irradiation Facility	Irradiation Facility	Operating
Waste Treatment Centre and Associated Facilities	Treatment of solid and liquid waste	Operating
Fuels and Materials Cells	12 isolation cells for examining radioactive material	Operating
Waste Management Areas	Storage and handling of waste	Operating/Shutdown
Nuclear Fuel Fabrication Facility	Production of low enriched uranium fuel for research reactors	Operating
Nuclear Fuel Fabrication Facility	Production of low and high enriched uranium fuel targets for research reactors	Operating
Heavy Water Upgrading Facility	Upgrading of heavy water	Dcommissioning
CECEUD Test Facility	Upgrade and detritiate heavy water	Shutdown pending decommissioning
Tritium Laboratory	Processing of tritium	Operating
Whiteshell Laboratories (AECL)		
WR-1 Reactor	Organically cooled experimental reactor	Decommissioning
WL Concrete Canister Storage Facilities	Storage of irradiated fuel	Operating
Van de Graaf Accelerator	Proton accelerator, >30 microamps	Decommissioned
14 MeV Neutron Generator		Decommissioned
Active Liquid Waste Treatment Centre	Treatment of liquid waste	Operating
WL Shielded Facilities	Post irradiated examination of fuels, reactor core components and other	Decommissioning
WL Waste Management Area	Storage and handing of waste	Operating
SLOWPOKE Demonstration Reactor	2 MW pool-type reactor	Decommissioned

Uranium Mine and Mill Facility Licences

Facility	Activity	Status
Beaverlodge, Saskatchewan (Cameco Corporation)	Long-term monitoring	Decommissioned
Cigar Lake Project, Saskatchewan (Cameco Corporation)	Mining	Operating
Cluff Lake, Saskatchewan (AREVA Resources Canada Inc.)	Long-term monitoring	Decommissioned
Key Lake Operation Saskatchewan (Cameco Corporation)	Milling	Operating
McArthur River Project, Saskatchewan (Cameco Corporation)	Mining	Operating
McClean Lake Project, Saskatchewan (AREVA Resources Canada Inc.)	Milling	Operating
Rabbit Lake Saskatchewan (Cameco Corporation)	Mining and milling	Operating
Denison Mines, Elliot Lake, Ontario (Denison Mines Ltd.)	Above-ground tailings	Decommissioned
Stanrock, Elliot Lake, Ontario (Denison Mines)	Above-ground tailings	Decommissioned
Madawaska Bancroft, Ontario (Madawaska Mines Ltd.)	Long-term monitoring	Decommissioned

Canada's Nuclear Facilities *continued from page 51*

Refinery and Fuel Fabrication Facility Licences

Facility	Annual Licensed Production Limit	Status
GE Hitachi Nuclear Energy Canada Inc., Toronto, Ontario	1,800 tonnes of uranium	Operating
GE Hitachi Nuclear Energy Canada Inc., Peterborough, Ontario	1,800 tonnes of uranium	Operating
Port Hope Fuel Manufacturing Facility, Port Hope, Ontario (Cameco)	125 tonnes of UO2	Operating
Blind River Uranium Refinery, Blind River, Ontario (Cameco)	24,000 tonnes of uranium as UO3	Operating
Port Hope Uranium Converstion Facility, Port Hope, Onatario (Cameco)	12,500 tonnes of uranium as uranium hexaflouride 3,800 tonnes of uranium as UO2 1,000 tonnes of uranium as ammonium diuranate 2,000 tonnes of uranium metals	Operating

Waste Management Licences

Facility	Activity	Status
Radioactive Waste Operations Site 1 Tiverton, Ontario (OPG)	Storage of intermediate level radioactive waste from the Douglas Point nuclear reactor in in-ground concrete trenches and tile holes. The licence was amended in July 2006 to include the Spent Solvent Treatment Facility as minor amounts of nuclear substances remain in the facility from the past processing of spent solvents Contaminated with nuclear substances. No new radioactive waste is accepted at the facility.	Storage with surveillance
Western Waste Management Facility, Tiverton, Ontario (OPG)	Processing and/or storage of low level radioactive waste and storage of intermediate level radioactive waste, and processing and storage of spent nuclear fuel from the Bruce NGS	Operating
Pickering Waste Management Facility Pickering, Ontario (OPG)	Processing and storage of spent nuclear fuel from the Pickering NGS and storage of retube components from the Pickering NGS	Operating
Bruce Heavy Water Plant Tiverton, Ontario (OPG)	Decommissioning of the heavy water plant and remediation of the site	Decommissioning
Douglas Point Radioactive Waste Storage Facility Tiverton, Ontario (AECL)	Storage of solid waste from Douglas Point Generating Station, spent fuel storage, no new waste accepted	Storage with surveillance
Gentilly-1 Radioactive Waste Storage Facility Gentilly, Quebec (AECL)	Storage of solid waste from Gentilly-1 NGS, spent fuel storage. No new radioactive waste is accepted.	Storage with surveillance
Gentilly-2 Radioactive Waste Storage Facility Gentilly, Quebec (Hydro-Quebec)	Storage of solid waste and spent fuel storage from Gentilly-2 NGS	Operating
Point Lepreau Solid Radioactive WMF Point Lepreau, New Brunswick (NB Power Nuclear Corporation)	Storage of solid waste and spent fuel storage from Point Lepreau NGS	Operating
Darlington Waste Management Facility Bowmanville, Ontario (OPG)	Processing and storage of spent nuclear fuel from the Darlington NGS	Operating
University of Toronto WMF Toronto, Ontario (University of Toronto)	Storage, handling and compaction of waste from university	Operating
Central Maintenance and Laundry Facility Tiverton, Ontario (Bruce Power)	Managing waste (slightly radioactive clothing materials) from decontamination activities	Operating
Energy Solutions WMF Brampton, Ontario (Energy Solutions Canada)	Storage, handling and compaction of waste from Ontario and Quebec	Operating
Nuclear Power Demonstration WMF Rolphton, Ontario (AECL)	Storage of solid waste from the partial decommissioning of NPD NGS. No new waste accepted.	Storage with surveillance
Port Granby Long-term (LT) WMF Clarington, Ontario (AECL)	Storage of historic waste and chemical treatment of drainage and run-off. No new waste is accepted. Currently undergoing construction.	Storage with surveillance and remediation
Port Hope Long-term (LT) WMF Port Hope, Ontario (AECL)	Storage of historic waste and treatment of drainage and run-off. No new waste is accepted. Currently undergoing construction.	Storage with surveillance and remediation

Waste Management Licences (cont'd)

