CANADIAN NUCLEAR SOCIETY

Bulletin

DE LA SOCIÉTÉ NUCLÉAIRE CANADIENNE

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- 31st CNS Annual Conference
- W.B. Lewis Lecture
- Technical Papers
- Honours and Awards

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Governments need a strong safety culture too!

Oil and methane continue to gush into the Gulf of Mexico making it the worst environmental catastrophe in American History. The disaster has reminded us that we continue to rely on this dwindling resource. However, what a lot of people don't realize is how easy it is to lose focus on safety when motivated by production and profit. What BP is now realizing is the enormous cost of NOT focusing on safety. They may not even have the cash to pay for the cleanup, relying on taxpayers to pick up the tab. No doubt BP will be implementing a new safety culture, if they survive at all given the fact that Moody's has degraded BP's rating to junk level.

The well was damaged following an explosion on the Deepwater Horizon drilling platform on April 20 and it sank two days later. Eleven workers were killed in the blast. In a US congressional hearing legislators accused Tony Hayward, BP's CEO, of being evasive and of failing to take responsibility for the spill. Being in the spotlight has also revealed a poor safety record of the oil giant.

Last year the US Occupational Safety and Health Administration found hundreds of violations at BP's refineries in the US. In March 2003, a BP oil rig in Texas, the third largest in the US, exploded killing 15 workers and injuring 170 others. Investigators found shortcomings in their risk management, staff management, equipment problems and inadequate maintenance and inspections. The company promised to improve safety, but in 2009 BP was fined $87 million for failing to implement safety features. BP claimed the explosion was caused by operator error and had fired seven workers.

In August 2006, an Alaskan Pipeline operated by BP failed resulting in a massive oil spill. The failure was caused by pipe corrosion, undetected due to a failure to properly inspect and maintain the facility.

One can only wonder about the other oil companies. Indeed, BP's lack of safety culture has tarnished the entire oil industry. There is now a moratorium on off shore drilling, a sign that a strong safety culture may be missing in US Legislators. It will limit the availability of a precious energy resource that is running low, putting more pressure on Canadians to further develop its tar sands.

Sunrise Propane, which had a long history of safety violations, did not have the cash to pay for the cleanup and reimburse 12,000 people left homeless after their massive explosion in August 2008. Toronto and Ontario taxpayers paid for it.

The massive gas explosion at Kleen Energy, a combined-cycle natural gas fuelled power plant in Middletown, Connecticut, experienced a catastrophic natural gas explosion that caused six deaths and at least 50 injuries. Natural gas was being pushed through the piping at high pressure and high velocity and vented directly to the atmosphere as a means to "clear debris" from the pipes. Apparently that procedure is common and ignition sources need to be removed or controlled. Nevertheless, the electricity was on, welding was underway and diesels were running. It damaged buildings five kilometres away. The Ontario Government is pushing for a similar facility to be built in Oakville, Ontario, to be located within, not five kilometres, but 500 metres away from the nearest residents and schools.

We need a strong safety culture, not just in the nuclear industry, but in all industrial facilities that are responsible to effectively manage a hazard. We need a strong safety culture in Government who make decisions on where hazardous facilities, such as Sunrise Propane and the Oakville Gas-fired electric generator are sited. We need a strong safety culture in Governments who specify safety regulations, operator training, and minimum buffer zones around these facilities. Placing a large gas fired generating station in Oakville, similar to the one that exploded in Connecticut, just 500 metres from the nearest residence, is just plain wrong!

In This Issue

The main event for this edition of the Bulletin is the 31st Annual Conference and Annual General Meeting of the Canadian Nuclear Society, held this year in Montreal. There were over 400 attendees and more than 100 technical papers and several plenary presentations. A summary of the conference is included. Also included in this edition is the W.B. Lewis Lecture delivered by Dr. Daniel Meneley. This lecture has become a tradition for the annual conference.

Two technical papers from the conference have been included, as well as a selection of general news. In the CNS News section there is a report on the Annual General Meeting as well as reports from outgoing president Eleodor Nichita and incoming president Adriaan Buijs. Last but never least is the politically incorrect Endpoint by Jeremy Whitlock.

As always, comments and letters are welcome!

FROM THE PUBLISHER

The past three months have been "interesting" ones for the Society and for me personally.

On the personal front, I have moved from the house in which I lived for over 40 years into an apartment, which ended up much more stressful than I anticipated. The actual move was just days after the Annual Conference. That ridiculous timing was a result of my forgetting the date of the conference and thinking that it was always in June. Although I gave away most of my furniture and painfully discarded more than half of the documents and books accumulated over the years I have ended up with boxes of "stuff" with no place to put it. Maybe when I move again (after another forty years !!) I will learn how to do it intelligently. Any way, if my writings in this issue appear even less logical than usual, I have an excuse.

The Society

The major event over the past few months was the Annual Conference, held this year in Montreal after an absence of over a decade. Organization of the conference was entirely by volunteers, as has been the practice over the years. All of the meetings were by teleconferencing, which is not the easiest way to organize a complex operation. There were times when it appeared that a definite plan would not be achieved but it was and the conference was very successful. As conference chair, our new president, Adriaan Buijs, deserves accolades for this achievement.

Over the first few months of this year the Society's governing Council wrestled with a proposed Strategic Plan prepared by a Working Group and finally adopted it. However, the decision of whether or not to implement it has been referred to the new Council.

The Strategic Plan clarifies the mission and mandate of the Society and proposes special focus on several areas, such as branches and new divisions. Its most contentious proposal, which became the object of most discussion, is the engagement of an Executive Director, initially part-time. That idea has been floating around Council for a couple of years, having been recommended in a report prepared by two members of Council three years ago.

Most members of Council acknowledge that the operation of the Society is becoming a strain on the central core of volunteers. However, there remains a desire to maintain that volunteer focus. If the new Council does proceed with the engagement of an Executive Director, it is recognized that the person taking on that role must know how to work with, engage, and support the volunteers.

Another initiative approved but not yet implemented is the launching of a Canadian Nuclear Journal. The Society did publish a journal 25 years ago but canceled it after four issues because of the cost. That was in print format. The current proposal is for an electronic format which avoids publication costs. The lingering impediment is the need for an editor. Several members have offered to be on an Editorial Board but no one yet has come forth to take on the challenging role of editor. If you feel that you would like to consider this, please contact me, as I currently have the responsibility for implementing the Journal. You could make a significant contribution to the dissemination of Canadian nuclear science and engineering knowledge.

The Canadian nuclear scene

The word "nuclear" has almost disappeared. At a recent forum held by the Energy Council of Canada that was on the Canadian energy scene in general, the speakers included senior political and staff members of Environment Canada and Natural Resources Canada, as well as heads of several energy industry associations. In their reviews of the Canadian energy scene "nuclear" was not mentioned until some questions from the floor elicited a response.

This is reflected in the media. Even the typically extreme anti-nuclear rants have diminished. Neil Alexander, president of the Organization of CANDU Industries, has managed to give a number of talks and to be reported, but he is like a biblical prophet in the wilderness.

While the industry has been silent, we should thank Michael Binder, president of the Canadian Nuclear Safety Commission, who has replied repeatedly in the media to correct erroneous and extreme statements about the safety of nuclear activities in Canada.

The time has come for our Society to be more vocal, publicly. The Education and Communication Committee did hold a Workshop on Education and Outreach just as this issue was going to press and one of the observations was the positive effect of knowledgeable persons speaking to their neighbours or small groups.

The small number of members in Alberta have been very active and, reportedly, quite effective, in the nuclear debate in that province. A thousand voices in Ontario might make a difference.

Fred Boyd

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~ Cover Photo ~

Gentilly-2 Nuclear Generating Station is Canada's first "700" Class CANDU 6.

Photo courtesy of Hydro Québec.

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The Containment Vessel 1st Ring is set at Sanmen Unit 1, China

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Good turnout in Montreal for 31st CNS Annual Conference

by Fred Boyd

There was generally an upbeat atmosphere at the 31st CNS Annual Conference held in Montreal, May 24 - 27, 2010, despite the uncertainty facing the future of the Canadian nuclear program. Over 400 attended the major annual event of the Canadian Nuclear Society, close to that of the past few years.

Because of the national holiday on Monday, May 24, the conference proper began on the Tuesday with the opening reception on the evening of the 24th. There were three half-day plenary sessions with senior speakers and three half days of parallel sessions of technical papers.

Highlights of the conference included the presentation of the Canadian Nuclear Achievement Awards *(see separate article),* an enlarged student poster session, an increased number of exhibitors, the presentation of the W. B. Lewis lecture, this year given by **Dr. Daniel Meneley,** former Chief Engineer at Atomic Energy of Canada Limited, and an excellent dinner at the Belevedere room attached to the Science Centre and overlooking the St. Laurence River. A special technical session was dedicated to the memory of Prof. Daniel Rozon, former dean of École Polytechnique de Montréal.

A positive note was provided on the final day when **William Pilkington,** Senior Vice President and Chief Nuclear Officer at AECL, announced that repairs to NRU vessel had been completed.

CNS outgoing president, **Eleodor (Dorin) Nichita,** opened the conference on the Tuesday morning with greetings, an overview of the program and thanks to the many sponsors and exhibitors whose contribution made the conference possible.

The first plenary session was focused on *New Build and Refurbishment.* Leading off was **Tony De Vuono,** Senior vice President and Chief Technology Officer at AECL. He stated that AECL is offering two products, the ACR 1000 and the Enhanced CANDU 6, with potential markets in Argentina, China, India, Romania and here in Canada. In addition, he noted, all of the existing CANDU units present life-extension opportunities. He mentioned in particular the Chinese interest in using recovered PWR fuel and the test in a Qinshan unit begun in March of 2010. He noted the recent recommendation by a senior Chinese committee for two more CANDU units to use thorium.

Next was **Tom Mitchell,** President and CEO, Ontario Power Generation, who began by stating that whether it is new build or refurbishment it is essential to "get it right". He noted OPG's decision of February 2010 to refurbish the four units of the Darlington station beginning in 2015. OPG has invited "expressions of interest" for the retubing and are erecting a building to house a full-sized mock-up. At the same time it was decided not to refurbish the Pickering B units but to do extensive work to ensure an additional 10 year life.

Completing the first half of the opening plenary was **Gaetan Thomas,** recently named President and CEO of New Brunswick Power, who was the first to run into projector problems. After noting that the Point Lepreau station is a third of the province's generation capacity he pointed out that it had now been down for two years. Stage two of the refurbishment, retubing the reactor, had been scheduled for 13 months. It is now estimated to be 30 months. Among lessons learned was that the radiation protection challenge had been significantly under estimated. Installation of the calandria tubes is nearing completion and the upper feeders have been installed. Refurbishment is not science, he emphasized in closing, saying that a construction mentality is needed.

After the requisite break, **Mike Ruysseveldt,** Director, Business Development, AREVA NP (Canada), spoke about the complete fuel cycle, noting that his company is active in all areas. AREVA predicts building 300 nuclear plants by 2030. Currently, in the USA the Calvert Cliff 3 unit has design certification, the Finnish project is expected to be completed in 2013, Flamanville 3 in France is under construction as are the Taishan 1 and 2 units in China.

Through acquisitions and partnerships AREVA intends to have an integrated manufacturing capability. It has recently purchased Sfarsteel a maker of reactor vessels. He emphasized that a Canadian EPR would have significant Canadian content.

John Roberts, of the University of Manchester, provided an overview of the renewed nuclear program in the United Kingdom. He noted that the UK had a long nuclear history beginning with Calder Hall which started in 1956. Most of the early Magnox reactors have been shutdown but the Advanced Gas-Cooled plants and the Sizewell B PWR unit are still operating. Plans are underway for a large new-build program with Westinghouse and AREVA being the primary contractors.

Closing this opening plenary session was **Claude Drouin,** Director, Centrale Gentilly 2 who focused on the refurbishment plans for his unit. A specific management structure has been created for the refurbishment. Almost half of the pre-engineering has been completed and procurement is underway. The schedule is to start in March 2011 with a target completion date of November 2012.

Following lunch on the first day the W. B. Lewis lecture was presented by Dr. Daniel Meneley. *(The full text of Meneley's address is reprinted in this issue.)*

The afternoon of the first day and the mornings of the second and third days were devoted to the presentation of technical papers in typically six parallel sessions under the following topic headings:

- Process Systems
- Material Properties and Applications
- Education and Outreach
- Physics
- Thermalhydraulics
- Safety Management and Safety Culture
- Plant Life Management and Refurbishment
- Environment and Waste Management
- Advanced Reactors and Applications
- Performance and Environmental Improvements
- Safety and Licensing
- Operation and Maintenance
- Instrumentation and Control
- Radiation and Medical Radionuclide Production

In the late afternoon of the first day the Student Poster Conference was held in the exhibit area along with a wine and cheese reception. Everyone was invited to judge the student posters and many did (while juggling their wine and cheese). After the lunch of the second day the *2010 Canadian Nuclear Achievement Awards* were presented. *(See separate article)*

The second plenary session, held on the afternoon of the second day, was on the subject of *Performance and Environmental Improvements.*

Jill Doucett, Director of Business Excellence at Point Lepreau, began with an overview of the planned organization for Point Lepreau following the refurbishment currently underway. The current management system will be retained but there will be expanded programs for leadership, growth and development for management of both processes and people.

A five-year plan has been developed with targets established. Attrition of the current staff is expected and planned for and there will be integration of the various management systems. In the short term emphasis is on outage and refurbishment support. She stated that it is recognized that there will have to be a mindset transition from the refurbishment phase back into operation. Among key factors that they have learned is the need to engage employees and to simplify communication.

Bill Cooper, Senior Project Manager at AREVA NP (Canada), chose to talk about *Severe Accident Management,* with reference to a recent publication of the International Atomic Energy Agency, IAEA – NS-G-2-15. The approach is to develop management guidance regardless of the probability. He focused on the AREVA Containment Filter Venting System which is now installed at the Point Lepreau station.

A completely different perspective was provided by **Chun Zeng,** Deputy Director Technology at the Third Qinshan Nuclear Power Company in China. He noted first that TQNPC is a subsidiary of the China National Nuclear Company, the biggest nuclear company in China, which is in the entire fuel cycle including uranium mining, fuel manufacturing, design and reprocessing.

Currently, he said, China has 11 nuclear plants in operation, 22 under construction and 17 in planning. All of those, except the two CANDU units at Qinshan are PWRs. The CANDU units complement PWR, he noted, with plans to recycle PWR fuel. They are also exploring the use of thorium and loaded test bundles in one of the Qinshan CANDU units last fall.

The final speaker of this session was **John Froats,** President of the CANDU Owners Group (COG), who spoke on *Enhancing Performance through Collaboration.* In the 1980s, he commented, the business model was to cut costs, which had serious results. The TMI and Chernobyl events led to the creation of INPO (International Nuclear Power Owners) and WANO (World Association of Nuclear Operators) which recognized that a problem at any plant was a problem at all. The programs developed by INPO and WANO improved operation markedly but there was no similar development for design or construction. Collaboration through COG has provided "leverage", he stated, giving an example of the development of shut-off rod motors that cut the cost by a factor of ten.

The luncheon speaker on the third day was **Dr. John Roots,** Director, NRC-Canadian Neutron Beam Centre, which is based at the NRU reactor at the Chalk River Laboratory. He began by noting that Dr. John McDougall was appointed as the new president of the National Research Council in April 2010. The Neutron Beam Centre uses neutrons from NRU to conduct research of materials. Funding is 50% NC, 30% NSERC and about 15% from industry for cost-recovery research.

There are two lines of research being conducted, materials and nano films. A facility for research on nano solutions is being developed. Unfortunately, he noted, NRU does not have a facility to provide "cold" neutrons.

The final plenary session began with a presentation by **Michael Binder,** President of the Canadian Nuclear Safety Commission, who began with his often-repeated comment that the CNSC "regulates everything". The focus is on clarity of requirements and capacity for action. He noted that the CNSC has been conducting [paper] research on topics such as ageing of materials, behaviour of tritium, security, epidemiology of radiation effects. New documents have recently been issued on the CNSC approach to small reactors.

Regarding isotopes he emphasized that the CNSC mandate was safety not supply. Nevertheless the agency has clarified the relationship with AECL regarding NRU and is prepared to be flexible about the timing of the restart of the reactor. However, he noted, the Commission is required to give 16 days public notice of a Hearing.

Carrying on the isotope theme, **Dr. Jean-Luc Urbain,** President of the Canadian Association of Nuclear Medicine, referred to what has been called "Canada's Isotope Crisis". With a number of detailed slides he described the progression of cancer diagnosis with six stages to manifestation.

On a global scale there are about 35 million nuclear medicine procedures conducted every year of which 80 % use Molybdenum 99 / Technetium 99m. That involves 12,000 "6-day curies" per week. Half of that is in the USA.

The final speaker was **Bill Pilkington,** Senior Vice-President and Chief Nuclear Officer for Atomic Energy of Limited, who provided an overview of the current shutdown of the NRU reactor and the plan for its return to service.

NRU was shutdown on May 15, 2009, he reminded the audience, when a leak was discovered from the reactor vessel. The leak (or leaks) were at the bottom of the nine-metre high vessel and accessible only through small openings on the top deck. Ingenious tools were developed to inspect then repair the leaking areas of the vessel by the combined method of weld build-up and weld replacement. He reported that the welding was now essentially completed and that the restart of the reactor was expected to be possible in July 2010. He referred the audience to the excellent special website that had been developed to provide on-going information to the public.

The conference was organized by a committee of volunteers chaired by (then) CNS Vice-President Adriaan Buijs which conducted all of its planning meetings by teleconferencing. Ben Rouben served as vice-chair and made all of the hotel arrangments. Ken Smith was the treasurer; Marc-Antoine Petrilli chair of the plenary program and Wei Shen and Guy Marleau co-chairs of the technical program.

Eric Williams and Frank Doyle shared the all important sponsorship task. Sponsors were: AECL; AECON; AMEC; ANRIC; AREVA; Atlantic Nuclear; Babcock & Wilcox Canada; Black & McDonald; BPR Engineering; Bruce Power; Cameco; CNA; Comstock; Dessau; E.S.Fox; Ganotec; GE Hitachi; Genivar; Hitachi; HSL Nuclear' Hydro Québec; Ian Martin; Kinectrics; NB Power; NLI; Nucleonex; OPG; Oxand; Power Workers' Union; SNC-Lavalin Nuclear; Wardrop; Westinghouse.

