CANADIAN NUCLEAR SOCIETY

Bulletin

DE LA SOCIÉTÉ NUCLÉAIRE CANADIENNE

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- 50th CNA Conference and Trade Show
- Government Response to Expert Panel
- Letter to US Director of Science & Technology Policy
- General News

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Government of Canada Responds to Expert Panel Recommendations

As the world-wide isotope crisis continues the NRU remains shut down for repairs. The extended outage prompted the Government of Canada to establish an expert panel to review and make recommendations to secure a reliable supply of medical isotopes. The Panel Executive Summary is published in the December 2009 edition of this Bulletin. The Government's response is carried in this edition of the Bulletin.

The Government rejected the Panel's recommendation for a new multi-purpose research reactor to replace the ageing NRU. Furthermore, the Government has rejected the Panel's recommendation to reconsider completion of the two MAPLE reactors. The MAPLE project was cancelled by AECL in May 2008, prompting its customer, MDS Nordion, to launch a $1.6 billion law suit aimed at compelling AECL to complete the MAPLE project.

What does this mean for future supplies of medical isotopes, Canadian neutron research, and the needs of the CANDU industry and indeed the future of CRL?

As for the two MAPLE reactors, there are differences of opinion on the cost to completion. There is also the issue of replacing the MAPLE core with low-enriched uranium, which will reduce through-put. Originally designed for highly enriched uranium targets, the core replacement will be necessary to meet Canada's obligations under the Nuclear Non-Proliferation Treaty. Nevertheless, the specific response was that no more taxpayer money would be spent on the MAPLEs. This leaves to door open to private investment to complete the project.

Neutron research and materials testing requires a neutron source. A research reactor for this purpose is needed to support the CANDU industry and to develop new fuel designs for the ACR. Furthermore, the CANDU is well suited to "burn" used LWR fuel, which China is now testing with its CANDUs. However, research is need to support this and other concepts in Canada, and this requires a test reactor.

Who would pay for such a multipurpose research reactor? Unfortunately we are in a "holding pattern" until the Government completes its restructuring of AECL.

The basis for the Government's decision not to replace NRU was that, for isotope production only, it would not be cost effective use of taxpayer money. However, as noted in the Government's response, the question on the need for a neutron source for research, as well as the needs of the CANDU industry, were outside the scope of its response. This means that the door is still open, but until private investment is obtained and the new CANDU Inc is formed, there cannot be a broad-scope decision to replace the NRU.

The decision to sell the CANDU division of AECL has also put Ontario New Nuclear into a holding pattern. The timing of that decision was not good. AECL has a customer that it is not serving, a customer that has just awarded another 2500 MWe of wind and solar generation that it claims will create 20,000 new jobs. These would be temporary "low tech" jobs because the Ontario Government is purchasing the wind turbines from foreign suppliers. Meanwhile, Ontario is at risk of losing 30,000 permanent indigenous high tech jobs that will inevitably move south if the sale of AECL lingers on. The sale of the CANDU business has become urgent and must be completed ASAP – actually, sooner than ASAP!

Concerned about selling AECL? Get over it and get on with it!

In This Issue

You may have wondered if your copy of the March 2010 Bulletin got lost in the post, or maybe the editor quit, the dog ate the copy or something like that. More like the latter – my computer crashed. It's amazing how dependent we have become on technology. You will also note that the Publisher's Page is missing. No, Fred did not quit, but also experienced a number of distractions this month. We apologize for the delay and any inconvenience.

In this issue we have a report on the **50th Anniversary CNA Nuclear Industry Conference and Trade Show** which attracted a record 800 delegates. We also feature an extended "***Letters***" section including an urgent request sent to Dr. John Holden, Director of Science & Technology Policy for the President of the US, with 98 signatories from 11 countries including Canada. The letter urges the US to accelerate the licensing and building of new reactors, citing the success of LWR in the US and CANDU in Canada. It also urges the US to accelerate research and development of Generation IV reactors. Dr. Holden's response is also included.

The operation of the electricity grid in Ontario is becoming increasingly complex. **Don Jones**, a CNS member, has written an article to explain it, and warns of new problems to come with the way the grid is operated.

In addition to two technical papers we have included the Government's response to the Isotope Expert Panel Recommendations. As usual, we have a number of general news items, CNS news, and of course **Jeremy [wit] Whitlock's *Endpoint***.

We hope you enjoy this issue and as usual, your letters and comments are welcome!