Facility	Activity	Status
Elliot Lake WMF Elliot Lake, Ontario (Rio Algom Ltd.)	Multiple tailings management site, chemical treatment of effluent. No new waste accepted.	Decommissioned
Port Hope PSE TSS Port Hope, Ontario (Low-Level Radioactive Waste Management Office)	Storage of historic waste	Operating
Port Hope WMF Port Hope, Ontario (Low-Level Radioactive Waste Management Office, Pine St. Extension Temporary Storage Site)	Storage of historic waste no new waste accepted	Storage with surveillance
Roving Locations (Low-Level Radioactive Waste Management Office, decontamination projects)	Possession of historic waste on an as requested basis	Operating
Agnew Lake Idle Mine Site Nairn Centre, Ontario (Ontario Ministry of Northern Development and Mines)	Above-ground tailings	Decommissioned
Dyno Idle Mine Site Bancroft, Ontario (EWL Management Ltd)	Above-ground tailings	Decommissioned
Rayrock Idle Mine Site Northwest Territories (Department of Indian Affairs and Northern Development)	Above-ground tailings	Decommissioned
Port Radium Idle Mine Site Northwest Territories (Department of Indian Affairs and Northern Development)	Above-ground tailings	Decommissioned
Madawaska Bancroft, Ontario (EWL Management Ltd.)	Above-ground tailings	Decommissioned
Bicroft Tailings Storage Facility Bancroft, Ontario (Barrick Gold Corporation)	Above-ground tailings	Decommissioned

Particle Accelerator Licences

Facility	Type	Status
Health PEI Charlottetown, Prince Edward Island	2 linacs	Operating
Region Health Authority B Saint John, New Brunswick	3 linacs	Operating
Centre de santé et de services sociaux de Chicoutimi Chicoutimi, Québec	3 linacs	Operating
Centre universitaire de santé McGill Montréal, Québec	3 linacs	Operating
Hospital Maisonneuve-Rosemont Montréal, Québec	6 linacs	Operating
The Board of Governors of the Kingston General Hospital, Kingston, Ontario	4 linacs	Operating
Thunder Bay Regional Health Sciences Centre Thunder Bay, Ontario	3 linacs	Operating
Windsor Regional Hospital Windsor, Ontario	3 linacs	Operating
Cancer Care Manitoba Winnipeg, Manitoba	7 linacs	Operating
Saskatchewan Cancer Agency Regina, Saskatchewan	3 linacs	Operating
Saskatchewan Cancer Agency Saskatoon, Saskatchewan	3 linacs	Operating
Alberta Health Services Calgary, Alberta	6 linacs	Operating
Alberta Health Services Edmonton, Alberta	5 linacs	Operating
Alerta Health Services Lethbridge, Alberta	2 linacs	Operating
Hôpital Général Juif Montréal, Québec	3 linacs	Operating

Canada's Nuclear Facilities *continued from page 53*

Particle Accelerator Licences (cont'd)

Facility	Type	Status
Cape Breton District Health Authority Sydney, Nova Scotia	2 linacs	Operating
Régie régionale de la santé (Beauséjour) Moncton, New Brunswick	3 linacs	Operating
British Columbia Cancer Agency Kelowna, British Columbia	3 linacs	Operating
British Columbia Cancer Agency Victoria, British Columbia	3 linacs	Operating
British Columbia Cancer Agency Prince George, British Columbia	2 linacs	Operating
British Columbia Cancer Agency Abbotsford, British Columbia	4 linacs	Operating
Cancer Care Ontario St. Catherines, Ontario	3 linacs	Operating
British Columbia Cancer Agency Vancouver, British Columbia	9 linacs	Operating
Eastern Regional Integrated Health Authority (Eastern Health) St. John's, Newfoundland	4 linacs	Operating
Centre hospitalier universitaire de Sherbrooke Sherbrooke, Québec	1 linacs	Operating
Centre hospitalier universitaire de Sherbrooke Fleurimont, Québec	3 linacs	Operating
Centre hospitalier universitaire de Québec Québec, Québec	4 linacs	Operating
Capital District Health Authority Halifax, Nova Scotia	3 linacs	Operating
Hamilton Health Sciences Corporation Hamilton, Ontario	10 linacs	Operating
Centre hospitalier de l'Université de Montréal Montréal, Québec	7 linacs	Operating
Centre de sante et services sociaux Champlain-Charles-Le-Moyne Greenfield Park, Québec	4 linacs	Operating
Hôpital régional de Sudbury Sudbury, Ontario	6 linacs	Operating
The Ottawa Hospital Ottawa, Ontario	9 linacs	Operating
Sunnybrook Health Sciences Centre Toronto, Ontario	10 Cyclotron	Operating
Sunnybrook Health Sciences Centre Barrie, Ontario	3 linacs	Operating
Ciment Québec Inc. Saint-Basile, Québec	2 Neutron Generator	Operating
General Fusion Inc. Burnaby, British Columbia	1 Plasma Injector	Operating
Hilliburton Group Canada Inc. Nisku, Alberta	1 Neutron Generator	Operating
Hunter Well Science Ltd. Calgary, Alberta	1 Neutron Generator	Operating
Centre de sante et de services sociaux de Gatineau Gatineau, Québec	3 linacs	Operating
University Health Network Toronto, Ontario	20 linacs	Operating
Grand River Hospital Corporation Kitchener, Ontario	4 linacs	Operating
London Health Sciences Centre London, Ontario	8 linacs	Operating
McMaster University Hamilton, Ontario	1 tandetron accelerator	Operating

Particle Accelerator Licences (cont'd)

Facility	Type	Status
McMaster University Hamilton, Ontario	1 cyclotron	Operating
McMaster University Hamilton, Ontario	1 Van de Graaff	Operating
University of Guelph Guelph, Ontario	1 linacs	Operating
University of Western Ontario London, Ontario	1 tandetron accelerator	Operating
Queen's University at Kingston Kingston, Ontario	2 Neutron Generator	Operating
Université de Montréal Montréal, Québec	1 Van de Graaff tandem accelerator 1 tandetron accelerator	Operating Operating
Centre de santé et services sociaux de Laval Laval, Québec	2 linacs	Operating
National Research Council Canada Ottawa, Ontario	2 linacs	Operating
Schlumberger Canada Limited Calgary, Alberta	1 Neutron Generator	Operating
Scientific Drilling International (Canada) Calgary, Alberta	1 Neutron Generator	Operating
Hotwell Canada Ltd. Calgary, Alberta	1 Neutron Generator	Operating
Montreal Neurological Institute and Hospital Montreal, Quebec	1 Cyclotron	Operating
Centre for Addiction and Mental Health Toronto, Ontario	1 Cyclotron	Operating
Centre hospitalier universitaire de Sherbrooke Sherbrooke, Québec	1 Cyclotron	Operating
Hamilton Health Sciences Corporation Hamilton, Ontario	1 Cyclotron	Operating
University of Ottawa Heart Institute Ottawa, Ontario	1 Cyclotron	Operating
Mervex Corporation Stittsville, Ontario	1 linacs	Operating
Lakeridge Health Oshawa, Ontario	6 linacs	Operating
PharamaLogic P.E.T. Services of Montreal Company Lachine, Québec	1 Cyclotron	Operating
Southlake Regional Health Centre Newmarket, Ontario	3 linacs	Operating
St. Joseph's Health Care London, Ontario	1 linacs	Operating
Vancouver Cancer Centre Vancouver, British Columbia	1 Cyclotron	Operating
Weatherford Canada Ltd. Edmonton, Alberta	1 Neutron Generator	Operating
Winnipeg Regional Health Authority Winnipeg, Manitoba	1 Cyclotron	Operating

Nuclear Substance Processing Facility Licences

Facility	Type	Status
New Processing Facility Chalk River Laboratories Chalk River, Ontario	Production and processing	Operating
Nordion (Canada) Inc., Ottawa, Ontario	Production and processing	Operating
SRB Technologies, Pembroke, Ontario	Processing	Operating
Shield Source Inc., Peterborough, Ontario	Processing	Shutdown