All of the technical papers and the PowerPoint versions of the plenary presentations will be on the conference CD which will be available from the CNS office.

The 2011 CNS Annual Conference will be held in Niagara Falls, Ontario in June 2011.

Canadian Nuclear Achievement Awards

2010 Award Winners Honoured at Annual Conference

A special ceremony was held after the luncheon on the second day of the 2010 CNS Annual Conference to honour a number of members of the Canadian nuclear community for their significant contributions to the Canadian nuclear program. The award program is a joint effort of the Canadian Nuclear Society and the Canadian Nuclear Association.

Following are the award winners with the citation accompanying their award.

W. B. Lewis Medal -Guy Marleau

The W. B. Lewis Medal was established in 1973 by the Canadian Nuclear Association to recognize a Canadian scientist or engineer who has demonstrated a leel of technicla comeptence and accomlishment as exemplified by Dr. W. B. Lewis duiring his involvement in the Canadian nucler energy program from 1946 to 1973.

This year's recipient was **Professor Guy Marleau,** Director of l'Institut de génie nucléaire de l'École Polytechnique de Montréal.

Citation

Le Professeur Marleau a contribué de façon majeure à l'avancement de la science nucléaire au Canada. Un expert en théorie de transport des neutrons, le Professeur Marleau a développé le logiciel de cellules DRAGON en collaboration avec d'autres professeurs et chercheurs, en particulier les Professeurs Alain Hébert et Robert Roy. DRAGON est un logiciel scientifique important, utilisé partout dans le monde pour les calculs déterministes en transport des neutrons dans des modéles à géométrie complexe en trois dimensions, dans tous genres de réacteurs nucléaires. Les travaux du Professeur Marleau dédiés à la vérification, la validation et la qualification de DRAGON ont contribué à l'inclusion de DRAGON dans la liste des « outils unifiés » de l'industrie nucléaire au Canada. Les contributions du Professeur Marleau en recherche continuent dans le développement de modèles avancés de calculs en théorie des perturbations, qui représentent un atout puissant dans l'évaluation des incertitudes de calculs et autres applications.

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Wayne Robbins, CNA Chairman, presents a plaque to Guy Marleau to accompany the W. B. Lewis Medal, at the CNS / CNA Honours and Awards ceremony in Montreal, 26 May 2010.

En plus, le Professeur Marleau a formé un grand nombre d'étudiants à l'École Polytechnique au cours des ans, et a contribué ainsi à augmenter le nombre de personnel hautement qualifié dans la communauté nucléaire canadienne et internationale.

Tout au long de sa carrière, le Dr. Marleau a démontré le niveau de compétence technique et de réalisations majeures dans son domaine qui avait été exemplifié par le Dr. Lewis dans ses contributions au programme canadien en énergie nucléaire.

Ian McRae Award - Ken Nash

The Ian McRae Award was established by the CNA in 1976 in honour of Ian McRae the first president of the Association to honour an individual for substantive contributions other than scientific to the advancement of nuclear energy in Canada.

Citation

After starting his career at British Nuclear Fuels, Ken joined Ontario Hydro in 1981. He worked in radioactive materials management, site support services, and financial planning. In 1998 he was appointed to the position of Senior Vice President following the formation of Ontario Power Generation. While at OPG, Ken led the program for managing low- and intermediate-level waste; that facility is now in the licensing approval phase. He was instrumental in establishment of the national Nuclear Waste Management Organization, which he now leads. The next step, the search for a permanent disposal site for used fuel, is about to begin under Ken's able leadership. Ken Nash and his associates also have succeeded in establishing funding instruments for long-term management of radioactive wastes, following the requirements of the Nuclear Fuel Waste Act.

Ken Nash (R) receives the plaque accompanying the Ian McRae Award from Wayne Robbins, CNA Chairman, at the CNS / CNA Honours and Awards ceremony in Montreal, 26 May 2010.

Outstanding Contribution Award

The Outstanding Contribution Award was established in1989 by the Canadian Nuclear Association to recognize Canadian-based individuals, organizations or parts of organizations that have made significant contributions in the nuclear field either technical or non-technical.

Two awards were made for 2010.

The operations staff, past and present, of the ZED-2 research reactor

Many dedicated staff at AECL Chalk River Laboratories have successfully and safely operated the ZED-2 research reactor since it first achieved criticality on September 7, 1960. It is now celebrating its 50th anniversary.

As a zero-energy heavy-water research reactor, ZED-2 has been a versatile and unique test bed for understanding the physics behaviour of various lattice and fuel designs that have contributed to the development of the CANDU power reactor.

In addition, physics tests were performed in ZED-2 to develop alternative fuels, coolants, fuel bundle designs, and other innovations. Today, experiments are being performed in ZED-2 to support the design of the ACR-1000 reactor, while supporting the safe operation of the current CANDU fleet.

Behind every successful research facility is a dedicated team, operating the facility safely and collecting vital data. The members of ZED-2's operating staff, past and present, have provided invaluable service to the Canadian nuclear industry for half a century. Those named were: Julian Atfield, Del Celli, Greg Cully, Paul Ferrigan, Debbie Goldberg, Dave Grice, David Irish, Rick Jones,Jerry McPhee, Chas Millar, Alex Rauket, Brock Sanderson, Ken Thomson, Bruce Wilkin, Mike Zeller *(photograph not available)*.

The Leadership Team of Ontario Power Generation's Nuclear Training Division

Ontario Power Generation's (OPG's) Nuclear Training Division Leadership Team includes Frank Howie, Jamie Chevers, Mary Duarte, Silviu Idita, Murray Hoggart, Jeff Schaefer, Greg Cornett, Carmelina Sagherian and David Charette. This group set up OPG's 2007-2009 Nuclear Training Improvement Plan to aggressively address areas for improvement identified during the 2007 Darlington Station Assessment.

The team conducted extensive industry benchmarking, fol-

OPG Nuclear Training Leadership Team.

lowed by developing and executing OPG's Nuclear Training Performance Improvement Plan to implement and institutionalize industry-best training techniques and strategies. This served to systematically and significantly strengthen OPG's core Nuclear Training Programs, and successfully re-establish a solid Systematic Approach to Training (SAT) foundation for all the training programs.

In November 2009 the World Association of Nuclear Operators (WANO) conducted an International Plant Evaluation at the Darlington Nuclear Site. OPG was awarded a WANO Strength for achieving high levels of effective line management involvement with and ownership of the nuclear training programs to achieve improved workforce performance in the nuclear station.

Fellow of the Canadian Nuclear Society

The category of *fellows of the Canadian Nuclear Society* was established in 1993 to acknowledge extensive contributions to the Society and meritorious service to the nuclear field in Canada.

Two members were name Fellows for 2010

Jadranka (Jad) Popovic

Jad Popovic is a long-standing member of the CNS and a Council member for over ten years. She is Chair of the CNS Interface Committee with Women in Nuclear (WiN) Canada. She has helped in organizing CNS conferences, mentored CNS and WiN members in nuclear education and professional development, participated in science fairs and science camps for children, and visited schools to promote subjects related to nuclear science.

Jad has Master's and Bachelor's degrees in Electrical Engineering and over 33 years of work experience with AECL. She held various design, supervisory and Section Head positions in control and instrumentation disciplines. She participated in the establishment of Canadian and International standards and applications of nuclear quality assurance for automation, control centre design and operator interface.

Jad was also Technical Consultant to the Electric Power Research Institute in California, supplying guidelines for digital control and safety systems operations for US nuclear generating stations and was involved in the implementation of digital feedwater control systems in two US plants.

Morgan Brown

Morgan Brown has made significant contributions to the Canadian Nuclear Society, especially in developing the Society's website over a period of seven years. As webmaster he created a remarkable history of the Canadian nuclear program. He also served as Chair of the Manitoba Branch, and subsequently Chair of the Chalk River Branch of the Society.

In a related area he was Chair of the Manitoba section of the Deep River Science Academy for several years. His other community involvement has included leadership in the Scout movement, chairing the Cooperative Daycare and the Recycling Program in Pinawa, and extensive volunteering in many other activities.

Morgan Brown has contributed significantly to the Canadian nuclear program through his work as a research engineer in severe-accident analysis

R. E. Jervis Award

The R. E. Jervis Award recognizes excellence in research and development carried out by a full-time graduate student in nuclear engineering or related field. It was established in 1992 by former students of Prof. Robert Jervis of the University of Toronto to honour his achievements. It is now sponsored and administrated by the Canadian Nuclear Society. This year's recipient is Aba Mortley of the Royal Military College.

Aba Mortley

Ms. Aba Mortley has successfully completed an eight-year graduate research program on addressing the issue of radioactive waste management, concentrating on the design of containers intended to isolate radioactive materials from the biosphere for several centuries. She first demonstrated the suitability of Inter-Penetrating Network (IPN) polymers for the fabrication of low-level waste (LLW) containers.

Then, through her highly skilled and patient Ph.D. research, she demonstrated that Castor Oil Polyurethanes (COPUs) can indeed resist simultaneous aggression by ground water at various pHs at high temperature and by a mixed radiation field produced by the SLOWPOKE-2 nuclear reactor at RMC. COPUs

can be used as coating materials to protect from corrosion the copper selected for the fabrication of spent CANDU nuclear fuel disposal containers. Her DND- and NSERC-supported research not only revealed a rare case of dose-rate dependence for properties of inert materials, but indeed represents a very important contribution toward the implementation of a sound nuclear waste management technology.

President's Award

Conceived during the reign of Jerry Cuttler (1995 -1996) and implemented the following year by Hong Huynh, the President's Award is given soley at the distrection of the current president of the CNS.

The award has been given only three times previously. This year Dorin Nichita decided to give it twice, to related recipients.

The first was a group award to the **Insitut de genie nucléaire de École Polytechnique de Montréal.**

Following is his citation.

The Institut de génie nucl´aire (IGN) at Ecole Polytechnique de Montréal has been a major contributor to the Canadian nuclear program trough invaluable research, the creation of industry-standard codes and the formation of countless nuclear specialists through its graduate program in nuclear engineering.

The IGN was founded in 1970 through the efforts of Wladimir Paskievici, who was instrumental in securing a $300,000 grant from the Québec government for its creation. The graduate program was approved by Université de Montréal with the help of industrial partners AECL and Hydro-Québec. The IGN subcritical assembly was commissioned the same year.

The first director of the IGN was Laurent Amyot, who led the efforts for the creation, in 1981, of the Groupe D'Analyse Nucléaire (GAN) in collaboration with Hydro-Québec and AECL. With the departure of L. Amyot in 1981, W. Paskievici became Director of the IGN and the GAN, and Daniel Rozon became Assistant Director of the IGN.

In 1984, Altan Tapucu became Director of IGN and Daniel Rozon became Director of the GAN. In 1988 part of the GAN's commercial activities were transferred to the private sector and its research activities were re-integrated into the IGN. Since 2001 the IGN has been affiliated with the Engineering Physics Department, led by Daniel Rozon until his retirement in 2006. In 2001 the direction of the IGN was taken by Jean Koclas who was succeeded, in 2007, by the IGN's current director, Guy Marleau.

Members of the current staff of the Institut de génie nucléaire.

From its inception to this day, the IGN has played a leading role in the Canadian Nuclear Industry.

Nichita's second President's Award was to the founder of the Institut de génie nucléaire, **Wladimir Paskievici.**

Following is the citation.

Professor Paskievici is the founder of the Institut de génie nucléaire at École Polytechnique de Montréal. He began his long and distinguished career in 1958 in the Engineering Physics department at École Polytechnique, where he became Associate Professor in 1963, the same year his research interests became centered on nuclear engineering.

Between 1967 and 1970 he prepared the development plan for an independent "Institut de génie nucléaire" (IGN) to provide training for graduate students in this field, and was instrumental in securing a $300,000 grant from the Québec government for the creation of the IGN. The IGN was officially founded in 1970 and its graduate program was approved by Université de Montréal with the help of industrial partners AECL and Hydro-Québec. The IGN subcritical assembly was commissioned the same year.

Prof. Paskievici continued his work within the IGN, focusing on space-time dynamics of reactors, the economics of nuclear energy, and nuclear safety. In 1981 he became the director of IGN and, the next year, also director of the Groupe D'Analyse Nucléaire (GAN), positions he held until 1984, when he became Director of research and graduate studies at École Polytechnique, a position he would hold until his retirement in 1990. As a member of the education committee of the Canadian Nuclear Association, Prof. Paskievici co-authored the report that resulted in the creation, in 1979, of the Canadian Nuclear Society.

Wladimir Paskievici (L) poses with CNS President Dorin Nichita after receiving the Predient's Award at the Honours and Awards ceremony during the CNS Conference in Monteal 26 May 2010.

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Nuclear Energy in This Century – A Bird in the Hand

[Ed. Note: Dan Meneley, Engineer Emeritus, AECL, Adjunct Professor, UOIT, presented the W.B. Lewis Lecture at the 2010 Annual Conference of the Canadian Nuclear Society. It is reproduced here.]

Abstract

This presentation reviews the past half-century of nuclear energy from one person's point of view, fully recognizing likely errors in fact and perception. It also takes a look at the coming 50 years of our enterprise. The future will demand a lot from nuclear technology, given the decline in the availability of cheap fossil fuels and the expected rising need for energy. We can supply safe and reliable energy for thousands of years, if such is necessary. Uncertainty remains in the short term regarding the support of the people and of the governments who serve them.

1. Introduction

My surprise at being asked to present this lecture soon gave way to concern about finding something useful to say on this occasion. So, I looked back to the papers written by two distinguished lecturers in this series dedicated to the memory of Dr. W. Bennett Lewis. There I found my answer. In June 2008 Dr. John Cowan, then principal of the Royal Military College of Canada, made a strong case for a truly liberal education as the necessary basis for the growth and maturing of a modern military officer. In 2009, Dr. David Torgerson, Emeritus Senior Technology Officer at AECL, presented an excellent description of some of the scientific opportunities ahead of us in the future of this great world energy enterprise.

At the end of my 50-plus years working in the nuclear industry, mostly as an engineer, it may be useful to review the past half-century of our progress as a possible guide to the future. Underlying this choice is my firm belief that three components are essential to our future success; namely, science, engineering, and sociology – this last in the broadest sense of that term.

Before going further I would like to mention a new award in Dr. Lewis' honor, established by the American Nuclear Society in 2006. The accompanying citation reads: "This award recognizes persons who have made major lifetime contributions in nuclear science and engineering toward minimizing the environmental footprint, attaining long-term global sustainable energy and development, and having shown great foresight in elucidating these goals." Dr. Lewis worked toward sustainable energy long before this term was invented. (This year's recipient of the award will be Dr. Georges Vendryes, a French pioneer in fast reactor research and development.

To recognize the sterling achievements of Dr. Lewis and all of the thousands of able scientists, engineers, and technologists who created the system, the last part of my title "A BIRD IN THE HAND" is symbolic of existing CANDU power plants. Whatever else happens, Canadians can be justly proud of the CANDU and all that it can do. Is it perfect? Of course not, but is it better than 48 out of 50 other design concepts? Yes, it is. Is it just as good as the other two modern reactor types that have reached commercial maturity? You bet!

As for the first part of the title, "NUCLEAR ENERGY IN THIS CENTURY", the phrase is meant to convey immediacy, and a real sense of urgency. Fatih Birol, chief economist of the International Energy Agency of the OECD, strongly reminds its member nations:

> "One day we will run out of oil, it is not today or tomorrow, but one day we will run out of oil and we have to leave oil before oil leaves us, and we have to prepare ourselves for that day. The earlier we start, the better, because all of our economic and social system is based on oil, so to change from that will take a lot of time and a lot of money and we should take this issue very seriously".

At the same time the world can take comfort in the fact that there is enough nuclear fuel available to supply us with energy for thousands of years. Once again we are fortunate to have "A bird in the hand" in the form of nuclear technology. Our descendants may well invent a better way to meet this need – but just in case they do not, we know that nuclear fission energy can do the job. I expect that a diverse suite of alternative sources will persist over time in niche markets, but that nuclear energy will provide the bulk of the world's supply for a very long time. We must do the heavy lifting!

Many of us have spent decades working in the nuclear industry. Most of our time has been spent with our figurative noses to the grindstone, working away at this or that technical task. By and large we have done our jobs with enthusiasm – and our efforts have been blessed with a good measure of success. What we did not always carefully note was a dark cloud of suspicion of our venture that built up in the community around us, fostered skillfully by radicals of various sorts and motivations. I will come back to this subject a bit later on.

2. The Need

Of course, it would be pointless to be doing any of this work if there were no need for the product, electrical energy. In making

this statement I draw a fine line of distinction between science and engineering. In the former case a lack of apparent need is irrelevant to the question of whether or not to follow a certain line of investigation. In contrast, the professional practice of engineering exists solely to satisfy the needs of at least some part of society. The engineer's task in this case is to provide energy to the world; national boundaries mean nothing to this responsibility. It is a global task.

The world is entering a major energy transition. Oil prices are fluctuating on international markets as costs of production increase and as producing countries restrict exports to retain domestic supplies within their own economy. The modern hypothesis of man-made global warming results in worldwide concern about the use of all fossil fuels. At the same time, especially in developing countries, the need for oil is increasing as economies expand. (The recent world recession has put a kink into this growth pattern, but it now seems to be ending.) Apparently, we need a new primary energy resource that can be utilized on a scale comparable to that of oil. It is obvious as well that this new resource must be safe, reliable, and must not cause substantive damage to the earth's environment.