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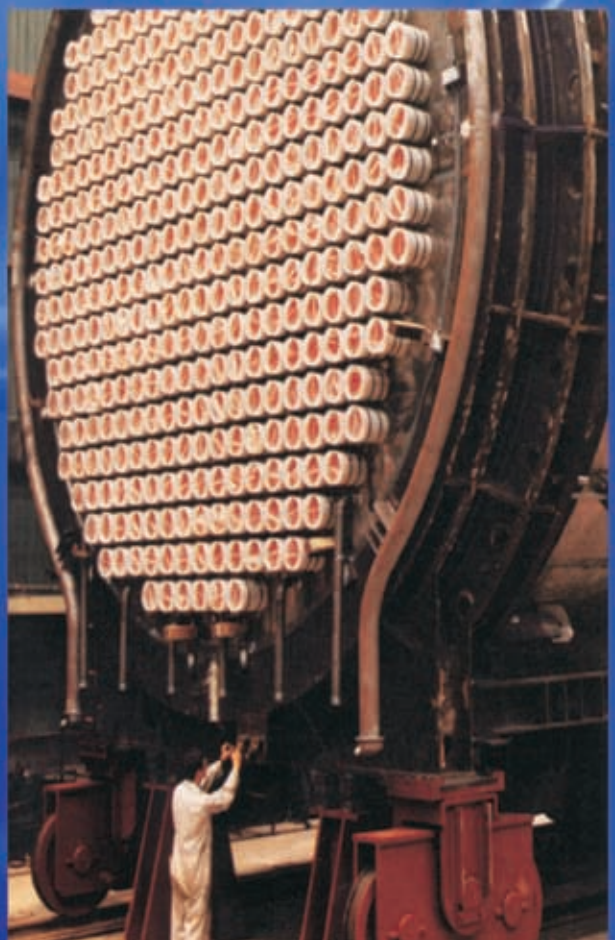

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~ Cover Photo ~

Ontario Power Generation announced that the Pickering Nuclear Generating Station will continue operating for an additional ten years, after which it will shut down permanently.

- CNS Bulletin File Photo

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Record number turn out for CNA 50th anniversary

The *Nuclear Industry Conference and Trade Show*, held by the Canadian Nuclear Association, 24 - 26 February 2010, was probably the largest gathering in the history of the Canadian nuclear program. Close to 800 delegates, exhibitors, students and others crowded into the conference floor of the Westin Hotel in Ottawa to celebrate the 50th anniversary of the of the CNA.

To mark that anniversary the CNA had produced an excellent 10 minute video highlighting the achievements of the Canadian nuclear community over the past century. This was shown at the breakfast of the first day.

The event began on the evening of the 24th with an impressive reception hosted by Areva Canada. Following the pattern of recent years the Minister of Natural Resources Canada, **Christian Paradis**, was the guest speaker. This was his first public appearance after his appointment in mid January to replace Lisa Raitt. After noting the recent appointment of Denise Carpenter as CNA president he acknowledged being new as Minister of NRCan but quickly asserted that he was not new to the "nuclear file".

He stated three government objectives: meeting energy and environmental goals; protecting interests of taxpayers, ensuring the nuclear industry is positioned to take advantage of opening opportunities. Then he listed current nuclear-related activities:

- a modernized Nuclear Liability and Compensation Act
- support for the Nuclear Waste Management Organization
- moving ahead with Port Hope
- ensure an economic and regulatory framework to support the uranium industry

Turning to Atomic Energy of Canada Limited (AECL) he stated that the "CANDU Reactor Division" (sic) needs strategic investors to take advantage of opportunities, strengthen global presence and reduce the financial risk carried by the taxpayers". "The restructuring of AECL ought not to hinder Ontario's goals [for new build] but strengthen prospects for solutions that can be delivered competitively, on time and on budget", he added.

The next day and a half were filled with interesting presentations on a range of topics. One that was surprising to some, and received considerable media reaction, was the talk by Joel Cohen, a co-creator and producer of the TV program "The Simpsons". More on that below.

The conference proper began with a breakfast sponsored by GE Hitachi. **Wayne Robbins**, CNA Chairman and Senior Vice President Darlington NGS, extended a welcome to all present and then reviewed briefly some highlights of the Canadian nuclear story as an introduction to the video noted earlier. *That video and videos of all of the presentations are available on the CNS website, www.cna.ca.*

While still in the breakfast format, **Pamela Wallin**, a former journalist now a Senator, began with a pitch about what "her government" is doing for the nuclear industry, then gave suggestions on how to communicate with the public based on her years in the media. On that topic she emphasized the need to tell stories. Be forceful, she said, especially about how nuclear science and technology has enhanced the well-being of Canadians.