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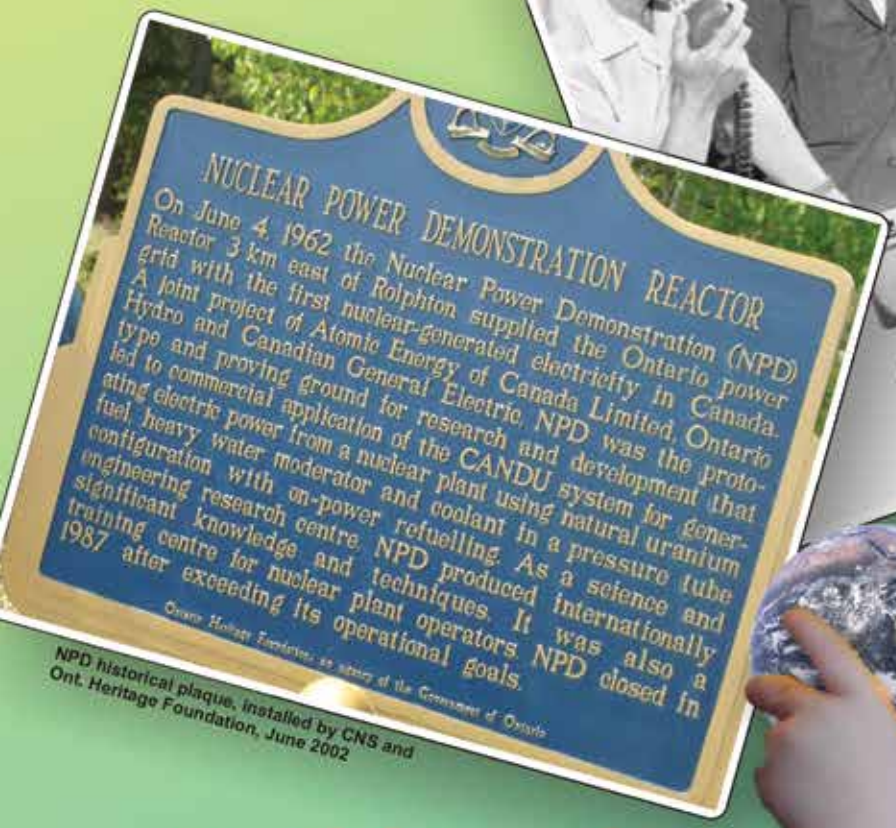

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Nuclear Products, Materials and Services

A

Activation Analysis Service
Atlantic Nuclear Services Inc.

Air Filtration Systems
CCI Thermal Technologies Inc. 31

Air Headers
Special Electronics and Designs Inc.

Airlocks, Reactor
RCM Technologies Canada Corp. 26

Alarm Systems
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Alpha Spectroscopy
Canberra Co.
Radiation Safety Institute of Canada

Analyzers
Avensys Solutions

Architects, Engineers
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Chambers, Ionization
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Candu Energy Inc. 10
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Clothing, Protective
Unitech Services Group

Coatings, Containment Quality
Nova Machine Products INC

Coatings, Protective
Aberfoyle Metal Treaters Ltd.

Commercial Grade Dedication
ATC Nuclear
Canadian Power Utility Services Limited
Henry Controls Inc.
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Compactors, Box and Drum
Container Products Corporation

Compressors, Gas
Thorburn Flex Inc. 8, 72
SIHI Pumps Limited

Compressors, Nuclear
SIHI Pumps Limited

Computer Software Development & Maintenance
AMEC NSS 49
Atlantic Nuclear Services Inc.
Hitachi Canada 79
SWI Systemware
Tyne Engineering Inc. 38

Computers, Reactor Control
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Configuration Management
AMEC NCL 49
AMEC NSS 49
Babcock & Wilcox
Canadian Power Utility Services Limited
GE Hitachi Nuclear Energy Canada Inc. ..... IFC
Hatch-Sargent & Lundy (HSL)
RCM Technologies Canada Corp. 26
SWI Systemware

Connectors, Electrical, Radiation Resistant
Henry Controls Inc.
Kanata Electronic Services Limited

Construction Management
Babcock & Wilcox
E.S. Fox Limited 4
Hatch-Sargent & Lundy (HSL)

Construction, Modular
Babcock & Wilcox
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Consultant, Waste and Decommissioning Planning
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Consultants, Design
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Babcock & Wilcox
Canadian Power Utility Services Limited
Candu Energy Inc. 10
Hatch-Sargent & Lundy (HSL)
RCM Technologies Canada Corp. 26
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Tyne Engineering Inc. 38

Consultants, Economic
Hatch-Sargent & Lundy (HSL)

Consultants, Engineering
AMEC NCL 49
AMEC NSS 49
ANRIC Enterprises Inc. 18
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Films, Radiation Detection
Alexander Vacuum Research, Inc.

Filter Baskets
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Fuel, Research Reactors
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Glass, Radiation Shielding
Marshield-Division of Mars Metal Co.

Nuclear Energy Services

Tetra Tech is an experienced full-service engineering and consulting firm providing support to the nuclear power industry in Canada and the United States. We support all aspects of the nuclear plant life cycle from licensing, design engineering and construction management, operations support and waste management, to decommissioning.

The Tetra Tech Advantage

- More than 40 years of experience in the nuclear industry
- Understanding of nuclear power plant issues
- Technical knowledge and hands-on experience
- Understanding of nuclear regulations and philosophy
- Ability to respond to critical demands on short notice
- Understanding of international and national environmental regulations
- Subject Matter Experts in engineering design and cost control

Services

SAFETY, SECURITY & LICENSING

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- Combined Construction & Operating License Applications

PROJECT & CONSTRUCTION MANAGEMENT

- Work Planning
- Field Engineering
- Commissioning

WASTE MANAGEMENT & DECOMMISSIONING

- Spent Fuel Management
- Dry Storage Facilities

MODIFICATIONS

- Conceptual Studies & Design Requirements
- Preliminary & Detailed Design
- Multidisciplinary Engineering

ASSET MANAGEMENT & EQUIPMENT RELIABILITY

- Plant Programs (Security, Fire Protection & Environmental Qualification)
- Preventative Maintenance Optimization
- Condition Assessments

TETRA TECH

commnuclear@tetratech.com
www.tetratech.com

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Glove Box Supplies
Unitech Services Group

Glove Boxes
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GE Hitachi Nuclear Energy Canada Inc. ..... IFC
Promation Nuclear Ltd.
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Hafnium
ATI

Hand Held Real-Time Gamma and Neutron Monitors
Canberra Co.

Harsh Environment Qualification Testing
ATC Nuclear
Henry Controls Inc.
Kinectrics Inc. 2
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Headers, Reactor
Niagara Energy Products

Headsets
Special Electronics and Designs Inc.