Each year the International Energy Agency of the OECD publishes a report titled "World Energy Outlook" [1]. The latest issue of their report presents a sobering picture in their reference scenario, which follows the expected trajectory of world energy development over the next 20 years, assuming that world governments make no changes to their existing policies and measures for energy supply. This scenario is dominated by large increases in demand for fossil fuels, extensive exploration, and consequent large capital requirements. The expected total investment requirement is 26 trillion dollars up to 2030. The power sector requires 53% of this total. Reference 1 concludes that:

> **"Continuing on today's energy path, without any change in government policy, would mean rapidly increasing dependence on fossil fuels, with alarming consequences for climate change and energy security."**

For the past several years the IEA has urged OECD governments to increase their commitment to nuclear energy. Most countries of the world show signs of taking up this challenge, with the surprising exception of the OECD countries themselves. In both Europe and North America the response is half-hearted at best, up to now. The IEA report notes the following:

> "The main driver of demand for coal and gas is the inexorable growth in energy needs for power generation. World electricity demand is projected to grow at an annual rate of 2.5% to 2030. Over 80% of the growth takes place in non-OECD countries. Globally, additions to power-generation capacity total 4,800 gigawatts by 2030 – almost five times the existing capacity of the United States. The largest additions (around 28% of the total) occur in China. Coal remains the backbone fuel of the power sector, its share of the global generation mix rising by three percentage points to 44% in 2030. Nuclear power grows in all major regions ***bar Europe,*** but its share in total generation falls."

The underlying driver of this demand growth usually is, of course, the rise in world population – energy demand growth is a consequence of this seemingly uncontrollable factor. At the present time, however, it seems that much growth arises from the need (or at least the desire) of underdeveloped countries to increase their standard of living. Any energy policy must be coupled with stabilization of the world population along with raising of living standards. A sustainable level of energy supply is a necessary prerequisite if we are to provide a respectable living standard for all people.

3. Meeting the Need

In its 2009-2030 alternative (preferred) scenario, called the "450 Scenario" to highlight a target of 450 parts per million concentration of carbon dioxide in the atmosphere, the IEA points out that

> "Power generation accounts for more than two-thirds of the savings (of which 40% results from lower electricity demand). There is a big shift in the mix of fuels and technologies: coal-based generation is reduced by half, compared with the Reference Scenario in 2030, while nuclear power and [*other*] renewable energy sources make much bigger contributions."

Three points are notable in this statement. First, I have inserted the word "other" in square brackets to emphasize the now-recognized fact that nuclear fuels are inexhaustible within the expected duration of human life on earth, and so this energy source must be included in the "renewable" category. Second, the hoped-for amount of demand reduction due to conservation in the electricity sector is very large – a most optimistic projection, given past performance. The third item of note is the imminent approach of the year 2030. There is very little time left for our world to adapt to the coming collapse of the present-day climate in which petroleum is relatively plentiful and cheap. It is quite apparent that someone must repay the tens of trillions of dollars that must be invested in oil supply development to ensure supply of oil up to 2030. It also leaves a big question as to what we might expect to happen during the following quarter-century. For a rather gloomy guesstimate of the upcoming situation, see the apocalyptic prediction in the book "The Long Emergency", by James Howard Kunstler [2].

Accepting the IEA estimate of "new build" generation capacity requirements up to 2030, and then assuming that all these new plants will be powered by uranium, we will need to build 240 nuclear units each of capacity 1 gigawatt every year between now and 2030. This ideal situation will not be realized, of course, but the number certainly provides a "stretch" target for new nuclear plant construction. Once again, with reference to the IEA alternative scenario, there is another challenge implied – the provision of transportation fuels. This additional challenge is addressed in the next section of this paper.

Where else could we get this massive energy supply? Dr. Charles Till, retired Deputy Director of

Argonne National Laboratory [3] reaches the following conclusion:

Figure 1 – Energy Options

Source	What's Available?	How Much?
Oil Natural Gas Coal Geothermal	Derived from stored solar energy plus the decay of radioactive materials in the earth. Half of available oil has already been used.	0.4 yotta (1024) Joules Coal is the largest source.
Hydro Wind Solar Tidal Biomass	Derived from direct solar (fusion) or from earth's and moon's kinetic energy. Diffuse and limited in either total capacity or achievable extraction rate.	3.8 yotta (1024) Joules per year. Approximately the same amount of energy is radiated to space per year.
Uranium Thorium	Derived from the explosion of a supernova, some 6.5 billion years ago. Inexhaustible total capacity and widespread availability. High potential extraction rate.	>320 yotta Joules Uranium in seawater is the largest source.

> "To sum up, the alternatives to fossil fuels that could promise the magnitudes of energy required to meet our nation's need are very, very few. It is not as though plentiful alternatives exist, and one can be weighed against another … "
>
> "The blunt fact is that there are the fossil fuels and there is nuclear."
>
> "Failure to recognize this, while focusing on options that do not and cannot have the magnitudes [of supply] required, will inevitably lead to increasingly dangerous energy shortages. Who then will answer? Will [it be] the environmental activist, who blocks real options, and then puts forth options that cannot meet the need?"

Who else indeed? Will it be the politician who is ready to subsidize unsustainable shortterm solutions and who forever plans for his re-election, carefully deferring difficult decisions until after that happy day? Not likely.

My conclusion is that the engineer will answer, based on past history. More generally, it is the organization that people really expect to deliver the goods – usually the electrical utility or other operating organization. Because of the long time scale of these decisions and their consequent good or bad impact on society, the politicians get away with no need to answer to anyone. As Rudyard Kipling wrote, the Sons of Martha must answer the people, and the Sons of Mary go free. [4].

Nuclear energy is similar to both the oil industry and coal industry, in terms of the time scale involved. Exploration, development and market delivery times are much longer than political cycles. Only real statesmen can and do listen to recommendations whose consequences lie further in the future than the next round of the election cycle.

4, The Problem of Scale

In the study of energy supply, both resource magnitude and achievable rate of extraction must be considered. For example, the sun provides us with a huge amount of energy, but this energy is spread over the whole earth and it oscillates down to zero daily. We should, of course, be very grateful to the sun for what it does well – it sustains the earth's temperature at a level 300 degrees higher than surrounding space. Without it we would not exist.

Figure 1 shows all of our primary energy options. Among the options that are concentrated and

thereby easily collected, by far the largest energy potential is from coal or uranium. Figure 2 compares nuclear and coal (this Figure is a summary of a summary taken from a larger work in process of publication, with permission of the authors.) Wind is included here to show the best of the diffuse options – and the most popular today. Its primary disadvantage is its highly variable nature, which must be compensated for by either backup sources or by major energy storage facilities.

Coal suffers from an extraction rate limit as well as uneven distribution of deposits – thereby causing transportation difficulty in some areas. Nuclear fission energy is the clear choice. Nuclear energy is concentrated and so has only minor transportation problems for either fresh fuel or for used fuel. In addition, this fuel is inexhaustible [5].

Figure 3 illustrates the very large quantities of fuel available from nuclear energy. Using today's technology (thermal reactors) along with the 2005 total world energy usage, we see that at least 40 years of fuel supply are assured. Assuming a reasonable rate of exploration and tolerable increases in fuel price, at least 300 years of fuel supply most likely is available from only uranium. Accounting for thorium fuel supply probably would double the amount shown here.

Fast reactors apparently are necessary to extend nuclear fuel availability in time, to well beyond the horizon of human existence. It is not practical to mine uranium from seawater to fuel thermal reactors, because of the very large required extraction rate. Fast reactors do not suffer from this drawback, however, because a one-gigawatt electric unit requires only 2 tons of makeup uranium per year. This makeup fuel also can be obtained

Figure 2 - Resources Consumed per Gigawatt of Production Capacity

Type of power plant	No. of units, land area	Fuel Required per year	Solid Waste tons/year	Gaseous Waste, incl. GHGs	Availability (%)	Cost US$ / MWh	Lifetime (yrs)
Nuclear (LWR)	One or two units, small area	20 tons uranium dioxide	1 ton fission products in ~15 tons HLW	No CO2 or other GHGs during operation	~ 90	45 - 120	>60
Coal	One or two units, small area	~ 4 million metric tons of coal	~ 0.4 million tons of ash	~ 13 million metric tons of CO2	~ 80	30- 90	~ 30
Wind	5,000 units, 1 Mwe each (area 450 km2)	~ 1.6 x 109 m3 nat. gas (backup)	Depends on type of backup power	Depends on type of backup power	20-35	120 - 220	~15

Figure 3 NUCLEAR FUEL QUANTITIES POTENTIALLY AVAILABLE FOR USE

Sources of Uranium and Thorium		Resources (thousands of tonnes)	Exajoules (Thermal Reactors)	Exajoules (Fast Reactors)
U	WNN, 2008	5,500	2750	437,000
U	[Metz, 2000]	15,400	7700	1,223,000
U	Used Fuel	2,000	—	160,000
U+Pu	Surplus Military	Small	—	Small
U	Phosphate Deposits	20,000	10,000	1,600,000
U	Dissolved in Seawater	4,400,000	—	317,800,000
Th	[IAEA TECDOC 412]	1,160 (low?)	600	95,300
NOTE: World Primary Energy Use in 2005: 457 Exajoules				

from dilute ore deposits, from the ocean, or from depleted uranium from enrichment plants. This huge diversity of fuel sources arises because of the very large amount of potential energy in each unit of natural uranium or thorium.

5. The Challenge

It may seem that the biggest challenge facing today's nuclear industry is the task of building more than 200 large nuclear units per year. This task certainly is large and filled with questions such as finding appropriate building sites for all those plants, acquiring all the steel, cement and other commodities necessary to get the job done, and many other items – to say nothing of accumulating all the capital necessary to get the job done. But the world nuclear industry has, after all, done this once already from a standing start with an inventory of zero commercial plants existing in the beginning. We now have three mature power plant concepts (PWR, BWR, PHWR), plus a fourth (the FBR) that is ready to meet the long-term challenge. Perhaps more importantly, having built a few dozen prototypes of different design, we now should know what does NOT work. It is important to study and remember these lessons.

Today we have the lessons of nearly five hundred operating commercial stations to back us up. We have greatly improved knowledge of the technology as well as excellent computer models of the hardware and the processes involved. We have a large group of people well versed in all the essential steps from research to waste disposal.

One of the largest technical tasks ahead of us is to reduce the volume of hydrocarbons required for transportation. Either gasoline and diesel must be replaced by electricity or hydrogen [6] or synthetic hydrocarbons must be produced. This will require an increase in nuclear capacity. North American cities in particular require people to drive personal automobiles. Plug-in hybrid or electric cars and electricity will be needed offset today's demand for gasoline and natural gas.

In these hundreds of 'new build' nuclear projects we see a challenge that is almost completely one of scale. This is not an R&D task. This is nation building - pure, but not so simple. We have all the tools in hand. If we cannot do this job correctly we must look to fundamental causes other than the technology, and correct them – fast. There is little time remaining.

The most immediate and pressing challenge lies in the field of government support and, at a broader level, in the issue of public acceptance. This is so in spite of nuclear energy enjoying the support of 60 to 80 percent of the general public. A vocal minority of opponents command disproportionate influence over the

actions of our governments. The result is continuing delay, cost escalation, and resultant uncertainty facing any "real" project proposal. We should ignore the many superficial proposals to 'do more R&D', on sometimes far-out possibilities – these proposals serve only to add to the delay in facing the immediate challenge. We can better address the challenge by first recognizing a few expectations about our future:

- Coal will meet a large portion of electrical demand, albeit at increasing social cost
- Oil prices will increase in response to demand, thus forcing fuel switching
- Many different energy systems will be tried. Some will succeed; others will fail
- Fission reactors of existing design will power most new plants for the next 50 years
- Development of fast breeder reactors will continue in a few countries
- Cost control and high cost certainty will continue to be vital to success
- People will not easily give up their modern creature comforts

The Canadian government recently proposed a new policy [7] that would see the phaseout of all coal-fired generation within the next twenty years, to be replaced with lowemission alternatives. Natural gas is identified as the leading alternative, but this dream is very unlikely to be realized due to a continental shortage of gas supplies (in spite of the 'shale gas' bubble.) Nuclear energy can meet this challenge – the CANDU reactor design is ready and able to replace coal-fired generation.

6. The Way Forward

The future is 'uncomputable' according to David Orrell, author of the book Appolo's Arrow, The Science of Prediction and the Future of Everything [8]. We can, however, construct a set of scenarios that illustrate our society's preferences for future development of humanity. Then, we can take actions that tend to point us in the desired direction even in the face of major uncertainties. We may even be so fortunate as to reach a future that is tolerable.

Two defensive concepts have been formulated to deal with uncertainty [9,10]. The first is the well-known concept of "Defence in Depth". In the case of energy supply, this concept can be expressed in terms of the objective of diversity; that is, we should develop diverse energy technologies, each of which offers at least a partial solution to the problem. Winston Churchill applied this idea in his plan for conversion of the Royal Navy from coal firing to oil firing. Its modern equivalent is the "wedge" theory of Socolow, as applied to the climate problem [11]. We

have an advantage relative to the Royal Navy's problem; they had no indigenous oil reserves but we hold an essentially infinite reserve of uranium inside our borders.

The second defensive concept can be identified as "Defence in Time". In the context of energy supply, this concept can be expressed in terms of the objective of preparedness; that is, at any given time we should be prepared to take timely action to adapt our energy supplies to changed circumstances. In order to be prepared, we must keep watch on apparent changes such as availability, price, and needs. We also must extrapolate at least 50 years into the future (because adaptation of new energy systems is slow) and take early action so that, when the need arises, we will be prepared to respond.

Today, industry involved in the delivery of uranium-fuelled power plants is in a fairly good position in spite of the recent drastic 30-year slowdown in orders for new plants caused by an organized anti-nuclear-energy minority, supported in some cases by national governments. Performance of existing plants has steadily improved as staff and equipment have evolved. These plants now may be considered to embody a mature technology. Recent new orders are stimulating a revival in design, manufacturing and construction capability. There are more than 52 large units under construction around the world, with about 140 on order or planned, and a further 340 proposed. The advent of detailed computer-aided drafting, design, and construction systems has overcome earlier problems arising from plant complexity. Design and construction is, in effect, now done first in the office (on a computer) before fieldwork begins. This change, plus a revolution in construction involving prefabricated subassemblies and "top-in" installation have enabled a revolution in plant construction [12].

In some countries, most notably in the United States, long-term fuel waste management has developed into a major political issue. Facts and practical realities seem to be of secondary importance in these arguments; the resulting impasse has dramatically slowed the promised renaissance of the industry in that country. The apparent high cost of "new build" plants in the US is acting as a powerful deterrent, as are various state-based negative initiatives. Price has been artificially increased by uncontrollable uncertainty factors. In at least one case in Canada, extreme demands in the RFP to accept all risk over the life of the plant have led to apparent cost increases as contingency allowances were applied to the bids.

At the same time, the rising cost and limited supply of commercial crude oil supplies promises to override the mainly political objections to expanding the application of nuclear energy. Coal and nuclear energy can combine, through nuclear-hydrogen-based liquefaction processes, to solve at least part of the transportation fuel requirement.

Where should we go from here? The need is great and the time is short.

Future development of this technology is constrained by several factors. The most important of these, which will be applied to each new unit of capacity, are:

- The plant, when proposed, must have a suitable site and associated facilities.
- The plant, when delivered, must be capable of reliable and safe operation for at least a half-century. Otherwise, the user will not purchase it.
- The plant must be cost-competitive with existing mature units. Otherwise, it will not be purchased.
- The plant must have a lifetime fuel supply, or at least a well-founded expectation of such.

- The plant must have a full complement of trained staff and a plan for continued staff replacement over a period of 50 years or more (several generations of engineers)
- The plant must have an achievable plan for waste storage.
- Society must accept the technical conclusion that a suitable method for disposal of long-lived radioactive materials exists, and work steadily toward that goal [13].

These factors are, today, quite different than the ones that existed during the first major building program of commercial uranium power plants some years ago. During that early period, new prototype and first-of-a-kind commercial plants were purchased very much "on faith". Development subsidies were the order of the day. That is not likely to happen again.

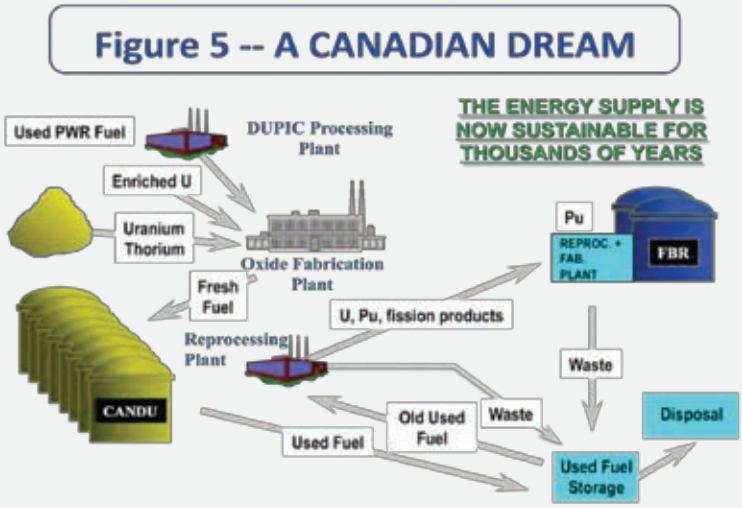
Government policy could provide a sound pathway for introduction of innovative new generation technologies [14]. However, given the broad demand for government subsidies by a wide variety of other proposed programs, long-term development funding cannot be expected by the nuclear industry – the electricity production business already is a large and mature industrial venture. This fact brings nuclear technology back to the customer as the main supporter for new generation. The needs of the customer will be paramount in any future decisions for new uranium-fuelled generating capacity. The rest of the industry must adapt to these needs. A major opportunity, on the other hand, lies in application of nuclear energy to satisfy energy needs outside of the delivery of electricity. Gurbin and Talbot [16] presented some of the possibilities in a 1994 paper.

Figure 4 – Bruce Site Today (a prototype for future) 6000 Mwe Electricity Production Capacity from CANDU

Figure 4 shows the Bruce site adjacent to the Bruce Energy Centre. It offers a good base for future development that could lead to a future industrial complex somewhat equivalent to a major oil field surrounded by industries using its product for various purposes.

Figure 5 indicates one possible long-term development [16] of the Bruce site. Such the world, could provide – along with small satellite reactor sites – a sustainable energy supply for thousands of years.