After moving into the conference room, CNA president Denise

Carpenter introduced **Hugh MacDiarmid**, CEO of AECL, and invited him to present the opening keynote address. The title of his presentation was *Canada's Nuclear Industry: Domestic and International Opportunities.*

We are innately tribal, Mac Diarmid commented, an extended family. There is a new energy at the CNA with the arrival of Denise Carpenter, he said, and urged support for the organization. He noted the Canadian Nuclear Society, the Organization of CANDU Industries, Team CANDU, CANDU Owners Group, the Nuclear Waste Management Organization, Women in Nuclear, the entire uranium industry, universities and colleges, the regulator, the Canadian Nuclear Safety Commission; and the utilities. We are a community of 50,000 people, he noted, and we take pride in our accomplishments.

Turning to the global scene he noted the large programs in China and India, the likely "awakening" in the USA, the work of the World Association of Nuclear Operators and that of the International Atomic Energy Agency.

Domestically, he unashamedly stated that AECL wants to win the Darlington new build competition and asserted that the ACR-1000 is an excellent machine that can hold its own with the best in the world. There is good export potential with the Enhanced CANDU 6. He stated that NRU would be back in service soon, renewal and modernization of the Chalk River Laboratories is underway, design improvements on ACR-1000 and the Enhanced CANDU 6 are continuing as is technical support for the operating CANDU units.

Where will we be in another 50 years, he asked. "Will we be a global player or watching from the sidelines?" "I am an optimist", he said, "a believer and a competitor".

Although the UK High Commissioner had been scheduled to be the next speaker he stepped aside to allow **Malcolm Witts**, former UK Energy Minister, now Special Representative on International Energy Issues, to provide the view from that country.

Witts began by noting that the UK was an early country in nuclear energy but it had lost its way. However, a nuclear renaissance is under way. A review

conducted in 2008 when he was Energy Minister concluded that a substantial increase in nuclear generation will be necessary if the UK is to reach its target of reducing CO_2 emissions by 80 % by 2050. Because it has been recognized that energy and environmental issues are inseparable a new Department of Energy and the Environment has been created.

Plans have been advanced to build 16 GW of nuclear generation by 2020. EDF has purchased British Energy, including its 10 nuclear sites, and plans to build 6.4 GW of new nuclear. RWE / E.ON of Germany have purchased the Wylfa and Oldbury nuclear sites and have stated their intention to build 6 GW. Finally, a consortium of GDF SUEZ SA, Iberdrola SA and Scottish and Southern Energy has announced plans to build 3.6 GW at Sellafield. While all of these organizations are foreign owned a substantial British supply chain is emerging.

After a break **Claude Jaouen**, Deputy CEO of the Reactors and Services Group of AREVA, spoke on the *Challenges and Realities of New Nuclear Construction.* Building a new nuclear power plant today means starting at the ground which means finding or developing new skilled workers, he stated.

He turned to describing AREVA's extensive activities which includes the full fuel cycle. As an aside he noted that in Canada there is AREVA Canada (engineering and services), AREVA Resources (uranium mining) and Canberra (radiation instruments). Worldwide AREVA has built over 100 nuclear power plants and is currently involved in 20 projects.

Regarding Olkiluoto 3, the troubled project in Finland, he noted it was the first of a kind, the supply chain was inadequate and the Finnish regulatory organization demanded many additional safety features. However, he said, it is progressing and reported that the dome of the reactor building had recently been installed in one piece. Almost as an aside he commented that there were 55 different nationalities working on the project. To a question he responded that the "fallback" language was English.

Luncheon speaker, **Jeff Rubin**, an economist and author, provided rambling comments on a number of economic factors. Costs of "inputs" are increasing around the world, he stated, which will harm the global economy. When he mentioned that we can not afford electricity at 40 cents / kilowatt-hour as in Denmark because of wind generation, he received applause. On the local scene he suggested that Ontario's policy of paying up to 19 cents/ kwhr for wind-generated electricity will end up killing demand.

The afternoon session began with a panel discussing *Climate Change and the New Reality Post Copenhagen 2009*. Panelists were: **Robert Page**, a professor at the University of Calgary and Chair of the National Round Table on the Environment and the Economy; **Patrick Moore**, Chair of Greenspirit Strategies Ltd. (and founder of GreenPeace); and **Robert Dixon**, leader of the Climate and Chemicals Team at the World Bank. The moderator was CNA President, **Denise Carpenter**.