Health Physics
Unitech Services Group

Health Physics
AMEC NSS 49
Canadian Power Utility Services Limited
Candesco 2
Nuvia Canada

Heat Exchanger Tubes
Canadian Power Utility Services Limited

Heat Exchangers
Babcock & Wilcox
Canadian Power Utility Services Limited
CCI Thermal Technologies Inc. 31

Heat Exchangers, Nuclear
Babcock & Wilcox
Canadian Power Utility Services Limited
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RdF Corporation

Heat Treatment
Aberfoyle Metal Treaters Ltd.
Babcock & Wilcox
Cameco Fuel Manufacturing
Team Industrial Services

Heater Controls SCR Power
Ametek HDR Power Systems
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Heaters, Immersion, Flanged, Electrical
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Kinectrics Inc. 2
Radiation Safety Institute of Canada

Laboratories, Chemical
ATI

Laboratories, Testing
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Kinectrics Inc. 2
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Canadian Power Utility Services Limited
CTS North America

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ATI

Tubing, Heat Exchangers
ATI
Canadian Power Utility Services Limited

Tubing, Nuclear Instrumentation
Canadian Power Utility Services Limited
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Lakeside Process Controls Ltd.
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Armour Valve Ltd.
Canadian Power Utility Services Limited
Flowserve Flow Control
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Automatic Valve
Canadian Power Utility Services Limited
Henry Controls Inc.
Lakeside Process Controls Ltd.
National Technical Systems (formerly Wyle Laboratories Inc.)

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Whole Body Contamination Monitors
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Whole Body Counters
Canberra Co.

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Zircaloy
ATI
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Candu Energy Inc. 10

Zirconium
ATI
Kinectrics Inc. 2

UNENE · REUGN

University Network of Excellence in Nuclear Engineering
Réseau d'Excellence Universitaire en Génie Nucléaire

What the UNENE Universities offer...

- A Master's of Engineering Degree from one of the five member universities (McMaster University, Queen's University, University of Waterloo, University of Western Ontario, and University of Ontario Institute of Technology).
- Courses are tailored to individuals already working in the nuclear industry, and are delivered on weekends in Whitby, so as not to conflict with core working hours.
- For the degree 10 courses, or 8 courses and an industrial research project, must be successfully completed over a period of 5 years.
- A student can take just one or a few courses rather than the full program.
- Students must be registered as graduate students in one of the participating universities.
- The courses are also offered using Distance Education tools for sites remote from the GTA.

The courses include, among others:

- ☐ Nuclear Plant Systems and Operations
- ☐ Reactor Physics
- ☐ Heat Transport System Design
- ☐ Nuclear Reactor Safety Design
- ☐ Nuclear Materials
- ☐ Control, Instrumentation and Electrical Systems in CANDU Power Plants
- ☐ Engineering Risk and Reliability
- ☐ Fuel Engineering
- ☐ Fuel Management
- ☐ Operational Health Physics
- ☐ Reactor Chemistry and Corrosion

Courses in management areas are also available in cooperation with Advanced Design and Manufacturing Institute.

PLUS: FREE refresher mini-courses prior to the core subjects.

Who we are...

The University Network of Excellence in Nuclear Engineering (UNENE) is an alliance of universities, nuclear power utilities, research and regulatory agencies for the support & development of nuclear education, research and development capability in Canadian universities.

The 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.

For more information, please:

- visit our website **www.unene.ca**
- email our President, Basma Shalaby basma.shalaby@rogers.com
- email our Programme Director, Victor Snell snellv@mcmaster.ca

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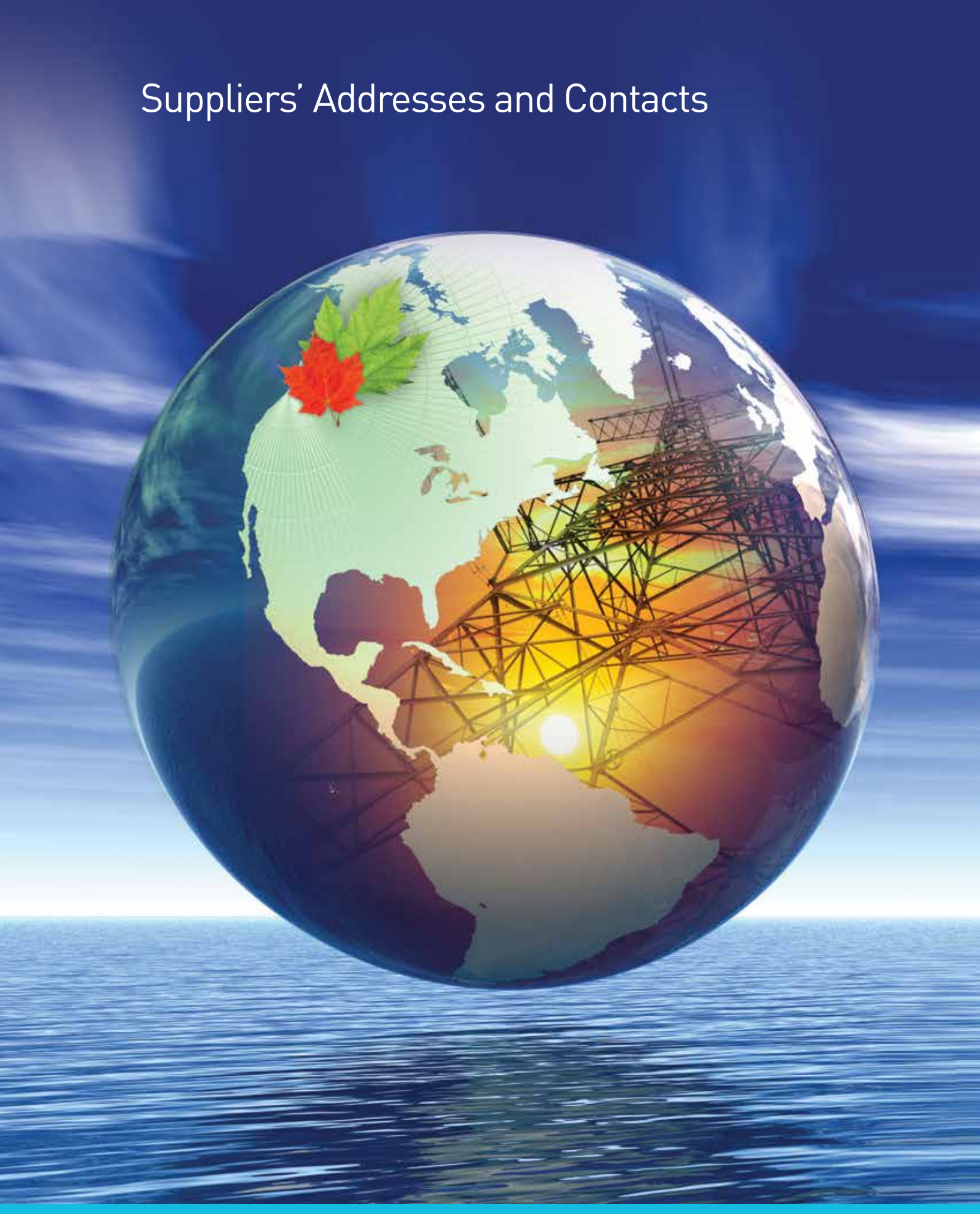
University Network of Excellence in Nuclear Engineering
Réseau d'Excellence Universitaire en Génie Nucléaire

Suppliers' Addresses and Contacts



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Flexible Piping Specialist

Since its conception over 50 years ago, Thorburn has become a world leader in the design and manufacture of custom engineered precision bellows, metallic and non-metallic expansion joints. Operating under a strategy of global presence in the Power Generating & CANDU Nuclear Industries, Thorburn is structured to consistently meet and exceed customers expectations in quality, value and service.