Figure 6 shows the "energy cascade" proposed by Gurbin and Talbot. Their ideas were scheduled for implementation at the Bruce Energy Centre, but the project was cut short. The concept was



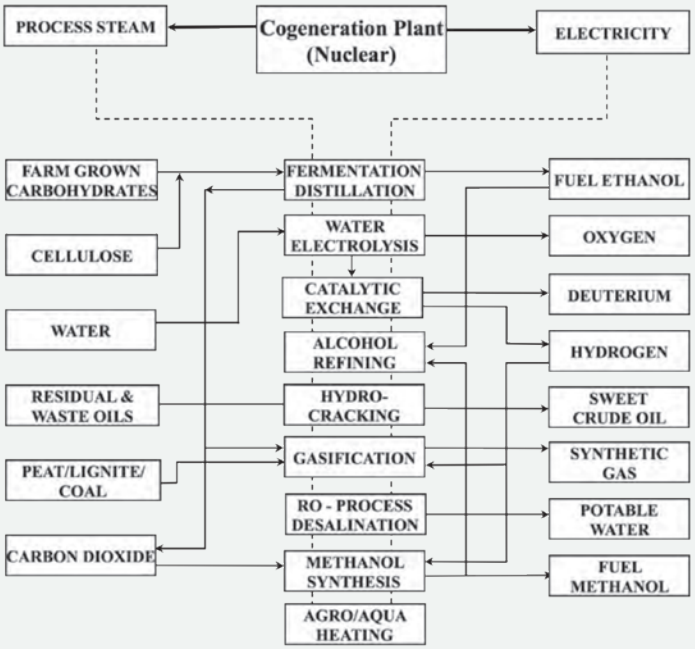


Figure 6 – Potential ladder of industrial processes at BNPD [15]

scrapped when British Energy, the company that leased the site from Ontario Hydro (now OPG) rejected the idea of using excess steam from Bruce A to provide steam to the energy centre.

Figure 6 includes a variety of applications beyond the production of electricity. The list is not exhaustive, nor is it guaranteed that all of these possibilities could be realized economically.

7. Financing

Financing is difficult for large projects such as nuclear plants. Two good comparisons are seen in development of a new oil field and the construction of a continental highway network. In the first case large capital resources must be committed many years before any return can be expected. In the second case, people expect that taxpayers will fund major highway construction.

Bill Gates [14] puts forward a precise and simple explanation of the problems of nuclear plant finance. He argues that the private sector will remain unable to finance this new build program, but that governments can help a great deal. The US government has, in fact, begun this process by offering loan guarantees. A similar system was utilized to finance construction of the Qinshan-3 project in China; nations associated with several major systems and components used export development loans of various kinds. This operation was very successful, and the loans are now being paid back expeditiously.

Financing of a nuclear plant to be built in Canada would appear to be even easier. Government loan guarantees could be established in support of the project. Loans would be repaid over time during plant operation. Financing also would be greatly eased if some of the capital expenditures incurred during plant construction could be charged into the rate base, recognizing that plant benefits will eventually accrue largely to those same ratepayers. Both of these alternatives depend completely on the support of the community where the plant is located, thus underlying the paramount importance of their trust that the plant being constructed is truly in their interest. Of course, this is a political and sociological question.

The complexity and uniqueness of project arrangements for building a large plant defeat any attempt to generalize the process. There is no doubt that it is one of the crucial steps toward success. Expert management combined with careful project planning, clear definition of roles and goals, along with comprehensive design and scheduling of each step of the project can lead to timely and economical project completion [12].

8. The Customer

The customer is sometimes forgotten in the multi-year design and organization process that must be completed before the actual project begins. It is vital for project management to know the customer and to understand the specifics of the buyer's capabilities, needs, and limitations. Even an "ideal" plant design may not match these basic requirements, and so will fail.

Given this situation it seems obvious that the most productive path forward for new generating plants is one of slow design evolution, with new designs firmly anchored in the technology and operating experience of existing successful power plants. The utility customer must, after all, be willing to accept each "improvement"; otherwise, it will not be incorporated in the plant.

One of the paramount needs of the plant customer today is a predictable policy for medium term used fuel storage, and a sound plan for long term waste management. The customer must take the initiative; as the waste producer it is the customer's basic responsibility to push forward these waste management plans. In Canada, this task is in the hands of the Nuclear Waste Management Organization, led by the nuclear utilities.

9. The Community

The customer lives and works within the larger community served by the plant. Without the support of the community, any project of this large scale simply cannot succeed. Vocal, minority opposition that has dogged the industry for many years seems now to be decreasing, but it easily could increase again if and when some problem arises in the industry.

In one sense this opposition is useful – it keeps us on our toes. At the same time the common sort of opposition requires a large amount of effort to repeatedly refute the spurious claims of those who are dedicated – some say religiously dedicated – to opposing any activity associated with the adjective "nuclear". The distribution of these zealots is wide. Some can be found embedded in governments and other respected institutions, at times very near to the top levels.

Do we have any "respected institutions" remaining in our society? Hugh Heclo [17], in his book

"On Thinking Institutionally" asks us to re-examine our opinions of those institutions on which we rely so heavily, and yet for which we show very little respect. At times, of course, institutions go off the rails and no longer deserve respect – Heclo addresses this phenomenon as well. He illustrates the situation with many examples, and points out that the systematic denigration of our basic institutions has been building up over the past century, to the point that it is now hardly appropriate to support many of them when speaking in polite company.

It must be obvious that our society cannot function without a large number of institutionalized organizations and processes. It is equally obvious that these institutions must earn and hold the respect to the general population. In the case of an operating nuclear utility, this generates a powerful need to deserve the trust of the people from day to day. The same applies to all aspects of our industry, and more so because the integrity of this institution is always under challenge.

"Deserving of trust" is, of course, in the eye of the beholder. Today's political climate of challenge to all institutional authority, coupled with our new instant and worldwide communications pathways, makes it very easy to generate dissent on virtually any topic. The virtue of truth-telling, and the normal penalties for violating that norm, have decreased in recent years. Herein the root cause of our public relations trouble. Perfectly rational people who have a deep understanding of the nuclear industry criticize the industry for not "standing up" to the onslaught, and presenting the true story. An excellent example can be found at Ted Rockwell's blogsite, < http://www.learningaboutenergy.com/>. We must do whatever we can to eliminate the falsehoods, the distortions, and the extreme assumptions from our technical discussions.

Over the years of verbal conflict between scientists and engineers versus their opponents, the "defensive ramparts of truth" have become bent and battered to some degree. This is especially so in the area of nuclear regulation, where the technical arguments of the proponents meet the political reality of the day, in which the regulator must defend any decisions to allow a project to proceed with a very high degree of assurance. That institution also is challenged every day, the same as all the rest.

In order to continue this great enterprise of providing the world with plentiful energy, we must remember always to defend the "ramparts of truth" and to rebuild them as and when necessary.

11. Conclusion

Nuclear fission energy is ready and able to provide the world supply of energy for thousands of years. There is a need for this energy to reduce and, in many cases, to eliminate the use of fossil fuels. The need to engage in building facilities to accomplish this huge task is an urgent one; there are clear signs that petroleum supplies are not sustainable at the rate that we are now extracting them, and equally clear signs that coal cannot do the whole job due to atmospheric pollution considerations. Reluctance to proceed with building new is apparent in some countries, while other countries are going ahead energetically, some building several units in parallel. The wisdom of each choice will be revealed within the coming decades.

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LETTERS TO THE EDITOR

Dear Editor:

I appreciated the mention of the article I wrote for the 50th anniversary Nuclear Canada Yearbook in the April issue of the Bulletin. It did, however, increase my time with CNA by 50%! It consisted of just 20 good years.

A big regret about my article as it appeared in the CNA Yearbook was the failure to identify the members of the first CNS Council in the photo from the CNA archives on page 21. Upon request from CNA at the very last moment I had supplied the names of all but the person on the extreme right of the back row whose name I could not recall in my old age. Hopefully the picture with the complete list is available in the CNS archives. If so, perhaps it should be sent to the CNA for future reference.

Finally, it is worth mentioning in connection with the first paragraph of the Conference report that, although an attendance of 800 was probably the largest for an all-Canadian nuclear event, well over 2,000 people attended the joint CNA/ANS conference in Toronto in June 1976.

With every good wish to the Society for its continued success. I always felt proud to have been associated with its conception.

Sincerely,
Jim Weller

Response to Mr. Beare's letter

To the editor:

I would like to respond to Mr. Beare's letter, published in the last edition of the CNS Bulletin. It is unfortunate that Mr. Beare chooses to perpetuate myths around the proliferation resistance of CANDU reactors. As such, I would like to set the record straight. As measured on the basis of per mass of discharged fuel, CANDU spent fuel contains roughly half as much plutonium as LWR spent fuel. Furthermore, there is no basis to any statements or allusions that CANDU reactors are more difficult to safeguard and thus present a proliferation hazard. These topics were discussed at a well-attended "side event" at the September 2009 IAEA General Conference, where these lingering misconceptions were thoroughly dispelled by AECL, IAEA and CNSC staff.

The CNSC goes to great lengths to fulfill its mandate of protecting the health, safety and security of Canadians and the environment. We would never grant a licence unless a facility has been proven to be safe, secure and highly compliant with international safeguards requirements. As for other myths surrounding CANDU and the Canadian nuclear industry, your readers may be interested in the new "Mythbusters" section on the CNSC Web site, found at nuclearsafety.gc.ca.

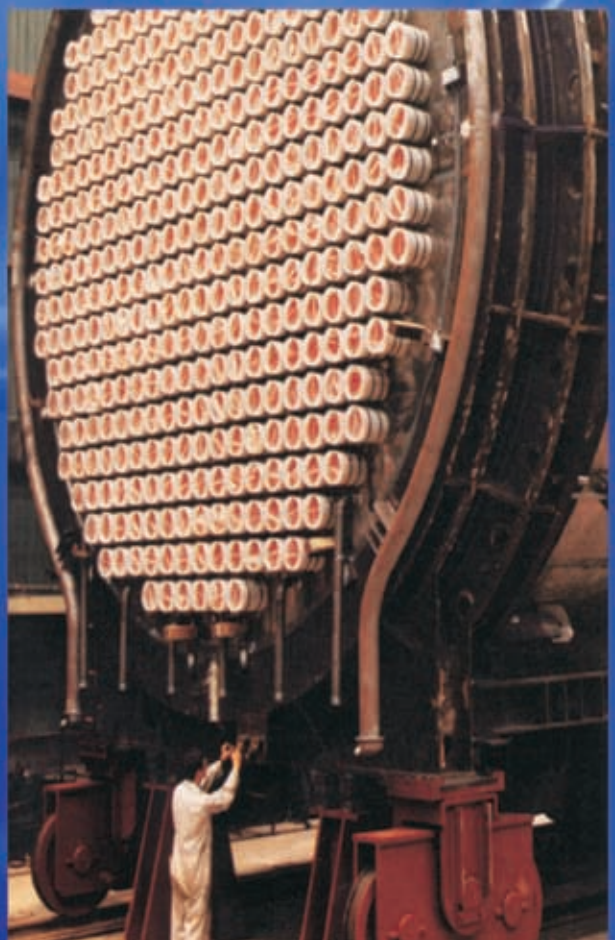
Terry Jamieson
Vice-President
Technical Support Branch
Canadian Nuclear Safety Commission

Notice to readers:

The CNS Bulletin welcomes comments from our readers and letters to the editor. The editor reserves the right to edit letters for clarity and length. If a comment or letter refers to a printed article or paper, the author will be given the opportunity to respond. The intent is to share opinion and encourage dialogue.

Letters and comments can be sent to the editor by email.

Maximizing Plant Performance Enhancing Safety



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UNENE: An Update on Nuclear Education and Research

Dr. B.A. Shalaby[1], Dr. V.G. Snell[2] and Dr. B. Rouben[3]

[Ed. Note: The following paper was presented at the 2010 Annual Conference of the CNS.]

Abstract

University Network of Excellence in Nuclear Engineering (known as UNENE) was created in 2002 as a partnership between Industry and universities with the objectives of establishing a nuclear R&D program in universities, train and develop Highly Qualified Personnel (HQP) to address the demographic gap, and to create a sustainable source of expertise for independent industry and public consultation. Seven years into its creation, UNENE is now a well established and fully functional framework with programs mainly focussing on education and research serving the industry at large. The educational component is in the form of an M. Eng. program mainly catering for working professionals by being offered on weekends and using distance-learning tools. It is intended to enhance competencies and build knowledge for students. The R&D programs are led by Industrial Research chairs (IRCs) and other prominent researchers in areas of importance to the industry. This paper examines the above topics and its outcomes as of March 2010.

1. Introduction

UNENE (University Network of Excellence in Nuclear Engineering) was established in 2002 as a partnership between the nuclear industry and universities with the objectives of:

1. Establishing university research in key areas of interest to the nuclear industry
2. Developing a sustainable supply of Highly Qualified Personnel (HQP) to address demographic gaps in the industry
3. Providing an independent university-based source of scientific expertise for public and industry consultation

UNENE members are listed in Figure 1.

2. UNENE: A Partnership

The industry members, (namely Ontario Power Generation (OPG), Bruce Power (BP) and Atomic Energy of Canada Ltd (AECL)) initiated UNENE research by sponsoring Industrial Research Chairs (IRCs) in many of the UNENE Universities. These chairs are held by world-class scientists with considerable industrial experience and they are well respected in the industry, both nationally and internationally. These IRCs became anchors for establishing research programs and competent research teams within their respective universities. Industry funding of the IRC programs has also served to leverage additional funds from federal and provincial research grants, thus widening the scope and size of these programs – which have allocated $50M (Canadian) to date.

UNENE is a non-profit organization governed by a Board of Directors (BoD) with member representation from the funding industrial partners and universities. Two Advisory Committees, one on Education (EAC) and one on Research (RAC), manage and oversee the respective programs. The EAC and RAC committees consist of both Industry and University members. Both committee chairs report quarterly to the BoD on the status and results of research and educational activities (Figure 2).

3. UNENE and Current Industry Challenges

Canada's nuclear industry is well established as a $6B industry with nearly 60,000 jobs. It started in 1945 with the ZEEP (Zero Energy Experimental Pile), followed by the early nuclear research reactors (NRX and NRU), and continuing to the established CANDU - PHWR (Pressurized Heavy Water Reactor) technology – with a current market share of 8-10% of the world-wide commercial NPP's (Figure 3).

Nuclear power in Canada now provides 15% of the national electricity supply, and 50% of the electricity supply in the most industrialized province of Ontario.

Most of the plants are Generation II vintage, coming on stream from the mid-1970s (Pickering A Units 1 to 4) to the mid-1990s (Darlington Units 1 to 4). Some of the CANDUs have been life-extended beyond their 25-30-year design life while others are being (or are planned to be) refurbished for a 50 to 60-year life. Future nuclear construction of Generation III and Generation III+ plants are expected to replace retired nuclear capacity and to meet clean energy targets (Figure 4).

As with any industry, an NPP is a complex project with long lead times, and is multifaceted and multidisciplinary in nature, making knowledge one of its key enablers and a vital component over its entire lifecycle: design, licensing, construction, operation, decommissioning and long term waste management. This is even more crucial in view of life extension or life doubling: nuclear competencies and continuity in knowledge need to be maintained for two to three generations.

So for the industry to secure safe and economic long term operation of the current CANDU fleet, it recognises the role of knowledge preservation and continuous competence-building in order to meet the following strategic priorities:

1 UNENE President, email: basma.shalaby@rogers.com
2 UNENE Program Director, email: vgssolutions@rogers.com
3 UNENE Secretary-Treasurer, email: roubenb@alum.mit.edu

UNENE Members

- Atomic Energy of Canada Limited
- Bruce Power
- Ontario Power Generation
- Canadian Nuclear Safety Commission
- CANDU Owners Group
- Nuclear Safety Solution
- CAMECO
- McMaster University
- Queen's University
- University of Ontario Institute of Technology
- University of Saskatchewan
- University of Toronto
- University of Waterloo
- University of Western Ontario
- University of Windsor
- Ecole Polytechnique
- University of New Brunswick
- Royal Military College
- University of Guelph

Figure 1: UNENE Members listed by Government/Industry and Academic

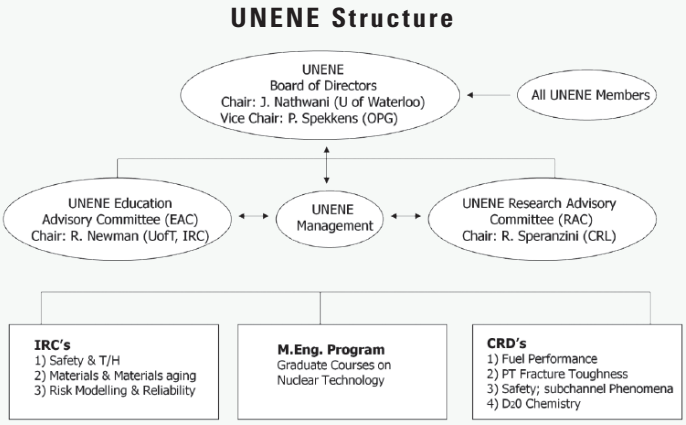

Figure 2: UNENE Structure

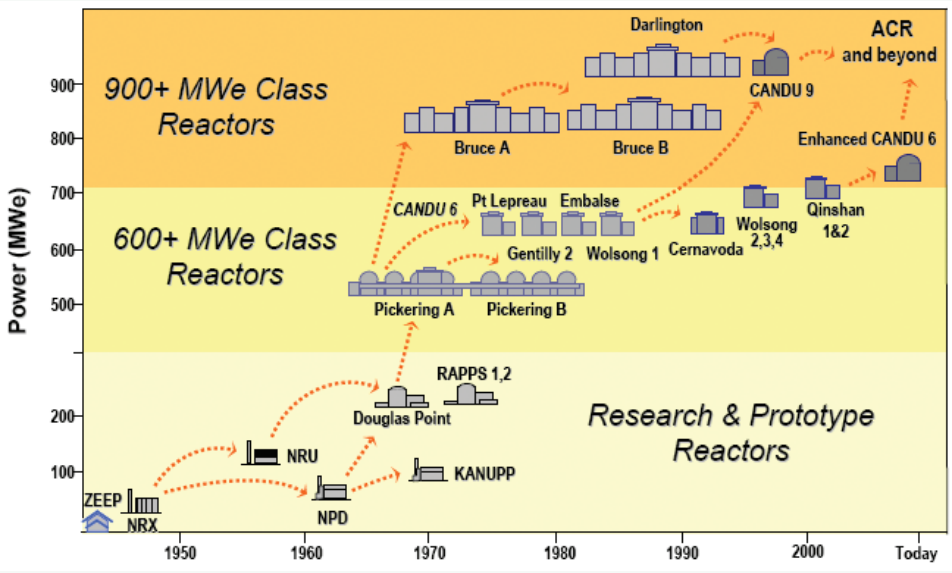

Figure 3: CANDU Genealogy

1. Maintain the safe and economic Long Term Operation of its current nuclear plant fleet.
2. Maintain knowledge of the design and licensing basis of current plants.
3. Advance knowledge and tools towards successful design and licensing of future Gen III+ plants (such as the Enhanced CANDU 6 and the ACR-1000).