Dixon led off with comments on the disappointing Copenhagen Accord. Expectations were too high, he commented, there had been no progress on key issues over the previous two years, and the issues are very complex. Most serious was that the key countries, China, India and the USA did not want a deal. While OECD countries have stabilized their CO_2 output the emerging economies are rapidly increasing theirs. To reduce CO_2 output by the desired target of 55%, 130 gigawatts of nuclear generation will be needed.

Robert Page stated that a "systems approach" is needed rather than looking at individual components. He observed that almost all of the electricity interconnections were north-south and suggested that there are export opportunities. Alberta is looking at carbon capture and storage (CCS) for coal generation but, he said, it is very costly. There are likely to be surprises in the future, he commented in closing.

Moore began by saying he did not think it possible for the USA and China to agree on the CO_2 issue. He added that, because of the complexity, he did not believe that a full understanding of the world's climate was possible. The current fads of "renewable", "sustainable" "clean" "green" are just marketing terms, he asserted, and politicians are being hypocritical. He closed by emphasizing the value of ground-source heat pumps which could supply most of the heat and cooling of buildings, and noted that Sweden now requires them for new house construction.

An active question period followed the panelists' presentation.

After the break there was an unusual presentation for a nuclear conference, and one that engendered media attention. It was by **Joel Cohen**, co-creator of the *Simpsons TV* show, titled *Lessons in Creativity and Innovation from the Simpsons.*

He acknowledged at the beginning that the Simpsons show presents an unflattering view of nuclear plants but, he added, they make fun of everything.

In an animated and humorous presentation he provided an insight into the process of writing the show. It is a group effort, he said, working against hard deadlines. The rule is that there is no criticism, rather, each member of the group builds on the ideas of the others. Only about 5% of original ideas survive, he noted.

That evening there was a reception in the extensive exhibit area which occupied almost the entire fourth floor of the hotel. The reception also acknowledged the career fair that was held in conjunction with the conference. About 100 students from universities in different parts of the country had been sponsored to attend. A "briefing" for them was held on the afternoon of the Wednesday prior to the opening reception.

Friday began with breakfast and a breakfast speaker, **Jason Grumet**, Executive Director of the US National Commission on Energy Policy.

The US energy policy is "fluid", he said, with the earlier cap and trade policy for CO_2 now discarded. There is, he said, general sentiment for market-based approaches not government mandated ones. The nuclear industry is tied to the climate change issue, he stated with nuclear being accepted as carbon free but with the "back-end" (nuclear waste) problem. However, he noted, when the president mentioned nuclear in his State of the Union address it got applause. A major problem is the difficulty of getting bills through the two houses of Congress.

Beginning the conference session was **Michael Binder**, President of the Canadian Nuclear Safety Commission, who began by noting the surge of nuclear construction, mostly in Asia.

Turning to his agency he pointed out that, including the CNSC's predeccesor, the Atomic Energy Control Board, they were now in the 64th year of nuclear regulation in Canada. The CNSC staff is very qualified, he stated, with 50 per cent having post-graduate degrees. Phase 1 of the design review for the Enhanced CANDU 6 has now been completed, satisfactorily. Considerable effort is going into updating documentation.

The last speaker of the conference brought a different, and needed, perspective. Using the title of her recent book, *33 Million People in the Room: How to Create. Influence and Run a Successful Business with Social Media*, as her theme, **Juliette Powell** described how many companies are using communication methods such as Facebook and YouTube to get their message out to the younger generation.

Born in New York but raised in Montreal, Powell was Miss Canada in 1989, the first black winner. She studied finance and business at McGill University and economics at University of Toronto. She was host of the TV show MusiquePlus during the 1990s and founded her consulting company Powell International Entertainment Inc. in 1999.

"Social media" is a two-way process, she noted. If companies are to use it they must understand engagement. Despite that challenge she stated that 65 % of top US companies now use some form of the process, with Twitter, FaceBook, YouTube, and corporate blogs. She commented that the science adviser to the US President has his own blog.

She offered three requirements for an organization that is going to move into social media:

- get top management to "buy in"
- develop a social media strategy
- monitor its social media presence.

The conference closed with a buffet lunch in the exhibit area.

The conference was organized primarily by the staff of the CNA, headed by **Claudia Lemieux**, Director of Communication and Media Relations.