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- OPG Pickering (8 Units)
- OPG Darlington (4 Units)
- OPG/BP Bruce (8 Units)
- HQ Gentilly (1 Unit)
- NB Power Point Lepreau (1 Unit)
- Cernavoda Romania (2 Units)
- Quinshan China (2 Units)
- Wolsong South Korea (4 Units)
- Embalse Argentina (1 Unit)

Designers and OEM's:
- AECL
- GE Canada
- SNC-Nuclear
- CANDU Energy
- AREVA

Products:
- Annulus seal bellows for calandria fuel channel
- Bellows for snout indexing mechanism & loop liner tube
- F/M head separator & linear potentiometer assemblies
- Reactivity mechanism expansion joints
- Main steam penetration & dousing expansion joints
- Containment passage expansion joints
- Pressure balanced crossover expansion joints
- Metallic & rubber expansion joints for RSW, CWC and CWS

Registered Quality Systems:
- CSA N285.0, B51, CAN3 Z299.3
- ASME B31.1, B31.3
- ASME U Stamp
- ASME NCA4000 NQA-1 NPT Stamp (In Progress)
- ISO 9001:2008
- CRN for all Canadian Provinces

Quality Systems

ASME SGS SA U NPT

Thorburn Flex Inc
173 Oneida, Pointe-Claire, Quebec
Canada, H9R 1A9

Tel: +1-514-695-8710
Fax: +1-514-695-1321
sales@thorburnflex.com

Annulus seal bellows for calandria fuel channel


Fueling machine head separator assemblies


Bellows for snout indexing mechanism


Miniature bellows for fuel rod flask limit switch & rod cup seal


Loop liner tube bellows assemblies


Pressure balanced crossover expansion joints


Containment passage rectangular expansion joints


Main steam penetration gimbal expansion joints


In-line pressure balanced rubber expansion joints

Suppliers' Addresses and Contacts

Aberfoyle Metal Treaters Ltd.
18 Kerr Crescent
Puslinch, Ontario
N0B 2J0
Canada
Contact:
Harry Hall
Tel: 519-763-1120, ext. 223
Email: hhall@aberfoyle-mt.com

Alexander Vacuum Research, Inc.
P.O. Box 589
Greenfield, Massachusetts
01302-0589
USA
Contact:
Daniel Carson
General Manager
Tel: 413-498-9924
Fax: 413-498-9926
Email: avr_inc@verizon.net

AMEC NCL 49
700 University Avenue, 4th Floor
Toronto, Ontario
M5G 1X6
Canada
Contact:
Martin Tulett
Commercial Director
Tel: 416-592-2050
Fax: 416-592-8284
Email:
walter.thompson@amec.com
www.amecncl.com

AMEC NSS 49
700 University Ave, 4th Floor
Toronto, Ontario
M5G 1X6
Canada
Contact:
Martin Tulett
V.P. Commercial Operations
Tel: 416-592-2050
Fax: 416-592-8284
Email: martin.tulett@amec.com
www.amec.com

Ametek HDR Power Systems
3563 Interchange Road
Columbus, Ohio
43204-1400
USA
Contact:
Brad Boldt
Tel: 614-308-5500
Fax: 614-308-5506
Email: brad.boldt@ametek.com
www.hdrpower.com
Representative(s):
Hank Rasanen
Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Tel: 905-871-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hci@idirect.com
www.henrycontrols.com

Ametek Solidstate Controls Inc.
875 Dearborn Drive
Columbus, Ohio
43085
USA
Contact:
Jim Amicon
Tel: 614-846-7500
Fax: 614-885-3990
Email: jim.amicon@ametek.com
www.solidstatecontrols.com
www.nuclearups.com/
Representative(s):
Hank Rasanen, P.Eng.
President
Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Tel: 905-877-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hci@idirect.com
www.henrycontrols.com

ANRIC Enterprises Inc. 18
202 - 701 Evans Ave. Ste. 202
Toronto, Ontario
M9C 1A3
Canada
Contact:
Anne Barnes
Manager
Tel: 416-253-9459, ext. 104
Fax: 416-252-5335
Email: afbarnes@anric.com

Armour Valve Ltd.
126 Milner Ave.
Toronto, Ontario
M1S 3R2
Canada
Contact:
Jennifer Jones
Tel: 416-299-0780, ext. 126
Fax: 416-299-0394
Email: sales@armourvalve.com

ASI Group Ltd. (ASI Marine) 30
250 Martindale Road
St. Catharines, Ontario
L2R 6P9
Canada
Contact:
Carmen Sferraza
Tel: 905-641-0941
Fax: 905-641-1825
Email: carmen@asi-group.com

ATC Nuclear
588 Broadway
Schnectady, New York
12305
USA
Contact:
Brendan Kelly
Tel: 518-612-8945
Fax: 518-382-0283
Email: bkelly@argoturbo.com
www.argoturbo.com
Representative(s):
Hank Rasanen
Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Tel: 905-877-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hci@idirect.com

ATI
1600 NE Old Salem Road
P.O. Box 460
Albany, Oregon
97321
USA
Contact:
Customer Service
Tel: 1-877-777-5140
Fax: 541-967-6977
Email: nuclearenergyinquiries@
atimetals.com

Atlantic Nuclear Services Inc.
P.O. Box 1268, Station A
Fredericton, New Brunswick
E3B 5C8
Canada
Contact:
Keith Scott
President
Tel: 506-458-9552
Fax: 506-451-0525
Email:
KScott@AtlanticNuclear.ca
www.AtlanticNuclear.ca

Suppliers' Addresses and Contacts *continued from page 73*

Automatic Valve
41144 Vincenti Court
Novi, Michigan
48375-1922
USA
Contact:
Todd Hutchins
Tel: 248-474-6700
Fax: 248-474-6732
Email:
toddh@automaticvalve.com
www.automaticvalve.com
Representative(s):
Hank Rasanen, P.Eng.
President
Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Tel: 905-877-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hci@idirect.com
www.henrycontrols.com

Avensys Solutions
422 Consumers Road
Toronto, Ontario
M2J 1P8
Canada
Contact:
Jennifer Loeffler
Tel: 416-499-4421
Fax: 416-499-0816
Email: jloeffler@avensys.com
www.avensyssolutions.com

B.C. Instruments
41 Proctor Road
Schomberg, Ontario
L0G 1T0
Canada
Contact:
Harshad P. Patel, P.Eng
Director/Section Manager
Tel: 905-939-7323, ext. 354
Fax: 905-939-8206
Email:
harshadp@bc-instruments.com
www.bc-instruments.com

Babcock & Wilcox
581 Coronation Blvd.
Cambridge, Ontario
N1R 5V3
Canada
Contact:
Natalie Cutler
Tel: 519-621-2120
Email: nacutler@babcock.com
www.babcock.com/bwc

Cameco Fuel Manufacturing
200 Dorset Street East
Port Hope, Ontario
L1A 3V4
Canada
Contact:
Doug Burton
Manager Marketing, Zirconium
& Reactor Components
Tel: 905-885-4537, ext. 3300
Fax: 905-372-3748
Email:
doug_burton@cameco.com
www.cameco.com
Representative(s):
Celeste Pendlebury
Marketing Manager
Tel: 289-251-2601
Fax: 905-372-3748
Email: celeste_pendlebury@
cameco.com
www.cameco.com