With these priorities, the UNENE partnership between Industry and Academia focuses on two key aspects: Education and Research.

4. UNENE Educational Program

A graduate level Master's program was set up by UNENE in collaboration with the member universities. Program courses from member universities, duly accredited in Ontario by the Ontario Council of Graduate Studies, allow UNENE to coordinate a joint course-based Master's of Engineering Program in Nuclear Engineering. The courses cover key areas fundamental to nuclear plant design, safety, operation and other related topics geared to enhance the knowledge and competence of students and other professionals working within the industry. Courses are offered outside working hours; acceptance is according to the normal graduate-level admission pre-requisites. The courses currently offered are noted in the Table below.

The M.Eng Program continues to grow both in student enrolment and in the selection of courses offered, as shown below (Figure 5).

The UNENE M. Eng. offers many benefits to the industry, such as:

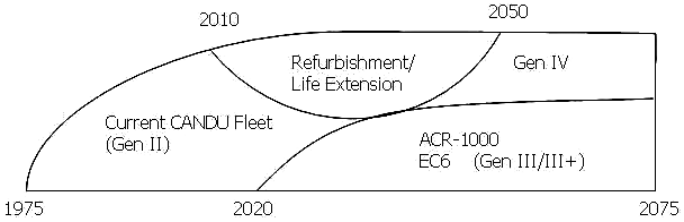

Figure 4: Nuclear R&D and Industry Challenges

Table 1: Courses offered towards the UNENE M. Eng. in Nuclear Engineering

Course #	Course Title
UN0801*	Nuclear Plant Systems and Operations
UN0802*	Nuclear Reactor Analysis
UN0803*	Nuclear Reactor Safety Design
UN0804*	Nuclear Reactor Thermalhydraulics
UN0601	Control, Instrumentation an Electrical Systems in CANDU Plants
UN0602	Nuclear Fuel Waste Management
UN0603	Project Management for Nuclear Engineers
UN0701	Engineering Risk and Reliability
UN0702	Power Plant Thermodynamics
UN0805	Radiation Health Risks and Benefits
UN0901	Nuclear Materials
UN0902	Fuel Management
UN1001	Reactor Chemistry and Corrosion
UN0800	Industrial Research Project

***Core M. Eng courses**

- Development of HQP to meet industry needs.
- Assisting industry in knowledge transfer and preservation.
- Professional/career development of employees towards an effective and highly skilled workforce.
- Lower cost than in-house training (employees take courses outside of working hours on their own time).
- Forum for employee's interaction with industry and university peers.

One utility explicitly recognizes the UNENE M. Eng. as an advantage when an individual applies to become a supervisor. Also, some of the M.Eng course material is now being proposed for high-calibre non-accredited enhanced training to utility professionals.

To accommodate and attract students who work at sites distant from the greater Toronto area, synchronous distance learning over the internet is now routinely applied to all course deliveries through the use of the ELLUMINATE program. As of September 2009, student feedback with distance learning has been positive, and even "live" students appreciate and use the recording feature. New

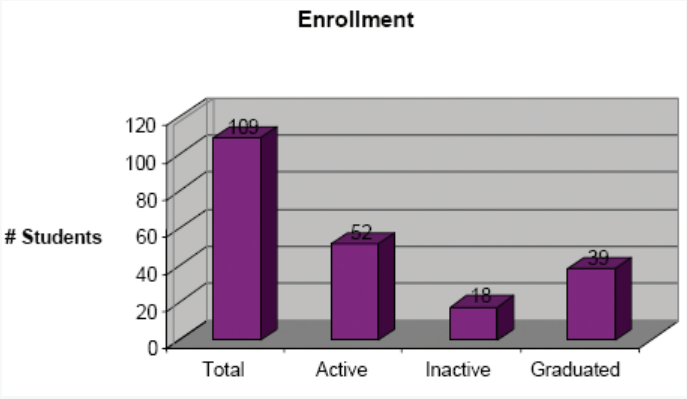

Figure 5: Chart showing Student Enrolment

video conferencing systems are currently under assessment; with additional features such as enhanced visual capability, viewing of full screen lecture presentations by all students and ability to see all participants (real time) at different locations.

5. UNENE Research Programs

Since UNENE's inception, Industrial Research Chairs (IRCs) and Collaborative Research and Development (CRD) projects were established as the platforms for nuclear research in Universities. World Class IRCs were endowed in prominent Canadian universities to become anchors for research in key areas of the technology, while developing Highly Qualified Personnel for industry hiring. The IRCs established are:

- McMaster University: Safety and Thermal hydraulics
- Queens University: Material Sciences
- University of Toronto: Nano-engineering of Alloys
- University of Waterloo: Risk and Reliability
- University of Western Ontario (UWO**):** Instrumentation and Control, and Electrical
- Royal Military College (RMC): Fuel Technology
- University of Ontario Institute of Technology (UOIT): Health Physics

Most programs focus on key R&D in areas of interest to the industry such as safety analysis methodologies, phenomena and analytical codes; fuel channel material sciences; corrosion chemistry in nuclear materials; and probabilistic and risk modelling in support of Life Cycle Management in current plants.

To date many outcomes have been achieved.

- Nine (9) CRDs have been funded by UNENE/NRCan on topics closely tied to the IRC programs. The initial CRD projects are nearing completion with five (5) new ones being initiated in 2010 for a three-year duration.
- UNENE program funding leveraged additional provincial and federal funding; making current available funds for UNENE universities in excess of Can $50M.
- The number of HQP developed by member universities has reached 100 HQP (PhDs, PDFs, MASc with most of them successfully recruited within the industry, research institutions, government and universities.

National & International collaborations are forged within the university itself across many engineering disciplines and scientific departments, among different universities, and with industry on specific research programs. Examples of such collaborations are the University of Toronto / University of New Brunswick / University of Waterloo study on corrosion chemistry; the McMaster / CANS (Centre for Advanced Nuclear Systems)work on Thermal hydraulics; Queen's University / Kinetrics on pressure tube deformation; McMaster / Chalk River Laboratories on fuel cycle and physics; and Royal Military College / Chalk River Laboratories on fuel performance.

International collaborations are established with many US universities and the US Department of Energy National Labs, and some European Union universities in areas such as thermal hydraulics (between McMaster / University of Pisa and Trinity College), and development of integrated fuel performance codes between Royal Military College and Oak Ridge National Laboratory.

Consultation /Interactions with industry: Many technical exchanges, consultations and technical activities take place between industry and universities. IRCs' and Associate IRCs' expertise is sought by industry on resolution or regulatory queries; Life Cycle Management (LCM) decisions for optimal maintenance and risk-based inspections (OPG); NRU leak repair (AECL); ACR-1000 Independent Safety Review (AECL); OPAL Reactor (ANSTO); Pickering Unit 7 Calandria Tube crack (OPG), etc.

Equipment and Facilities:

- A High Performance Computing Center (HPCC) was set up at McMaster enabling Safety Analysis code coupling and code development. The HPCC is accessible by users University wide.
- A Nuclear Materials Testing Lab is being planned at Queen's with commissioning expected in 2012.

Other notable benefits and successful spinoffs to the industry are:

1. **Integration of research programs** among universities and institutions.
2. **Interaction of Universities with industry** through UNENE Technical Advisory Committee (TAC) (AECL, BP, OPG), resulting in detailed discussion on research directions and opportunities, ensuring industrial–university technical research objectives are met.
3. **Expansion of R&D base** with eleven (11) universities becoming players in research and knowledge building.
4. **Technology Transfer** on topical issues of critical importance to industry on operational, regulatory and new build such as Steam Generators, Fuel Channels, Feeders and MTS components, Regulatory and Operational Safety, Gen IV designs and risk-based inspection and maintenance.

6. Summary

UNENE continues to grow and provide technical and educational support to industry members in key areas of importance to industry. Establishment of research programs in universities has increased the knowledge base and facilitated integration of R&D among Universities and industry, making technology transfer viable and effective in all aspects of the technology. The UNENE M.Eng program has continued to attract students from industry and is expected to grow further now that Distance Learning has been further honed and become easier through the use of Elluminate Software through McMaster University. It is expected that further enhancements in these tools will attract more students from distant sites.

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Safety analysis: its role and current trends

Alexandre Viktorov[1]

[Ed. Note: The following paper was presented at the 2010 Annual Conference of the CNS.]

Abstract

Safety analysis is one of the components of the overall safety assessment required to demonstrate that a proposed nuclear power plant, once constructed, would operate safely, without posing unreasonable risks to the public, workers and the environment. It is also one of the so-called safety programs utilized by the CNSC in the on-going evaluations of safety performance of the operating plants. This presentation will explore why, after decades of safe nuclear power plant operation, the safety analysis remains to be an area of significant regulatory attention, both in general terms as well as from the Canadian perspective. With regard to the latter, the paper will touch upon specifics and evolution of the Canadian regulatory framework and some of the recent "discovery issues". The current trends, such as introductions of novel complex methods, ever-increasing attention to consideration of uncertainties, and prioritization based on safety significance will also be explored. Finally, this presentation will venture to consider potential future developments and expectations that may shape the safety analyses for nuclear power plants in the future.

1. Concepts of Safety Assessment, Safety Areas and Programs

Safety analysis is only one of several safety assessment activities

Safety assessment, as promulgated by the IAEA [1], is a comprehensive study to demonstrate that a nuclear facility would operate safely, without posing unreasonable risks to the public, workers and the environment. Safety assessment is conducted as a required pre-condition to obtaining a licence or approval for design or operational changes; it may also be conducted at regular intervals during the operating life of the facility or in response to certain circumstances, such as discovery of a major deficiency in the existing safety assessment.

For pragmatic reasons, the overall safety assessment is divided into several safety areas, mostly according to the disciplines involved. Table 1 below lists all Safety Areas used by the CNSC until recently while Table 2 presents the list of safety areas that was revised by CNSC staff taking into account the accumulated experience (one of the reasons for revision was the intent to expand its applicability beyond nuclear power plants). It is apparent that the overall safety assessment of a facility can be subdivided in any number of ways depending on the complexity of the facility and the level of desired regulatory scrutiny; in any case Safety Analysis will remain to be one of key safety areas.

Just as Safety Analysis is part of a more generic activity, it in turn is subdivided into several sub-elements.

Note, that while the concept of safety assessment would apply to any nuclear facility or activity, it is the safety analysis for nuclear power plants that will be the focus of discussions below. This presentation will explore why, after decades of safe nuclear power plant operation, the safety analysis program remains to be an area of significant regulatory attention, both in general terms as well as from the specific Canadian perspective.

2. Definition and Objective of Safety Analysis

Safety analysis aims to demonstrate plant's safety in case of malfunctions and errors

In general sense, safety analysis is an evaluation of potential risks to the public, workers and environment associated with the facility. Expanding on this basic definition, we will call "safety analysis" a process which:

- aims to quantify the attributes of various hazards, namely their probability and impacts or consequences;
- considers all possible plant states from normal operation up to significant and multiple equipment failures or operator errors;
- uses well structured formal methods;
- is based on up-to-date knowledge gained through experience or scientific research;
- in the end, allows to compare with high confidence the potential risks associated with the facility against the regulatory requirements.

Safety analysis deals with hypothetical events deemed likely or at least possible to occur at the facility; the focus of the probabilistic analysis is on the quantification of probabilities of accidents, whereas the deterministic analysis predicts the consequences of a postulated accident.

Naturally, for a well designed plant, it is expected that the safety analysis will demonstrate that for all credible events, such as malfunction of equipment, operator errors or common cause events, the risks to workers, public and the environment are within the allowed limits.

Note that the current safety analysis methods cannot reliably capture effects of how well the plant is operated and maintained, or how well the operators are trained.

1 Canadian Nuclear Safety Commission (CNSC), Ottawa, Ontario, Canada

Table 1 - Safety Areas used by the CNSC until 2010

Safety Area	Sub-Areas
1. OPERATING PERFORMANCE	Organization and Plant Management Operations Occupational Health and Safety (Non-radiological)
2. PERFORMANCE ASSURANCE	Quality Management Human Factors Training, Examination, and Certification
3. DESIGN AND ANALYSIS	Safety Analysis Safety Issues Design
4. EQUIPMENT FITNESS FOR SERVICE	Maintenance Structural Integrity Reliability Equipment Qualification
5. EMERGENCY PREPAREDNESS	
6. ENVIRONMENTAL PROTECTION	
7. RADIATION PROTECTION	
8. SITE SECURITY	
9. SAFEGUARDS	

3. Safety Analysis program

Safety analyses are performed under governance of an established program

Definitely, a programmatic approach to performing safety analysis is not a novel notion, however it has only firmed up as a principle probably in the last decade, and perhaps it is still in the process of being accepted as a customary practice. It is indisputable though that the safety analysis is not performed just once in the lifetime of a plant but is rather an ongoing process set up to react to the various demands. Experience shows that such demands are much more likely to arise for a large sophisticated facility such as a nuclear power plant, rather than for a small research reactor. From the modern project management it follows that efficiency is to be gained through development of a programmatic approach to conduct of similar projects.

According to the dictionary definition, a program is a process of managing of several related projects, with the intention of improving the overall efficiency. A safety analysis program sets forth a coherent framework of requirements, practices and responsibilities related to performing safety analyses. As the regulator, the CNSC expects all licensees to have firmly established safety analysis programs as part of their overall safety management system; regulatory evaluation of licensee's performance in "Safety Analysis" area (Tables 1&2) without doubts includes consideration of the programmatic aspects.

Key attributes of a Safety Analysis program sought by the CNSC can be summarized as follows:

- Alignment: The program must support higher level organizational goals and objectives.
- Governance: The program must include a set of metrics to indicate the health and progress of the program in the vital areas.
- Management: Roles and accountability of management, participants, stakeholders and suppliers are defined.
- Integration: The program performance is optimized through integration of program components.
- Resources: Costs of administering the program are tracked and assessed. Allocation of resources promotes success of the program.
- Planning: Working plans tying together the priorities, projects, resources, timescales, monitoring and control are developed.
- Assurance: The program is reviewed, verified and validated, ensuring adherence to applicable standards and goals.
- Improvement: Performance is continuously assessed; new capabilities are researched and developed; and new knowledge is systemically applied to the program.

From the regulatory perspective, compliance with the safety analysis program is an essential element of the overall safety performance.

4. Safety Analysis regulatory framework

Regulatory framework for safety analysis is evolving

While safety analyses were performed for the very first nuclear power plants, the expectations for safety analysis as well as the capabilities to perform it have greatly advanced since then. It is relatively easy to distinguish several major phases in the Canadian regulatory framework applied to the safety analysis; notable differences among those are examined below.

On the other hand, one can distinguish several major stages in the development of the analysis methods [2]. Such development was necessitated by very specific needs, more often than not related to the Large Break Loss of Coolant Accident analysis.

For example, "limit-consequence" methodology applied analysis assumptions to assuredly envelope the possible reactor conditions and event characteristics in such a way that maximized the consequences. The driver for using this approach was to circumvent the gaps in supporting experimental data and models. Thus, limiting assumptions were made with regards to the phenomena and not necessarily systematically when considering the reactor operating parameters. The idea was that if a very conservative analysis showed acceptable results then the relatively accurate knowledge of accident phenomena was not crucial to gain regulatory acceptance.

The "limit consequence" was convenient as a relatively simple approach and perhaps the only option when the modelling capabilities were not allowing more accurate representation of all important phenomena. It also predicted results that, in some cases, were not acceptable. The ensuing advancement of the knowledge base and modeling tools permitted development of

Table 2 - Revised set of Safety Areas

Safety and Control Areas	Sub-Areas or Programs (examples)
Management System	• Management System
	• Monitoring and Review of Safety Management Performance
	• Management of Safety Issues (including R & D Programs)
	• …
Human Performance Management	• Personnel Training
	• Personnel Examination and Certification
	• …
Operating Performance	• Conduct of licensed activity
	• Operating Experience (OPEX)
	• …
Safety Analysis	• Deterministic Safety Analysis
	• Probabilistic Safety Analysis
	• Hazard Analysis
	• Safe Operating Envelope
	• Robustness Analysis
	• Criticality Safety
Physical Design	• System Classification
	• Facility Safety Systems
	• Reactor Control Systems
	• Configuration Management
	• …
Fitness for Service	• Equipment Fitness for Service/Equipment Performance (e.g. System Health Report)
	• Reliability
	• Ageing Management
	• …
Radiation Protection	• Application of ALARA
	• Dosimetry Services
	• …
Conventional Health and Safety	• Compliance with the applicable Labour Code
	• …
Environmental Protection	• Effluent and Emissions Control
	• …
Emergency Preparedness	• Nuclear Emergency Management
	• …
Waste Management	• Waste minimization, segregation and characterization
	• …
Security	• Facility Security
	• …
Safeguards	
Packaging and Transport	

an approach that is still widely in use - the Limit of Operating Envelope (LOE) method. The LOE relies on the use of best estimate codes and assumes bounding operating parameters such that the safe plant operation can be demonstrated. Analysis values of key operating parameters are set at their operating limits plus uncertainty allowance; this makes the analyzed plant state to be highly unlikely but still possible. It is assumed (and recently has been confirmed through the BEAU analysis at least for one case) that the LOE method produces conservative results.