Canadian Nuclear Society 28, 36, 56
655 Bay St., 17th Floor
Toronto, Ontario
M5G 2K4
Canada
Contact:
Bob O'Sullivan
Tel: 416-977-7620
Fax: 416-977-8131
Email: cns-snc@on.aibn.com
www.cns-snc.ca

Canadian Nuclear Workers' Council
244 Eglinton Ave. E.
Toronto, Ontario
M4P 1K2
Canada
Contact:
David Shier
President
Tel: 705 725 3902
Fax: 416-481-7115
Email: dshier@cnwc-cctn.ca
www.cnwc-cctn.ca

Canadian Power Utility Services Limited
155 Rexdale Blvd, Suite 700
Toronto, Ontario
M9W 5Z8
Canada
Contact:
Derek Mori
Vice President
Tel: 416-231-9559, ext. 222
Fax: 416-231-9230
Email: dmori@cpus.ca

Canberra Co.
West 50B Caldari Rd.
Concord, Ontario
L4K 4N8
Canada
Contact:
Scott Laing
Canadian Sales and Service
Manager
Tel: 905-660-5373, ext. 249
Fax: 905-660-9693
Email: scott.laing@canberra.com
www.canberra.com
Representative(s):
Simon Feuiltault
Account Manager
Tel: 905-660-5373, ext. 263
Fax: 905-660-9693
Email:
simon.feuiltault@canberra.com
Brian Agnew
Sr. Account Manager/KAM
Tel: 905-660-5373, ext. 267
Fax: 905-660-9693
Email:
brian.agnew@canberra.com

Candesco.....2
230 Richmond St. West
10th Floor
Toronto, Ontario
M5V 1V6
Canada
Contact:
Katherine Moshonas Cole
General Manager
Tel: 416-585-2552
Fax: 416-585-9559
Email:
katherine.cole@candesco.com
www.candesco.com

Candu Energy Inc. 10
2285 Speakman Drive
Mississauga, Ontario
L5K 1B2
Canada
Contact:
Brian Fehrenbach
Tel: 905-823-9040
Email:
brian.fehrenbach@candu.com
www.candu.com

CCI Thermal Technologies Inc. 31
2721 Plymouth Drive
Oakville, Ontario
L6H 5R5
Canada
Contact:
Alejandro Maldonado
Tel: 905-829-4422
Fax: 905-829-4430
Email:
amaldonado@ccithermal.com

Chempump Division of Teikoku USA
959 Mearns Road
Warminster, Pennsylvania
18974
USA
Contact:
James McDaniel
Contract Administrator
Tel: 267-486-1010
Fax: 267-486-1037
Email:
jmcdaniel@chempump.com
www.chempump.com

Container Products Corporation
P.O. Box 3767
Wilmington, North Carolina
28406
Contact:
John Hollinden
Sales
USA
Tel: (910) 392-6100
Fax: (910) 392-6778
Email: sales@c-p-c.com

CTS North America
P.O. Box 272
Kincardine, Ontario
N2Z 2Y7
Canada
Contact:
Neil Smith
President & CEO
Tel: 519-396-7910
Fax: 519-396-7901
Email: neil.smith@ctsna.ca

Cuttler & Associates Inc.
1781 Medallion Court
Mississauga, Ontario
L5J 2L6
Canada
Contact:
Jerry M. Cuttler
Tel: 416-837-8865
Email: jerrycuttler@rogers.com

E.S. Fox Limited 4
9127 Montrose Road
Niagara Falls, Ontario
L2E 7J9
Canada
Contact:
Zed Janakovic
Sales Vice President
Tel: 905-354-3700, ext. 262
Fax: 905-354-5599
Email: zed.janakovic@esfox.com
www.esfox.com

Eaton Industries (Canada) Company
6175 Kenway Drive
Mississauga, Ontario
L5T 2L3
Canada
Contact:
Gordon Thompson
Tel: 905-364-2908
Fax: 905-542-2321
Email:
gordthompson@eaton.com

Eclipse Scientific
97 Randall Drive
Waterloo, Ontario
N2V 1C5
Canada
Contact:
Robert Ginzel
Tel: 519-886-6717
Fax: 519-886-1102
Email: info@eclipsescientific.com

EcoMetrix Incorporated
6800 Campobello Rd.
Mississauga, Ontario
L5N 2L8
Canada
Contact:
Don Hart
Tel: 905-794-2325, ext. 236
Fax: 905-794-2338
Email: dhart@ecometrix.ca
Representative(s):
Al Shpyth
Innovation Place
Suite 303, 111 Research Drive
Saskatoon, Saskatchewan
S7N 3R2
Canada
Tel: 306-933-3939
Fax: 306-933-3943
Email: ashpyth@ecometrix.ca

Ellwood Quality Steels Company
700 Moravia Street
New Castle, Pennsylvania
16101
USA
Contact:
Gregory J. Manzo
Tel: 724-658-6507
Fax: 724-658-6802
Email: gmanzo@elwd.com

EnergySolutions Canada 34
180 Walker Drive
Brampton, Ontario
L6T 4V8
Canada
Contact:
Bart Campbell
Tel: 613-584-2899
Fax: 613-584-9227
Email:
bpcampbell@energysolutions.com
www.energysolutions.com

Ezeflow Inc.
985, rue André-Liné
Granby, Quebec
J2J 1J6
Canada
Contact:
Jacques Latendresse
President
Tel: 450-375-3575
Fax: 450-375-3772
Toll-Free: 1-800-363-6310
Email: laporte-s@ezeflow.com
www.ezeflow.com

Suppliers' Addresses and Contacts *continued from page 75*

Flowserve Flow Control
1900 South Saunders Street
Raleigh, North Carolina
27603
USA
Contact:
Floyd Bensinger
Sales and Contracts
Tel: 919-831-3200
Fax: 919-831-3369
Email: fbensinger@flowserve.com
www.flowserve.com
Representative(s):
Richard B. Granstrand
Area Sales Manager
Flowserve Corp, FCD
Power Generation Group Sales
12 Moose Horn Road
P.O. Box 318
West Granby, Connecticut
6090
USA
Tel: 860-653-6407
Email:
rgranstrand@flowserve.com
www.flowserve.com

GE Hitachi Nuclear Energy Canada Inc... IFC
1160 Monaghan Rd.
Peterborough, Ontario
K9J 7B5
Canada
Contact:
Mike Gabbani
VP Sales
Tel: 705-748-7944
Fax: 705-748-7338
Cell: 705-760-1288
Email: Mike.Gabbani@ge.com
www.ge.com
Representative(s):
Dale Cosh
Nuclear Sales Manager
Tel: 705-748-7946
Cell: 705-930-3681
Email: Dale.Cosh@ge.com
Edward Genge
Parts Sales Manager Nuclear Services
1160 Monaghan Road
Peterborough, Ontario
K9J 7B5
Canada
Tel: 705-748-7039
Fax: 705-748-7076
Cell: 705-875-8045
Email: edward.genge@ge.com