Best Estimate Analysis with Uncertainties (BEAU) method [3] arose from the need to better quantify safety margins for events where the LOE analyses showed small, and diminishing, margins. BEAU represents a more systematic method for

Table 3 - Safety Analysis regulatory frameworks

	Siting Guide, AECB-1059, R-10	C-6, R-7, R-8, R-8	RD-310, RD-337
Analysed events	Single (process) failure (1 in 3 years) Dual (process + safety system) failure (1 in 3000 y)	Prescribed list of events binned into five classes	Applicant to identify events using a systematic process. Classify as AOO, DBA or BDBA based on probability
Acceptance criteria	Dose limits to the public. Minimizing damage to fuel. Minimizing escape of fission products from plant.	Dose limits to the public. Effectiveness criteria for special safety systems.	Dose limits to the public. General qualitative acceptance criteria and applicant-defined quantitative criteria.
Analysis assumptions	Unavailability of special safety systems. Specific weather category and model for calculation of public doses	Unavailability of special safety systems. Rules for availability of off-site power. Double guillotine pipe failure. Single-failure criterion.	Single failure criterion. Consider consequential failures. Consider equipment being out of service
Analysis models / computer codes	No guidance	Conservative predictions. All important phenomena to be considered. Justified simplifications. Verification by experimental evidence.	Computer codes to comply with CSA 286.7
Conservatism	No guidance	Input parameters to ensure conservative predictions	Conservatism to off-set uncertainties
Treatment of uncertainties	No guidance	Use of conservative correlations Use of limiting assumptions where models are not suitable	Analysis method to include accounting for uncertainties
QA / analysis review	Follow the best applicable codes, standards or practices	Analysis rules to be approved by the AECB, including use of mathematical models	Systematic analysis method. Review of analysis results. Comprehensive QA program.

accounting for various sources of uncertainties and generating results with desired level of probability and confidence. This is achieved through explicit consideration of uncertainties in key analysis parameters and application of statistical techniques to propagate these uncertainties up to the output parameters. While CNSC staff concluded that the recent pilot BEAU applications were not fully and adequately supported, we also find that this method offers numerous useful insights and has undeniable merits. Its future use and success will depend on resolution of few key challenges, primarily, the ability to quantify the modelling uncertainties.

5. Will Safety Analysis ever be done?

Safety analysis is an on-going activity

Let explore the statement made in the preceding section that the analysis is an ongoing process in response to various demands. What kind of "demands" could that be? Will they always be there? These can be grouped into the following four categories:

The first two reasons for performing a new analysis are mostly in response to operational needs of a licensee, and rarely in response

to findings that the current plant operation may not be meeting regulatory requirements. It is unusual when the plant design or operational conditions would be found such that the safety is seriously questioned; such cases would be treated as "discovery" issues.

At the same time, "discovery" issues have been occurring regularly in the Canadian practice. In such cases changes in either design or operating conditions may be necessary, in addition to a revised analysis. One can speculate that the relatively regular occurrence of "discoveries" can be explained, at least partially, by the relatively scarce CANDU-prototypic experimental data to develop and validate analytical models or fully test performance of all systems up front.

Will the above drivers fully disappear in the near future? There is no reason to think so - the plant operator may always wish to improve plant operations by modifying design or operating conditions. On the other hand, occurrence of "discoveries" can not be controlled or predicted but these can never be ruled out completely. It makes sense, though, to think that the likelihood of the need to redo safety analyses will decrease.

6. Recent developments

Several factors are in play to change current expectations for safety analysis

6.1 New regulatory expectations

We saw in the recent years a significant evolution of the expectation and practices in the area of safety analyses. The following comes to mind:

- introduction of new regulatory documents (RD-310 for deterministic SA)
  - increasing role of accounting for uncertainties;
  - understanding of conservatisms;
  - justification of acceptance criteria
  - quantification of safety margins
  - accounting for ageing effects;
  - control of methodologies;
- standardization of computer codes though the IST program with more stringent requirements for verification and validation of codes (CSA 286.7)
  - formal code validation
  - quantification of modelling uncertainties
- development of new analytical methodologies or formalization of old ones
  - Formalization of the LOE method
  - Development of the BEAU method and guidelines
  - Extreme Value Statistics (EVS) method
- wider use of the international benchmarking and best practices, including recommendations from IAEA

6.2 PSR/ISR

Periodic Safety Review (or its current Canadian variety, Integrated Safety Review) introduces a formal process of a periodic comparison of selected safety factors (safety analysis being one of them) against modern standards and best practices. Any gaps identified are addressed using a formal process which assesses the safety significance of the gap and considers costs associated with its resolution. This allows a conscious decision-making with regards to those safety analysis shortcomings that are not sufficiently safety significant and can be allowed to exist; at the same time the more important issues would be addressed on a priority basis.

6.3 New build

The planned new nuclear build necessitated a fresh look at the expectations for safety analysis (which are now reflected in the recently issued regulatory documents). Facing potential introduction of non-CANDU technology, an effort was undertaken to develop technology-neutral regulatory requirements and expectations. At the same time, to help CNSC staff as well as to assist potential applicants who may not be familiar with the established Canadian practices, detailed review guidance is being prepared.

This includes expectations to the contents and structure of Safety Analysis Reports. Two alternatives emerged – one following the US NRC Standard Review Plan [4], and the other one using the table of contents as given by the IAEA [5]. Both of these alternative include under the title of Safety Analysis Report much more than has been the practice for the currently operating plants (for example, the PSA would be a part of the Safety Analysis Report).

7. What s in the future?

Twenty years from now safety analysis may look quite different

If we take some of the recent trends in safety analysis and extrapolate them, say, 10-20 years in the future, what will we get? To help us answering the question, let put together a list of the key factors that are "shaping" these trends:

- accumulation of knowledge and data to close outstanding knowledge gaps
- fast development of computational and data storage capabilities
- expectation of continuously improving safety
- increased use of risk informed prioritization
- expectation of improved plant performance
- tighter cost controls
- increasing harmonization of national regulatory approaches.

Clearly, these factors do not pull in the same direction, but with some imagination the following seems if not likely then at least technically possible:

a) Digitalized plant design - all design parameters maintained up to date electronically) and available for multiple uses, including safety analysis. Any changes in SSC would be immediately indicated for assessment for their impact on safety analysis.
b) Fully coupled plant models - physics, thermal-hydraulics, fuel and channel behaviour, structural mechanics, etc.
c) Single input file for all safety analysis.

Table 4 - Demands for Safety Analysis

Analysis Demand Items	Examples	Summary Likelihood
1. Changes in the design of systems	- new fuel design - units in safe storage	Moderate (about once per year)
2. Changes in operating conditions or limits	- ageing effects - power penalty recovery - parallel parking of FM under a unit in a multi-unit station	Moderate (about once per year)
3. "Discovery" issues	- neutron flux tilts not accounted for in analyses - fuel relocation reactivity - increasing VREA - physics codes non-conservatism - CHF for 28-element bundle	Relatively rare (about once in 5 years) - negative impact on the licensee
4. Changes in regulatory requirements	- code validation requirement (G-149/GAI / CSA286.7) - transition to RD-310?	Rare

d) Advanced complex models - multi-phase CFD (TH), Monte-Carlo (physics), finite element models in fuel and channel deformation, etc.

e) Detailed consideration of uncertainties – aleatory and epistemic, operational and modelling.

f) Tuning of the conservatism concept to suit the analysis objectives and type of the event analyzed (AOO, DBA, BDBA).

g) Wider use of statistical techniques.

h) Intrinsic links to PSA - probability based analysis rules/assumptions.

i) Maturity of prioritization techniques (RIDM, CBA, etc) to provide better correlation of analysis priorities with safety or operational benefits.

j) Living deterministic safety analysis - i.e., analyses that are updated in (near-) real time to follow the plant configuration and operating parameters. This can be based on a combination of detailed (pre-existing) calculations and interpolation techniques to make the updating fast. This will allow monitoring, in the real-time mode, changes in potential consequences of postulated events as function of the actual plant state. This may also offer further opportunities for reductions of built-in conservatism of the modern safety analysis.

It remains to be seen whether any of the above will come about. One thing for sure — safety analysis will continue to evolve.

8. References

[1] IAEA Safety Standards GSR Part 4, Safety Assessment for Facilities and Activities, 2009.

[2] J. Luxat, "Safety Analysis Technology: Evolution, Revolution and the Drive to Re-Establish Margins", Presentation to CNS seminar, September 13, 2000.

[3] Guidelines for Application of the Best Estimate Analysis and Uncertainty (BEAU) Methodology to Licensing Analysis. COG-6-9012, Rev 1., April 2008.

[4] US NRC NUREG-800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.

[5] IAEA Safety Guide GS-G-4.1, Format and Content of the Safety Analysis Report for Nuclear Power Plants.

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GENERAL news

(Compiled by Fred Boyd from open sources)

NRU restart

As of June 9, 2010, Atomic Energy of Canada Limited predicted that the NRU reactor at the Chalk River Laboratories would be restarted in July 2010. Two days later the Canadian Nuclear Safety Commission reported that it was arranging for an early hearing to consider the restart of the reactor.

AECL reported that weld repairs on the reactor's vessel were ninety-eight per cent completed. Work was continuing to address a single imperfection identified during non-destructive examination of the final weld repair.

Activities related to the start-up phase of the NRU Return-to-Service project are ongoing in parallel to repair activities. Part of the Return-to-Service project's plan includes reactivating the NRU's operating systems.

AECL estimated that NRU will resume isotope production by the end of July.

The CNSC announced that it will hold a one-day public hearing to consider AECL's application for the restart of the NRU Reactor on 5 July 2010 in Ottawa.

The Hearing will be held in the CNSC Public Hearing Room, 14th floor, 280 Slater Street, Ottawa, Ontario and will be webcasted live on the Internet via the CNSC Web site and archived for a period of 90 days.

The CNSC noted that the Commission is aware of the importance of the NRU facility to nuclear medicine patients in Canada and around the globe. Therefore it considers returning the NRU to service as safely and as quickly as possible is a priority.

The Commission will vary the *CNSC Rules of Procedures* so that AECL's request can be dealt with in a fair and expeditious manner. This variation will significantly compress the notification period and the time usually allocated for the submission of documents by the licensee, the public and CNSC staff. CNSC states that AECL's submission and CNSC staff's recommendations to be considered at the hearing are available now on request.

The public is invited to comment on AECL's submission. Requests to intervene must be filed with the Secretary of the Commission within the time that will be set out in the Notice of Hearing on the CNSC website.

AECL's submission and CNSC staff's recommendations that are to be to be considered at the hearing are not yet available on-line. They can be requested through the Commission's Secretariat.

Gitzel appointed Cameco president

In late May 2010 Jerry Grandey, chief executive officer of Cameco Corporation announced the appointment of Tim Gitzel as president of the company.

Gitzel has been Cameco's senior vice-president and chief operating officer since 2007. Prior to joining Cameco, he was executive vice-president, mining business unit for AREVA based in Paris, France with responsibility for global uranium, gold, exploration and decommissioning operations in 11 countries. He also served as president and chief executive officer for AREVA's Canadian subsidiary.

Tim Gitzel was born and raised in Saskatchewan. He graduated from the College of Law at the University of Saskatchewan and worked with the firm MacPherson, Leslie and Tyerman in Saskatoon. He is a past president of the Saskatchewan Mining Association, and has served on the boards of SaskEnergy, the Saskatchewan Chamber of Commerce and Junior Achievement of Saskatchewan.

At the same time Bob Steane was appointed senior vice-president and chief operating officer.

Steane has been with Cameco since 1983 and has held increasingly senior positions within various divisions. These include general manager Key Lake, vice-president, mining, vice-president, fuel services and most recently, vice-president, major projects. Prior to joining Cameco, he developed extensive engineering, operations and project experience in Papua New Guinea, Namibia and Australia.

Government calls for proposals for non-reactor isotopes

In early June 2010, the Government of Canada issued a call for project proposals under a new $35-million medical isotopes supply program.

The $35 million in funding will be provided over two years to advance linear accelerator and cyclotron technologies for the production of the medical isotope technetium-99m. These technologies were viewed by the Expert Review Panel, which reviewed a wide range of proposals for medical isotope production last year, as having the greatest potential as alternative sources of supply. Funding will target projects that demonstrate a broad-based expertise to address research, development, demonstration, regulatory and commercialization issues.

The annoucement stated that the government will continue to address short-term isotope supply issues by working in close collaboration with international partners as well as the medical community, the provinces and territories. The government considers the supply of medical isotopes to be a global issue that requires a global solution, and has spearheaded work through the Organization for Economic Cooperation and Development to make the global supply of medical isotopes more secure and predictable worldwide.

The deadline for project submissions is July 26, 2010. For more information about the program and how to submit a project proposal, visit www.isotopes.nrcan.gc.ca.

Point Lepreau Refurbishment Update

In early June 2010 New Brunswick Power and Atomic Energy of Canada Limited reported that overall work on the Point Lepreau Generating Station's Refurbishment project is approximately 75% complete.

AECL is currently working on the reassembly of the reactor and have completed the upper feeder installation. The lower feeder installation will proceed once the fuel channel components are all installed.

AECL is progressing with calandria tube installation. This is proving to be one of the most complex aspects of the entire Project. The insertion of all 380 calandria tubes was completed on April 28, 2010. This is a major milestone for the Refurbishment project, as it marks the first time that all of the calandria tubes have been removed and new tubes inserted in a CANDU reactor.

Work is now focused on rolling the calandria tubes in order to create a seal tightness that meets specification. AECL is currently experiencing challenges with producing consistently acceptable tight seals.

Each calandria tube requires an insert at each end to be rolled and tested – 760 in total. Of the 760 inserts, 421 had been successfully tested at the time of the report. Resources are being applied intensely to ensure developed procedures will resolve this issue.

Information on the overall project schedule continues to be founded on the best data available. In September 2009, AECL revised the completion date for its retube activities to October 2010. AECL has stated that this completion date is no longer achievable. New guidance on the completion of the retube activities will be issued when plans are finalized for the calandria tube installation.

NB Power and AECL are committed to providing regular updates on the Point Lepreau Generating Station Refurbishment project at the end of each month.

RMC Slowpoke turns 25

On 17 Sep 2010 the SLOWPOKE-2 nuclear research reactor at the Royal Military College in Kingston, Ontario, will reach its 25th birthday.

In recognition of this event an afternoon and evening of celebration was held on 7 June 2010 at the university. The afternoon was marked by presentations by invited speakers, including Michael Binder, president of the Canadian Nuclear Safety Commission, followed by an evening dinner in the RMC Senior Staff Mess.

Kinectrics opens Pickering office

Back in April 2010, Kinectrics opened a new office in Pickering, Ontario, to be close to one of its major customers, Ontario Power Generation.

The new Kinectrics Pickering office enables convenient local access for Ontario Power Generation (OPG). Proximity to the Pickering nuclear station—as well as the Darlington station—is important in providing expanded support for OPG's existing facilities and future nuclear new build.

Non-destructive evaluation testing and nuclear licensing services, provided by Kinectrics' companies, Axiom NDT (Cambridge, ON) and Candesco Corporation (Toronto, ON) will be accessible from the new location.

Kinectrics is an independent energy services company with almost 100 years experience in the power industry. .

Pickering mayor, Dave Ryan joined Kinectrics president David Harris at the opening.

Enhanced CANDU 6 passes CNSC phase 1

The Canadian Nuclear Safety Commission (CNSC) has completed Phase 1 of a Pre-Project Design Review of Atomic Energy of Canada Limited's (AECL) Enhanced CANDU 6 reactor™ (EC6™). The conclusion is that, at an overall level, the design intent is compliant with the CNSC regulatory requirements and meets the expectations for new nuclear power plants in Canada.

The objective of a Pre-Project Design Review is to verify, at a high level, the acceptability of a nuclear power plant design with respect to Canadian regulatory requirements and expectations.

The CNSC Phase 1 Pre-Project Design Review of the EC6 concluded that:

AECL has, in general, provided sufficient design and analysis information for the purpose of this review; and

At an overall level, the design intent is compliant with the CNSC regulatory requirements and meets the expectations for new nuclear power plant designs in Canada.

This conclusion will be further confirmed during a Phase 2 review when outstanding information for specific technical items for each review topic will be provided to the CNSC. The CNSC staff anticipate that these items can be brought to closure during a Phase 2 review.

Annual General Meeting

The 2010 Annual General Meeting of the Canadian Nuclear Society Inc. was held on the afternoon of 26 May 2010 at the Bonaventure Hotel in Montreal, Quebec, in connection with the Annual Conference of the Society.

With appreciably more than the 30 members required President Dorin Nichita declared the meeting open.

Minutes of the 12th Annual General Meeting of the incorporated Society, held in Calgary, Alberta, 1 June 2009 were presented and approved.

There being no business arising from the minutes President Nichita proceeded to present his report (reprinted in this issue).

On behalf of Eric Williams, Ken Smith presented the Treasurer's report. A copy of this report along with the report from the Auditor has been enclosed with this issue of the Bulletin for all members in good standing.

Jim Harvie presented the list of nominees for the Executive and Members at Large of Council for the period 2010 – 2011. With no nominations forthcoming from the floor this slate was declared elected by acclamation. (See list elsewhere in this issue.)

A number of reports were presented or summarized on the activities of the various Divisions and Committees.

With the business completed, Dorin Nichita handed over the traditional gavel to incoming president, Adiaan Buijs, who then presented his thoughts for the coming year (reprinted in this issue). This was followed by 2009 – 2010 Past President Jim Harvie presenting a plaque to Dorin Nichita to mark his successful year as president.

Dorin Nichita (R) hands the traditional gavel to new president Adriaan Buijs.

The meeting was declared closed just in time for those attending to catch the buses to the conference dinner.

President's Report 2009-2010

Presented by Eleodor Nichita to the CNS Annual General Meeting – Montreal, Quebec. 26 May 2010

Already thirty years old, the Canadian Nuclear Society continues to be a vibrant organization dedicated to the exchange of information in the field of nuclear science and technology. During the past year the CNS has continued to be very active in its traditional areas of strength.

Conferences and Courses

Annual Conference

Following the successful New Brunswick Conference in 2007, a deliberate effort was made to hold the Annual Conference in diverse locations across Canada. In 2009, the annual CNS Conference and the CNS/CNA student conference were held in Calgary, Alberta and enjoyed excellent participation. Under the motto "New Nuclear Frontiers", the Conference included a very successful Western-Focus Seminar, dedicated to oil-sand and small-reactor applications of nuclear technology. By the numbers:

1. 116 technical papers
2. 18 student papers
3. 27 technical presentations in the western-focus seminar Excellent plenary program
4. 480 Participants

In 2011 the CNS Annual Conference will be held in Niagara Falls, ON and in 2012 it will be held in Saskatoon, SK, at the express invitation of Premier Brad Wall.

Other Conferences, Courses and Workshops

A very successful 6th International Steam Generator Conference was held in Toronto in November 2009 with an all-time high attendance of approximately 300.

The all-time popular CANDU Reactor Safety Course was offered in September in Toronto and the CANDU Fuel Teclmology Course was offered in October in Oakville, ON.

The Workshop on Radionuclide Production Methods was held in Ottawa in December and brought together approximately 80 experts (15 speakers) from different fields with the purpose of discussing the future of medical radioisotope production in Canada. This special event was very timely, relevant and successful.

The 2nd Canada-China Joint Workshop on Supercritical Water-Cooled Reactors (CCSC-201O) was held April 25-29, 2010 in Toronto.

Education and Communications

The CNS Education and Communications Committee (ECC) has been very active in promoting public education on nuclear science and technology matters. It has continued to provide high-schools with Geiger counters to be used in science classes and is planning to expand this activity in collaboration with the Alberta Branch.

The Alberta Branch has also been instrumental in providing balanced public information on nuclear matters in that province, where the prospect of nuclear power development has stimulated public debate.

A Nuclear Education and Outreach Symposium (NEO-20 1 0) is scheduled for June 2010 at the University of Calgary.

The CNS Undergraduate Scholarship Program has continued and a new CNS Graduate Scholarship Program was started.

Publications

The two main vehicles for disseminating up-to-date information to the members are the website and the CNS Bulletin.

In 2009 the website was re-designed to improve overall navigation and access to the calendar of events.

The Bulletin has continued to provide members with information on nuclear industry developments, insightful discussions, and reprints of notable technical papers published by members.

To expand the Society's ability to disseminate scientific and technical information and to foster technical debate, in 2009 the Council approved in principle the creation of a CNS technical journal. The publications committee has been directed to develop detailed recommendations for the Journal.

Society Developments

CNS functions as a volunteer organization and thus, with a few exceptions, relies heavily on the efforts of dedicated members who continuously invest substantial effort in organizing CNS events and advancing the goals of the Society. As the scale of CNS activities has increased, it has become more difficult to sustain the level of volunteer effort required. To address this issue, the Council has been working on ways to increase the use of professional services without compromising the volunteer nature of the organization.

Conclusion

Over the past year, the Canadian Nuclear Society has continued to serve its members and the Canadian nuclear industry through an ever-expanding array of activities.

E. Nichita
CNS President, 2009-2010

New President's Comment

*(Following is a slightly modified (by him) version of the comments from **Adriaan Buijs** at the CNS Annual General Meeting, 26 May 2010 after taking on the role of President for 2010 – 2011.)*

I would like to say a few words regarding the past, the present and the future.

Regarding the past, I should remind you that the CNS is (still) a volunteer organisation, and therefore it is my pleasure to acknowledge all the volunteer and quasi-volunteer work that has been done in the past year leading up to this moment. This includes all the organising committees, the branch activities, the division activities, the outreach and educational activities, the administrative and financial activities, all filled and performed by the volunteers, which I would like to thank here.

There is one volunteer, whom I would like to mention in particular. Eric Williams took it upon himself to follow up on the strategic plan for the CNS, which is a big task to which I will return when I talk about the future. He also took over from Jim Harvie, past president, the preparation of the slate for next year's Council, after an illness prevented Jim from performing this task. I would like to thank Eric for these two contributions, and also, on behalf of the CNS, to wish Jim a speedy and complete recovery.

The present is here: a successful conference; a new Council. I am excited to see that we managed to assemble a Council with members at large that more closely represent the nuclear playing field in Canada than was the case before.

Now for the future: I remember being envious of Dorin [Nichita] a year ago: under his presidency the sun was going to rise, nuclear new-builds were going to be announced in Canada and he would be in the middle of it. We all know how it turned out, and I have few illusions about such announcements during my tenure; we all know something is going to happen in the industry, but few of us know what, and I suspect even fewer know how it will work out for the industry and for nuclear power in Canada in general.

But let's return to our own business: the presidency is short, one year to accomplish things, but that is not the right way to approach it. After all, every CNS member can initiate an activity at any time, follow through on it, and make an accomplishment. Rather, in the first instance I see myself enabling existing initiatives that I believe in. One is the establishment of a CNS Journal. This is an old initiative, carried by several people in the past, that merits to be followed through.

Other initiatives involve a participation in discussions around medical isotope production, and perhaps radiation protection.

Finally, a major project, mentioned before, is the follow-up on the Strategic Plan. The plan deals with the issue of the identity of the CNS and its membership. But it also made the concrete proposal to move to more professional support for our core business, to bring continuity, new initiatives and growth to the core business, and to relieve the volunteering load.

This means we will need to identify the mandate and the scope, the conditions, and finally the right person for this professional support in the form of an executive managing director.

The original plan was conceived in the early days of the nuclear renaissance. There is the temptation to shelve this plan, just like plans for nuclear new-build are shelved. But as we ask our politicians not to take the short term view, we should not let ourselves be discouraged by negative short-term outlooks, either.

So, in summary, I am looking forward to working with the new Council to follow through on existing initiatives and to facilitate new ones.

Adriaan Buijs

CNS 2010 – 2011 Council Members

Executive		
President	Adriaan Buijs, McMaster University	
1st VP (President elect)	Frank Doyle, CANDU Owners Group	
2nd VP	John Roberts, CANTECH Associates	
Secretary	Prabhu Kundurpi, Retired (formerly Ontario Power Generation)	
Treasurer	Mohamed Younis, AMEC NSS	
Past President	Dorin Nichita, UOIT	
Members at Large		
Blair Bromley, AECL	Kris Mohan, Retired	Len Simpson, Retiree
Emily Corcoran, Royal Military College	Dave Novog, McMaster University	Nick Sion, Consultant
Mohinder Grover, AECL	Jacques Plourde, Consultant	Michael Stephens, Consultant
Krish Krishnan, Consultant	Jad Popovic, Consultant	Melanie Sachar, AECL
Peter Lang, Air Canada	Tasfia Preeti, UOIT	Jeremy Whitlock, AECL
James Leveque, Consultant	Ben Rouben, Consultant	Syed Zaidi, AECL
David Malcolm, Retired		

Preliminary Call for Papers

"Technical Meeting on Low-Power Critical Facilities and Small Reactors"

Ottawa, Ontario CANADA
2010 November 1-3

"Celebrating ZED-2's 50th Anniversary"

Objective

The Zero Energy Deuterium (ZED-2) Critical Facility, located at AECL's Chalk River Laboratories will be celebrating its 50th Anniversary this year. Built in the late 1950s, ZED-2 achieved first criticality on September 7, 1960. ZED-2 was initially built to test the fuel arrangement of Canada's first nuclear power plant, the Nuclear Power Demonstration (NPD), located along the shores of the Ottawa River about 20 km upstream of Chalk River. ZED-2 was the successor to the first nuclear reactor outside of the United States, the Zero Energy Experimental Pile (ZEEP), which was designed to investigate lattice physics and reactor kinetics. Since that time, the ZED-2 critical facility supports the development of the CANDU industry by testing a wide range of fuel bundle designs, fuel arrangements at low power under a variety of operating conditions and simulating accident scenarios. ZED-2 continues to operate today, supporting the current CANDU fleet, development of the Advanced CANDU Reactor and advanced fuel cycles including thorium fuels.

To mark the historic occasion of ZED-2's 50th anniversary, a Technical Meeting to showcase the numerous accomplishments of low-power critical facilities worldwide will be held in Ottawa in early November. The two-day Technical Meeting will cover topics of interest to operators, experimenters and analysts involved with low-power critical facilities. Following the conference, AECL will host all interested attendees for a day at the Chalk River Laboratories, with the highlight being a tour of the ZED-2 critical facility.

Key Deadlines

Abstract submission ….....Aug. 15, 2010
Notification of acceptance…….....Sept. 1, 2010
Early registration deadline ….....Sept. 15, 2010
.

Abstract Submission

Abstracts must be submitted via an on-line submission link, which will be posted on the CNS webpage at http://www.cns-snc.ca. Abstracts/ extended abstracts, up to three pages in length, and participants' presentations will be published on CD in the Conference Proceedings.

Conference Organizers

Honorary Co-chairs……..…..Ralph Green, Chas Millar
Rick Jones, John Hilborn
General Chair…….....Bhaskar Sur
Technical Program Co-chairs …….....Alex Rauket, Milan Ducic
Program Committee..... .....Peter Boczar
Ken Kozier
Rick Didsbury
Dave Irish
Bruce Wilkin
Brock Sanderson
Julian Atfield
Mike Zeller
Elisabeth Varin

Topics of Interest

Papers related to the following topics are of interest to this conference:

- Safety and licensing of critical facilities
- Measurements in critical facilities
- Analysis of measurements from critical facilities
- The use of measurements from critical facilities in reactor physics code validation
- Extension of bias and uncertainty from the critical facility to the test reactor
- Other uses of measurements from critical facilities
- Design development of instrumentation for measurements in or control of critical facilities
- Different fuel compositions, geometries, reactivity worth of devices, kinetics parameters, reactor types
- Measurements of irradiated materials, actinides
- Reactor physics benchmark databases and activities
- Education and research with small reactors

Further Information

Additional information may be obtained by contacting Technical Program Co-chair: Milan Ducic, AECL, Chalk River Laboratories, Chalk River, Ontario K0J 1J0 CANADA, Tel: (613) 584-3311;
Email: ducicm@aecl.ca

Education & Communication Committee Report

One of the most active CNS committees, if not the most active, is the one on Education and Communication. Following is an edited version of the report from that committee to the CNS Annual General Meeting, 26 May 2010.

1. Education Activities

1.1 Sponsorships

In 2009, the CNS continued to provide financial support to the following organizations:

- The Deep River Science Academy $10000
- Scientists in School $ 2100
- Visions of Science Network for Learning $ 2100

1.2 CNS Ionising Radiation Workshop for Science Teachers

The CNS ECC presented the Ionising Radiation Workshop at 5 events in 2009 to approximately 110 high school science teachers at:.

- Ottawa Carleton District School Board Ottawa,
- Atlantic Canada Association of Science Educators (ACASE) Annual Conference
- Alberta Teachers' Association Science Council (ATASC) Annual Conference
- Northern Secondary High School
- York Region District School Board PD day

30 Geiger Kits were distributed to teachers at the Moncton presentation. A total of 52 Geiger Kits were distributed in calendar year 2009. One of the donations was sponsored by Kinectrics Inc. (Canada).

The ECC has submitted a paper to the Nuclear Education and Outreach Conference 2010 on the workshop and Geiger donation program.

To date, in 2010 the workshop has been presented at:

- Rocky View School District Professional Development Day (Alberta) and
- The Ontario Association of Physics Teachers Annual Conference in Toronto, ON

Several additional presentations are planned for the remainder of 2010.

A second partial set of equipment for workshop presentations has been assembled. This facilitates concurrent presentations at separated venues. The extra equipment has been placed in the care of Jason Donev at the University of Calgary.

Status of CNS Geiger Kits for High Schools:

On hand at end 2009 +8
Donated to date in 2010 -2
Outstanding Requests -20
On order for 2010 +25
Available for balance of 2010 11

It should be noted that several request for donations have resulted from Jason Donev's U of C outreach activities.

1.3 Donation of "Half Lives" book to Canadian post-secondary libraries.

A total of 234 copies of the book "Half Lives – A Guide to Nuclear Technology in Canada" (Oxford University Press, 2009), by Hans Tammemagi and David Jackson were donated to Canadian post-secondary libraries (English and French). This is the (renamed) update to "Unlocking the Atom" (McMaster University Press, 2002), which the CNS also donated to Canadian post-secondary schools.

2. World Nuclear University

Aninda Dutta Ray of AMEC NCL working on the Bruce Restart Engineering Project is the sole applicant for and will be awarded the CNS bursary to assist with attending the WNU session at Oxford in the summer of 2010. (No applications were received for 2009.)

3. Undergraduate Scholarship Program

Glen Harvel of UOIT volunteered to lead the scholarship program for 2010. He has reported that only one application was received and the 2010 Undergraduate Scholarship has been awarded.

Jennifer Bates: University of Western Ontario; supervisor: **J. Clara Wren.**

Radiation Induced Colloidal Formation for Crud and Activity Transport.

4. Rutherford Documentary

Professor J. Campbell reports that the documentary on Ernest Rutherford is in final post production for 3 one-hour episodes. One will focus on Rutherford's work at McGill University in the early 20th century that won him the Nobel Prize It is expected to be available in the fall. *(CNS contributed towards the production of this documentary.)*

The report was prepared by hard-working member Bryan White on behalf of co-chairs Jeremy Whitlock and Peter Lang.

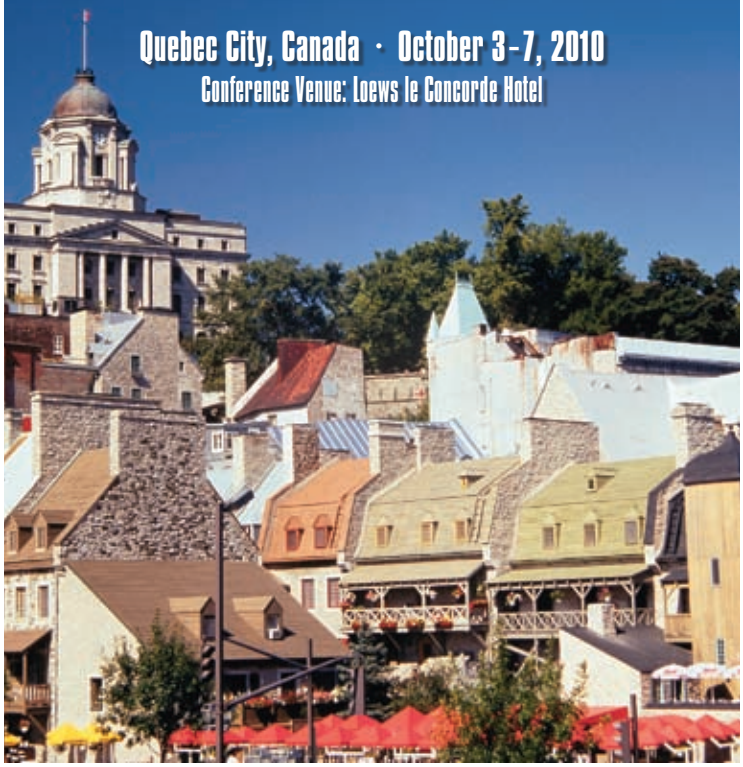
NPC 2010

Nuclear Plant Chemistry Conference 2010

(International Conference on Water Chemistry of Nuclear Reactor Systems)

Quebec City, Canada · October 3-7, 2010

Conference Venue: Loews le Concorde Hotel



The 2010 **International Conference on Water Chemistry of Nuclear Reactor Systems** focuses on the latest developments in the science and technology of water chemistry control in nuclear reactor systems. What began in the UK in 1977 as the Bournemouth Conference Series has of late been held biennially under the organization of a host country. For 2010, that country is Canada. The Conference is a forum where utility scientists, engineers and operations people can meet their counterparts from research institutes, service organizations and universities to address the challenges of chemistry control and degradation management of their complex and costly plants for the many decades that they are expected to operate. In 2010 the focus will be on operating experience and the subsequent lessons to be learned, with supporting material on new developments and research.

Features of the Conference

Quebec City – the Conference will be held in the heart of Old Quebec City, which in 2008 celebrated its 400th anniversary. The city is renowned for its old-world charm, history, fine cuisine and as the centre of the Province's unique and very dynamic culture.

Loews le Concorde Hotel – located within minutes walk from the heart of old Quebec City, is the perfectly located and appointed venue. Be sure to reserve early.

Conference Format – four days of single session presentations with Poster Sessions that will be promoted as part of the Technical Sessions. All Proceedings will be in English.

Walking Tours of Old Quebec City – in various themes and languages; and for your consideration, a **Canadian Forests in Autumn Excursion**.

Radiolysis, Electrochemistry & Materials Performance Workshop

The 8th Int'l Radiolysis, Electochemistry & Materials Performance Workshop will be held as an associated, but otherwise free-standing, event on Friday, October 8, 2010. Papers selected from requests for invitation to speak will be presented. For organization and registration information regarding this Workshop, see the website at **www.cns-snc.ca**

NPC2010 Program

Technical papers will be presented in the following topic areas. There is special interest in the experience of plants with Alloy 800 as well as of those with Alloy 600 and Alloy 690 steam generator tubing.

- Chemistry and NPP Performance
- PWR, VVER Operating Experience
- CANDU/PHWR Operating Experience
- Pressurised Water Scientific Studies
- Steam Cycle Operating Experience
- BWR Operating Experience
- Boiling Water Scientific Studies
- Water and Waste Treatment, Cooling Water Systems, Auxiliary Systems
- Materials Aging and Mitigation of Degradation
- Chemistry and Fuel Performance
- Cleaning and Decontamination
- Lifetime Management
- Chemistry Optimization Programs
- Chemistry Compliance Management
- Future Developments (GEN IV), Supercritical Water

Paper Submission

All authors have now been notified of acceptance of their papers and have instructions regarding their completion. Papers are due per the Milestone Dates noted below.

Milestone Dates

2010 June 25 . . . . . Papers Due
2010 October 3 to 7 . . . . . Conference
2010 October 8 . . . . . .Workshop

*** Sponsorship Opportunities ***

A number of opportunities remain for Sponsorship of various Conference Activities. Sponsorships providing assistance to Students for Participation in this important event are also available. Sponsorships include Sponsor recognition within the Final Program and at the Conference itself – don't miss this chance for recognition as an active supporter of the work and objectives of NPC 2010. To inquire, contact: Elizabeth@theprofessionaledge.com or call 1-800-866-8776.

Conference Information

For additional information on the Conference go to **www.cns-snc.ca**.

Registration

To register for the Conference and Workshop go to **www.cns-snc.ca**.

Event Administrator – The Professional Edge

If you require assistance with submissions or anything else related to NPC2010, please contact: Elizabeth Muckle-Jeffs (Elizabeth@theprofessionaledge.com)

Conference Sponsor and Organizer

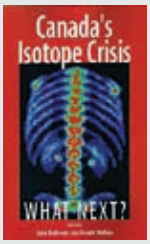
The Canadian Nuclear Society is pleased to serve as the sponsor and organizer of the NPC 2010 Conference.