Hatch-Sargent & Lundy (HSL)
2800 Speakman Drive
Sheridon Science and Tech Park
Mississauga, Ontario
L5K 2R7
Canada
Contact:
Jim Sarvinis
Global Director, Thermal
and Nuclear
Tel: 905-403-3831
Fax: 905-855-8270
Email: jsarvinis@hatch.ca

Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Contact:
Hank Rasanen, P.Eng.
President
Tel: 905-877-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hci@idirect.com

Hitachi Canada 79
301-5750 Explorer Dr.
Mississauga, Ontario
L4W 0A9
Canada
Contact:
Paul Eric Marko
Manager, Instrumentation and
Control Systems
Tel: 905-206-2970
Fax: 905-290-0141
Toll-Free: 1-800-906-4482
ext. 2970
Email: pauleric.marko@hitachi.ca
www.hitachi-hpsca.ca
Representative(s):
Taite Purnell
General Manager
460 10655 Southport Road SW
Calgary, Alberta
T2W 4Y1
Canada
Tel: 403-276-1881, ext. 5265
Fax: 403-278-1810
Toll-Free:
Email: taite.purnell@hitachi.ca
www.hitachi-hpsca.ca

IMI Nuclear/ Newman Hattersley
181 Superior Blvd
Mississauga, Ontario
L5T 2L6
Canada
Contact:
Sorin Necula
Regional Sales Manager
Tel: 647-408-8076
Email: snecula@iminuclear.com

Invensys/Schneider Electric
26561 Rancho Parkway South
Lake Forest, California
92630
USA
Contact:
James Jordan
Nuclear Marketing
Tel: 949-638-8066
Fax: 949-639-1835
Email:
james.jordan@invensys.com

Kanata Electronic Services Limited
20 Baywood Road, Unit 1
Etobicoke, Ontario
M9V 4A8
Canada
Contact:
Ron Stewart
Tel: 416-745-0688
Fax: 416-748-3452
Toll-Free: 1-888-371-KESL
(CAN & USA)
Email: info@kesl.com
www.kesl.com

Kinectrics Inc. 2
800 Kipling Ave.
Toronto, Ontario
M8Z 6C4
Canada
Contact:
Cheryl Tasker-Shaw
Marketing Manager
Tel: 416-207-6000, ext. 5970
Fax: 416-207-6532
Email: cheryl.tasker-shaw@
kinectrics.com
www.kinectrics.com

Laker Energy Products Ltd.
3435 Landmart Road
Burlington, Ontario
L7M 1T4
Canada
Contact:
Mariana Rogalo
Tel: 905-332-3231
Fax: 905-332-7151
Toll-Free: 1-888-375-2537
Email: rogalom@lakerenergy.com
www.lakerenergy.com

Lakeside Process Controls Ltd.
5250 Orbitor Drive
Mississauga, Ontario
L4W 5G7
Canada
Contact:
Eddie Saab
Sales Manager
Tel: 905-629-9340
Fax: 905-629-7185
Email:
eddie.saab@lakesidecontrols.com
www.lakesidecontrols.com

LND Inc. 64, 75
3230 Lawson Blvd.
Oceanside, New York
11572
USA
Contact:
William J. Lehnert
Tel: 516-678-6141
Fax: 516-678-6704
Email: info@lndinc.com
www.lndinc.com

Marsh Instrumentation Ltd.....29
1-1016C Sutton Drive
Burlington, Ontario
L7L 6B8
Canada
Contact:
Ron Bake
Tel: 905-332-1172
Fax: 905-332-1668
Email: rbake@marshinst.com
www.marshinst.com

Marshield-Division of Mars Metal Co.
4140 Morris Drive
Burlington, Ontario
L7L 5L6
Canada
Contact:
David Holden
Sales Manager
Tel: 1-905-637-3862
Fax: 905-637-8841
Toll-Free: 1-800-381-5335
Email: dholden@marsmetal.com

Marubeni Canada Ltd.
40 University Ave., Suite 600
Toronto, Ontario
M5J 1T1
Canada
Contact:
Yasuo Hasebe
Vice President, Machinery & Energy Group
Tel: 416-368-1171, ext. 233
Fax: 416-947-9004
Email:
hasebe-y@ncsa.marubeni.com

McMaster Nuclear Reactor
1280 Main Street West NRB A331
Hamilton, Ontario
L8S 4K1
Canada
Contact:
Christopher Heysel
Director, Nuclear Operations and Facilities
Tel: 905 525-9140, ext. 26223
Fax: 905-524-3994
Email: heyselc@mcmaster.ca
mnr.mcmaster.ca

Metal Improvement Company LLC, a business unit of Curtiss-Wright Surface Technologies
105 Alfred Kuehne Blvd
Brampton, Ontario
L6T 4K3
Canada
Contact:
Brad Hart
Division Manager
Tel: 905-791-8002
Fax: 905-791-4490
Email: brad.hart@cwst.com
www.cwst.com
Representative(s):
Sheamus Doherty
Technical Service Manager
Metal Improvement Company LLC
105 Alfred Kuehne Blvd.
Brampton, Ontario
L6T 4K3
Canada
Tel: 905-791-8002
Fax: 905-791-8002
Cell: 416-894-9353
Email:
sheamus.doherty@cwst.com
www.cwst.com

Mirion Technologies (IST Canada) Inc. 58
465 Dobbie Drive
P.O. Box 970
Cambridge, Ontario
N1R 5X9
Canada
Contact:
Rae A. Watson
Manager - Technical Sales
Tel: 519-623-4880, ext. 210
Fax: 519-623-4686
Cell: 519-497-8340
Email: rwatson@mirion.com
www.mirion.com

National Technical Systems (formerly Wyle Laboratories Inc.)
7800 Highway 20 West
Huntsville, Alabama
35806
USA
Contact:
Greg Mason
Manager, Nuclear Business Development
Tel: 256-716-4283
Email: greg.mason@wyle.com
www.wyle.com
Representative(s):
Hank Rasanen, P.Eng.
Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Tel: 905-877-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hank@henrycontrols.com
www.henrycontrols.com

Niagara Energy Products
4749 Buttrey Street
Niagara Falls, Ontario
L2E 7K7
Canada
Contact:
Robert Dimitrieff
President/G.M.
Tel: 905-371-2500, ext. 233
Fax: 905-371-2235
Email: neprd@vaxxine.com

Niagara Fasteners Inc. 6
6095 Progress Street
P.O. Box 148
Niagara Falls, Ontario
L2E 6S8
Canada
Contact:
Dean Zaniol
President
Tel: 905-356-6887
Fax: 905-356-5747
Toll-Free: 1-800-263-3602
(CAN & US)
Email:
nfsales@niagarafasteners.com
www.niagarafasteners.com

Nova Machine Products INC
18001 Sheldon Road
Middleburg Heights, Ohio
44130
USA
Contact:
Jim Skufca
Tel: 216-898-8024
Email: jskufca@curtisswright.com
nova.cwfc.com
Representative(s):
Dan Harnett
Regional Manager
Toronto, Ontario
Canada
Tel: 416-787-8539
Fax: 416-787-8746
Email:
dharnett@curtisswright.com
nova.cwfc.com
David Stark
Account Executive
Nova Machine Products
18001 Sheldon Road
Middleburg Heights, Ohio
44130
USA
Tel: 216-898-8978
Email: dstark@curtisswright.com
nova.cwfc.com