IAEA – This Conference is held in cooperation with the International Atomic Energy Agency; in certain circumstances the IAEA will provide assistance for attendance. Please contact John Killeen at the IAEA for details (J.Killeen@iaea.org).

Book

Canada's Isotope Crisis: What Next?

edited by Jatin Nathwani and Donald Wallace, McGill Queen's University Press 2010, ISBN 978-1-55339-283-5 (paperback and cloth)
reviewed by Fred Boyd



Cover note: The ongoing medical isotope supply crisis is affecting more than Canadian health. It not only puts at risk our aspirations to nurture a leading edge industry, it severely limits our options to help reduce the burden on future health care budgets. What got us into this mess is a tale of high minded optimism, missed opportunities and bureaucratic bungling. The more important question, however, is how can we re-establish Canada's prominence, and secure at reasonable cost the potential benefits that medical isotopes will deliver for our future health. Addressed in this collection are provocative essays from some of the world's top experts in nuclear physics and nuclear medicine.

Review:

This book contains ten essays or chapters by a number of authors knowledgeable about the history, science and politics associated with the production and use of radioisotopes for medical purposes complemented by comments and recommendations by the editors. The authors include three members of the CNS and, one chapter in particular, draws heavily on the *Workshop on Medical Radionuclide Production Methods* held in Ottawa in December 2009, which was organized by the Society.

Included in the ten chapters are: a succinct history of Canada's long involvement in radioisotopes; an explanation for the layman of the use and importance of those isotopes for diagnosis of a number of medical conditions, and a discussion of alternative methods of producing the isotope most used in diagnosis, Technetium 99m.

The editors use this background to offer four "general" recommendations and three "technology specific" ones.

General:

1. Strive for diversity and redundancy throughout the supply chain:
2. Leverage multi-use infrastructure:
3. Continue with international coordination and seek processing standardization within North America:
4. Recognize that highly enriched uranium options are only viable in the short term.

Technology specific:

1. Make policy decisions on the requirement for a new research reactor:
2. Support research and development for cyclotron-based Tc 99m production
3. Achieve better use of Tc 99m through advanced medical imaging technologies.

This book will enable CNS members to speak knowledgeably about this topic and is highly recommended.

Publications

Tritium Studies Project Synthesis Report

The Canadian Nuclear Safety Commission has announced the availability of its *Tritium Studies Project Synthesis Report.*

This report is a summary report of a series of research studies produced by the Canadian Nuclear Safety Commission (CNSC) under its Tritium Studies Project. The goal of the research is to expand the body of knowledge on tritium and to further enhance regulatory oversight of tritium-related activities in Canada. The Synthesis report summarizes the studies and provides overall conclusions and recommendations to make the regulation of tritium even safer, protect future drinking water resources and enhance environmental compliance monitoring.

CNSC staff submitted the Synthesis Report formally at the Commission meeting held 29 June 2010.

Background:

In January 2007, the Commission Tribunal directed CNSC staff to initiate research studies on tritium releases in Canada, and to study and evaluate tritium processing facilities exercising the best practices around the globe. In response, the CNSC has undertaken several research projects under the banner of the Tritium Studies Project. This research will enhance the information used in the regulatory oversight of tritium processing and tritium releases in Canada.

The following studies were conducted under the banner of the Tritium Studies Project:

- Standards and Guidelines for Tritium in Drinking Water (INFO-0766)
- Investigation of the Environmental Fate of Tritium in the Atmosphere (INFO-0792)
- Tritium Releases and Dose Consequences in Canada in 2006 (INFO-0793)
- Evaluation of Facilities Handling Tritium (INFO-0796)
- Tritium Activity in Garden Produce from Pembroke in 2007 and Dose to the Public (INFO-0798)
- Health Effects, Dosimetry and Radiological Protection of Tritium (INFO-0799)
- Tritium Studies Project Synthesis Report (INFO-0800)

All of these reports can be downloaded from the CNSC website: www.nuclearsafety.gc.ca
(All are extensive. For example the one on Health Effects is 209 pages)

Waste Management, Decommissioning and Environmental Restoration for Canada's Nuclear Activitities

Current Practices and Future Needs

The Canadian Nuclear Society is pleased to announce a conference on **Waste Management, Decommissioning and Environmental Restoration for Canada's Nuclear Activities,** to be held September 11-14, 2011 at the Marriott Toronto Downtown Eaton Centre, in downtown Toronto. An equipment and services exhibition is planned in conjunction with the conference.

Second Announcement and Call for Paper Summaries

The conference is intended to provide a forum for discussion of the status and proposed future directions of technical, regulatory, environmental, social, and economic aspects of radioactive waste management, nuclear facility decommissioning, and environmental restoration activities for Canadian nuclear facilities. Although the conference will focus on activities pertaining to Canada's nuclear industry, many of the technical issues involved have a broader relevance, therefore papers on the topic of the conference from outside the nuclear industry, and from other countries, will be welcome.

The conference is organized into plenary sessions and concurrent technical tracks and papers are being solicited for the Technical Sessions.

Topics to be addressed during the conference will include the following:

- Near-surface disposal of very low level waste
- Low and intermediate level waste management issues, with an emphasis on geological disposal and operational issues faced by waste-producers such as waste segregation, characterization, verification; treatment and processing; waste minimization, and waste inventories
- Uranium mining, milling and conversion wastes
- Transportation
- Used nuclear fuel, with an emphasis on geological disposal, but including storage practices
- Decommissioning and environmental remediation, including that of old waste management facilities
- Licensing and regulatory considerations, including standards and clearance criteria
- Social issues, including siting of facilities, and decision-making criteria and processes

Deadlines

- Submission of Paper Summaries: October 4, 2010
- Author notification of acceptance: November 12, 2010
- Submission of full papers: May 13, 2011
- Comments to authors on papers: August 15, 2011
- Submission of final full papers: September 11, 2011

Guidelines for Submission of Paper Summaries

Paper Summaries should be approximately 750 to 1200 words in length (tables and figures counted as 150 words each).

They should include:
- an introductory statement indicating the purpose of the work
- a description of the work performed
- the results achieved

Summaries are to be submitted no later than October 4, 2010 by e-mail to Mark Chapman: **CNSP2011@aecl.ca**

For more details see the conference website http://www.cns-snc.ca/events/waste-management-decommissioning-and-environmental/

Post Conference Technical Tours

Technical tours are being planned to three Canadian nuclear facilities: the Low-Level Radioactive Waste Management Office activities at Port Hope, the Darlington Used Fuel Dry Storage Facility, and the OPG Western Waste Management Facility at the Bruce site.

Questions regarding papers and the Technical Program should be addressed to:

Mark Chapman
E-mail: CNSP2011@aecl.ca

General questions regarding the Conference should be addressed to:

Elizabeth Muckle-Jeffs
Conference Administrator
The Professional Edge
Tel. North America toll-free: 1-800-868-8776
Tel. International: 1-613-732-7068
Fax: 613-732-3386
Email: Elizabeth@TheProfessionalEdge.com

Questions about Conference registration should be addressed to:

CNS Office
Tel.: 416-977-7620
E-mail: cns-snc@on.aibn.com

Organizing Committee

Colin Allan (AECL, retired), *Conference General Chair*
Alan Melnyk (AECL), *Technical Program Chair*
Ken Dormuth (AECL retired), *Plenary Session Chair*
Joan Miller (AECL), *Sponsorships and Exhibits*
Tracy Sanderson (AECL), *Treasurer*
Benjamin Rouben (CNS), *Facilities*
Pauline Witzke (OPG), Judy Ryan (COG), Barbara Gray (AECL, retired), *Technical and Social Tours*
Elizabeth Muckle-Jeffs, *Conference Administrator*
Denise Rouben (CNS Office), *Conference Registration*
Jo-Ann Facella (NWMO)
Ken Gullen (Cameco Corporation)
Don Howard (Canadian Nuclear Safety Commission)
Kathleen Hollington (Natural Resources Canada)
Janice Hudson (OPG)
Dave McCauley (Natural Resources Canada)
Jamie Robinson (NWMO)

The conference is being organized by the Canadian Nuclear Society in cooperation with the International Atomic Energy Agency, and is co-sponsored by the American Nuclear Society, the Argentina Nuclear Technology Association, the Atomic Energy Society of Japan, the Chinese Nuclear Society, the Indian Nuclear Society, the Korean Nuclear Society, the Nuclear Energy Agency of the OECD and the Romanian Nuclear Energy Association.

CALENDAR

2010

July 12-18 — **International Youth Nuclear Congress 2010 (IYNC 2010)**
Cape Town, South Africa
website: www.iync.org/iync-2010/

Aug. 15-18 — **Uranium 2010 – 3rd International Conference on Uranium; 40th Annual Hydrometallurgy Meeting**
Saskatoon, Saskatchewan
website: www.metsoc.org/u2010/

Aug. 29-Sept. 2 — **DD&R 2010 International Meeting on Decommissioning, Decontamination and Re-Utilization**
Idaho Falls, Idaho, USA
website: www.ans.org

Sept. 12-16 — **21st World Energy Congress**
Montreal, Quebec
website: www.wecmontreal2010.ca

Oct. 3-7 — **International Conference on Water Chemistry of Nuclear Reactor Systems (NPC 2010)**
(organized by CNS)
Quebec City, QC
website: www.cns-snc.ca

Oct. 10-14 — **8th International Topical Meeting on Nuclear Reactor Thermalhydraulics, Operation & Safety (NUTHOS-8)**
Shanghai, China
website: www.nuthos-8.org

Oct. 17-20 — **11th International Conference on CANDU Fuel**
Niagara Falls, ON
website: cns-snc.ca

Oct. 24-28 — **9th International Conference on Tritium Science & Technology**
Nara, Japan
email: uda.tatsuhiko@nifa.ac.jp

Oct. 24-30 — **17th Pacific Basin Nuclear Conference**
Cancun, Mexico
website: www.pbnc2010.org.mx

Nov. 7-10 — **AMP2010 International Workship on Aging Management of Nuclear Power Plants and Water Disposal Structures**
Toronto, ON
website: www.amp2010toronto.com

Nov. 7-11 — **2010 ANS Winter Meeting and Nuclear Technology Expo**
Las Vegas, Nevada
website: www.ans.org/meetings/m_74

Nov. 7-11 — **Embedded Topical: Isotopes for Medicine and Industry**
Las Vegas, Nevada
website: bmd.ans.org/isotopes.shtml

2011

June 5-8 — **32nd CNS Annual Conference**
Niagara Falls, Ontario
website: cns-snc.ca

June 26-30 — **ANS Annual Meeting**
Hollywood, Florida
website: www.ans.org

Sept. 11-14 — **Waste Management, Decommissioning & Environmental Restoration for Canada's Nuclear Activities**
Toronto, Ontario
website: cns-snc.ca

TENURE-TRACK FACULTY POSITION
NUCLEAR MATERIALS

The Faculty of Engineering at McMaster University invites applications for a tenure-track faculty position in the area of Nuclear Materials. The appointment is intended to be at the Assistant or Associate Professor level; however, consideration will also be given to exceptional candidates at the Full Professor level. This position will expand upon current McMaster expertise in nuclear engineering and materials research as well as contributing to the Faculty's strategic initiatives in sustainability.

The applicant should have expertise in the field of nuclear materials, with a focus on structure and properties relationships of various reactor components and technologies. The applicant is expected to develop a strong externally funded research program and capitalize on existing and new infrastructure at the university including the McMaster Nuclear Reactor, the accelerator laboratories and the state-of-the-art characterization facilities at the Canadian Centre for Electron Microscopy and a new facility to characterize irradiated samples. McMaster University has also received new funding from the Canada Foundation for Innovation (CFI), the Ontario Research Fund Research Infrastructure program and the Natural Sciences and Engineering Research Council totaling approximately $50 million in infrastructure in the areas of nuclear energy and $20M in materials analysis at the Canadian Centre for Electron Microscopy. This position will build upon faculty expertise in materials engineering, nuclear engineering, as well as facilities and experience available through the Brockhouse Institute for Materials Research and the McMaster Institute for Energy Studies.

Applicants must have earned a Ph.D. in Materials Science/Engineering or Engineering Physics or a closely related discipline. The successful applicant will be expected to develop an effective research program and demonstrate a strong commitment to teaching and curriculum development at both the undergraduate and graduate levels. The Faculty expects the successful candidate to become registered as a Professional Engineer in the Province of Ontario.

This position is available as of July 1, 2010 and will remain open until the position is filled. Applications by e-mail are encouraged.

All qualified applicants are encouraged to apply; however, Canadian Citizens and permanent residents will be given priority. McMaster University is strongly committed to employment equity within the community, and to recruiting a diverse faculty and staff. The University welcomes applications from all qualified applicants, including women, members of visible minorities, Aboriginal persons, members of sexual minorities, and persons with disabilities.

Interested applicants should send a letter of application, curriculum vitae, statements of teaching and research interests, a selection of research publications, and the names and addresses of at least three references to:

Faculty Selection Committee
Department of Materials Science and Engineering, McMaster University
1280 Main St. West, Hamilton, Ontario, L8S 4L7, Canada.
Email: matsci@mcmaster.ca
Reference: NUCLEAR 2010

Watt's in a name

by Jeremy Whitlock

In the Communication Age, perception is everything.

Nothing underscores this more starkly than the recent name-change of Canada's second-oldest magazine, "The Beaver", to the more prosaic "Canada's History Magazine". According to its publisher, Canada's National History Society, the rebranding was necessary since "beaver" has alternate connotations not foreseen 90 years ago when the Hudson Bay Company created the title.

The unintended double-entendre remained a harmless inside joke for many years, until customers started complaining that porn filters on email and search engines were preventing them from connecting with their beloved chronicle of Canada's past.

A century of tradition is one thing, but e-commerce is another: Au revoir, Beaver.

Here in the nuclear industry, we know of such perception woes. How many of us have bemoaned the choice of "critical" as the moniker of a self-sustaining chain reaction? Or the fact that our cores "poison out" occasionally, and use "burnable poison"?

CANDU plants, in particular, are known users of "liquid poison injections" (albeit in safe injection sites).

We "burn" our fissile material: the higher the "burnup" the better. Upon discharge this enormous energy resource is branded as "high-level waste", which we proudly claim can fit into five hockey rinks (which, as every red-blooded Canadian kid knows, are very, very big buildings…)

Our storefront needs work: we claim to have nothing to hide, but close our visitor centres and post armed guards at the gate. Our reactors, ultra-safe machines cocooned behind layers of defensive measures that require no human intervention, apparently require protection by crack paramilitary units from inquisitive families on Sunday drives.

The truth of the matter is that there is plenty about the nuclear industry that is worthy of emulation and cross-fertilization into everyday culture - if only everyday culture had the opportunity to see past the steel and concrete.

After all, "CANDU" is still the coolest tag ever given to a reactor design. It symbolizes the people who own it - the citizens of Canada - in both name and spirit. It also symbolizes the tenacity with which the technology has managed to cling to the marketplace, in the face of gale-force winds of economic and political pressure.

The word deserves a place in the common lexicon:

"CANDU" (*noun*): success despite enviable brilliance. As in: "Apple's CANDU was confirmed when its net worth surpassed that of Microsoft in May 2010."

Or how about these other useful terms from our own backyard:

"NRU" (*adj.*): indispensably useful, but generally invisible. As in: "We realized how NRU Mom was when she broke her arm and couldn't make our lunches".

"MAPLE" (*verb*): to be smothered to death by bureaucracy. As in: "Small independent meat shops are being mapled due to increased regulation in the food processing industry."

"Areva" (*noun*): rapid growth by absorption of all entities that come into contact. As in: "Google's success was accompanied by an unabashed policy of areva that soon made it one of the biggest corporations in America".

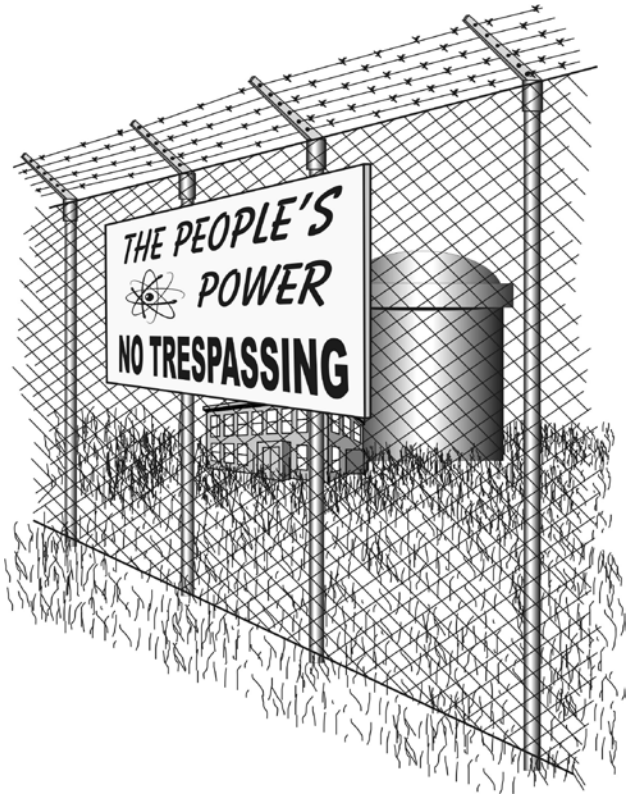
"Greenpeace" (*verb*): To employ terror tactics in order to achieve one's goals. As in: "The Taliban attempted to influence the election's outcome by greenpeacing the population into staying away from the polls."

"Caldicott" (*verb*): synonym for "Greenpeace", particularly with respect to medical scares. As in: "In 'Close Encounters of the Third Kind', the government faked an epidemic in order to caldicott the locals into evacuating the region around Devils Tower."

"Wind Power" (*noun*): an ability to achieve huge popularity despite mediocrity. As in: "Teen singing sensation Justin Bieber has amazing wind power."

"Thorium" (*noun*): a state of sudden renewed fame after decades of low-profile existence. As in: "Betty White achieved a new level of thorium when she hosted an episode of Saturday Night Live in May 2010."

Come to think of it, if "The Beaver" is up for grabs, perhaps the Canadian Nuclear Society's "Bulletin" could consider taking on the name. It would certainly mean more hits on the website.



2009-2010 CNS Council • Conseil de la SNC

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