Nuclear Canada Yearbook
655 Bay St., 17th Floor
Toronto, Ontario
M5G 2K4
Canada
Contact:
Colin Hunt
Publisher and Editor
Tel: 416-977-7620
Fax: 416-977-8131
Cell: 613-220-7607
Email: colin.hunt@rogers.com
www.cns-snc.ca
Representative(s):
Marlene Thomas
Advertising Sales Manager
241 Woburn Avenue
Toronto, Ontario
M5M 1L1
Canada
Tel: 416-482-5511
Fax: 416-482-5512
Email: thomasmcna@aol.com

Suppliers' Addresses and Contacts *continued from page 77*

Nuclear Logistics, Inc. 24

7410 Pebble Drive
Forth Worth, Texas
76118
USA
Contact:
Gerry Waterhouse
SIte Manager
Tel: 905-623-1235
Toll-Free: 1-800-448-4124
Email: gerrywaterhouse@azz.com
www.azz.com/nli
Representative(s):
Brett Hunsley
Account Manager – Bruce Power
AZZ | NLI
7410 Pebble Drive
Fort Worth, Texas
76118
USA
Tel: 905-623-1235
Toll-Free: 800-448-4124
Email: bretthunsley@azz.com
www.azz.com/nli

Nuvia Canada

2359 Royal Windsor Dr., Unit 4
Mississauga, Ontario
L5J 4S9
Canada
Contact:
Arkell Farr
Director, Business Development
Tel: 647-864-6428
Fax: 416-900-6058
Email: info@nuvia-canada.com
www.nuvia-canada.com

Patriot Forge Co. 33

280 Henry Street
Brantford, Ontario
N3T 5S7
Canada
Contact:
Paul Olah
Director of Sales
Tel: 519-758-8100
Fax: 519-756-2041
Toll-Free: 1-877-495-9542
Email: paulo@patriotforge.com
www.patriotforge.com

Power Workers' Union.....32

244 Eglinton Avenue East
Toronto, Ontario
M4P 1K2
Canada
Contact:
Bob Walker
Sector Vice President – Nuclear
Tel: 416-322-2426
Toll-Free: 1-800-858-8798
Email: bwalker@pwu.ca
www.pwu.ca

Promation Nuclear Ltd.

2767 Brighton Rd.
Oakville, Ontario
L6H 6J4
Canada
Contact:
Nagel Reynolds
Director, Business Development
Tel: 905-625-6093, ext. 302
Fax: 905-625-6910
Cell: 647-444-2543
Email:
reynolds.n@promation.com
www.promation.com

Radiation Safety Institute of Canada

165 Ave. Road, Suite 300
Toronto, Ontario
M5R 3S4
Canada
Contact:
Natalia Mozayani
Executive Director
Tel: 416-650-9090, ext. 28
Fax: 416-650-9920
Email:
nmozayani@radiationsafety.ca
www.radiationsafety.ca

RCM Technologies Canada Corp. 26

895 Brock Road South
Pickering, Ontario
L1W 3C1
Canada
Contact:
Danny A. White
S.V.P.
Tel: 905-837-8333, ext. 2111
Fax: 905-837-8248
Cell: 416-452-5250
Email: dan.white@rcmt.com
www.rcmt.ca
www.rcmt.com/

RdF Corporation

23 Elm Avenue
Hudson, New Hampshire
3051
USA
Contact:
Arthur Pearson
Tel: 603-882-5195
Fax: 603-882-6925
Representative(s):
Hank Rasanen, Eng.
Henry Controls Inc.
32 Heslop Court
Georgetown, Ontario
L7G 4J4
Canada
Tel: 905-877-8786
Fax: 905-877-0428
Cell: 416-931-6108
Email: hci@idirect.com
www.henrycontrols.com

Rolls-Royce Civil Nuclear Canada Ltd.

678 Neal Drive, PO Box 1776
Peterborough, Ontario
K9J 7X6
Canada
Contact:
Bill Potter
Business Development
Tel: 705-743-2708
Fax: 705-743-3216
Email: cncinfo@rolls-royce.com
www.rolls-royce.com/nuclear

SENES Consultants Inc.

121 Granton Drive, Unit #12
Richmond Hill, Ontario
L4B 3N4
Canada
Contact:
Leo Lowe
Ph.D., P.Phys., CRadP,
Vice-President, Senior Health
and Environmental Physicist
Tel: 905-764-9380
Fax: 905-764-9386
Email: llowe@senes.ca
www.senes.ca
Representative(s):
Douglas Chambers, Ph.D.
Vice-President, Director of Risk
and Radioactivity Studies
SENES Consultants Limited
121 Granton Drive, Unit 12
Richmond Hill, Ontario
L4B 3N4
Canada
Tel: 905-764-9380
Fax: 905-764-9386
Email: dchambers@senes.ca
www.senes.ca

SIHI Pumps Limited

225 Speedvale Ave. W.
P.O. Box 728
Guelph, Ontario
N1H 6L8
Canada
Contact: Guy Loken, P. Eng.
Quality Manager
Tel: 519-829-4273
Fax: 519-824-7250
Email: mail@sihi.com
WebPage:
http://www.sihi-pumps.com

Special Electronics and Designs Inc.

214 Bruce Avenue
Kincardine, Ontario
N2Z 2P3
Canada
Contact:
Terri Danahy
Tel: 519-396-8555
Fax: 519-396-4045
Email: sales@sed.bz

Structural Integrity Associates Inc 69

11515 Vanstory Drive, Suite 115
Huntersville, North Carolina
28078
USA
Contact:
Bud Auvil
Tel: 1-877-474-7693
Email: bauvil@structint.com

SWI Systemware

2300 Yonge St., Suite 1800
P.O. Box 2418
Toronto, Ontario
M4P 1E4
Canada
Contact:
Ed Mischkot
VP, Energy
Tel: 1-888-366-6632
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Team Industrial Services

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L6L 6R7
Canada
Contact:
Dan Gonzalez
Tel: 905-845-9542, ext. 114
Fax: 905-845-9551
Cell: 905-464-6010
Email:
dan.gonzalez@teaminc.com

Tetra Tech Wei Inc. 62

1055 Squires Beach Road
Pickering, Ontario
L1W 4A6
Canada
Contact:
Ryan DeCairos
Business Development Manager
Tel: 905-686-2810, ext. 224
Fax: 905-686-8560
Cell: 905-599-3939
Email:
Ryan.DeCairos@tetratech.com

Thorburn Flex Inc. 8, 72

173 Oneida Drive
Pointe-Claire, Quebec
H9R 1A9
Canada
Contact:
Robert Thorburn
President
Tel: 514-695-8710
Fax: 514-695-1321
Toll-Free: 1-800-363-6613, ext. 306
Email:
contracts@thorburnflex.com
www.thorburnflex.com

Tyne Engineering Inc.....38

730 Darlene Court
Burlington, Ontario
L7L 5V1
Canada
Contact:
Vince Robinson
Tel: 289-288-0490
Fax: 289-288-0493
Email:
vince.r@tyne-engineering.com
www.tyne-engineering.com

Unitech Services Group

295 Parker St.
Springfield, Massachusetts
C1151
USA
Contact:
Kent Anderson
Tel: 413-543-6911, ext. 126
Fax: 413-543-6989
Email:
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