It was made possible by the support of a large number of sponsors: AREVA; Cameco; Ontario Power Generation; Power workers' Union; Hitachi ; GE Hitachi; AECL; Bruce Power; E.S.Fox; Comstock; Wardrop; Society of Energy Professionals; Energy Solutions Canada; AMEC; RCM Technologies Babcock & Wilcox Canada; Worley Parsons; L3 Mapps; Black & McDonald; Kinectrics; SNC-Lavalin Nuclear; Aecon; Hydro Québec; Ontario East Economic Development; Crosby Dewar; Unified Engineering; Ian Martin; SWI; Industrial Audit; Candesco; Amidyne HSL.

Videos and text of most of the presentations are posted on the CNA website: www.cna.ca.

The CNA's *Nuclear Canada Yearbook 2010*, provided to all attendees, was a specially enlarged publication which contained long articles on the history of the CNA and on the large nuclear power program in Ontario. **Jim Weller**, CNA General Manager for thirty years, authored a 10 page review of *The First 30 Years of the CNA* (1960 - 1990) which was accompanied by a four page article by **Colin Hunt**, CNA Director of Research, covering the last 20 years.

A 37 page essay by **Lorne McConnell**, former Vice-President of Ontario Hydro and first head of the OH nuclear operations, is titled *Why Ontario Generates So Much Electricity from Nuclear Energy*. It covers the beginning of the nuclear program in Canada and the fascinating story of the OH program that saw 22 nuclear units constructed and put into operation, from the NPD prototype in 1962 to 1993.

Some Scenes from the Conference...

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LETTERS TO THE EDITOR

Dear Editor,

I thoroughly enjoy Jeremy Whitlock's "Endpoint" articles in the CNS Bulletin for their enthusiastic, spirited, humourous, and usually well-reasoned support for nuclear energy, in general, and CANDU, in particular. Alas, as a professional nitpicker from the former Atomic Energy Control Board, I cannot let pass a few lapses in "The Curious Case of CANDU" in the 2009 December issue of the Bulletin.

Although it was a natural uranium-fuelled, heavy water moderated, pressure tube reactor, NPD was not the first CANDU reactor because, strictly speaking, it was not a CANDU reactor. That sobriquet applies to natural uranium-fuelled, heavy water moderated, pressure tube reactors *designed by AECL*, which, I understand, owns the copywrite to the name. As everyone should know the NPD reactor was designed by Canadian General Electric. The first CANDU reactor was the Douglas Point NGS.

Jeremy goes on to extoll the "natural uranium design" of the CANDU reactor which require "...none of the enrichment technology that decades later would cause considerable consternation in the hands of questionable state nuclear programs". The aforesaid Douglas Point and also the Bruce A reactors used nuclear weapons-grade, highly-enriched uranium booster rods for the poison prevent role. Newer designs use absorber rods instead of boosters for that role but the latest design, the advanced CANDU, will use slightly enriched uranium for the main charge of driver fuel. Not only does the use of slightly enriched uranium render the design less efficient in terms of burnup per unit mass of mined uranium it adds to the rationale for enrichment of uranium. It looks like the ACR design is about to take the first steps from the fundamentals of the CANDU. Perhaps, in future, Canada will be able to obtain its slightly enriched uranium from Iran or Pakistan.

Having spent 15 years in the area of nuclear non-proliferation safeguards, including the Canadian Support Programme for International Atomic Energy Agency (IAEA) Safeguards, I am not so sure that on-powered fuelled reactors like CANDU can be said to be the "most comprehensively safeguarded commercial reactor on the planet". If the safeguards of CANDUs are more extensive than other types it's because they need to be more extensive. CANDUs are *adequately* safeguarded by the IAEA but, as far as the reactor is concerned, continual, on-power refuelling does require greater technological and manpower resources by the IAEA than for off-power refuelled reactors, such as light-water reactors (LWR). As far as irradiated fuel discharged from a reactor is concerned the issues are different and it's difficult to make comparisons. For a given size of reactor, and in terms of mass, a natural uranium-fuelled CANDU discharges more fuel which contains relatively more fissile plutonium than a LWR, but the irradiated uranium from a LWR is still somewhat enriched. If one compares international safeguards required for the whole fuel cycle the issues become even more complex. Making such comparisons could end up in the pot calling the kettle black, with only the anti-nukes benefiting.

Sincerely,

John W. Beare
Kanata, ON

Response to Mr. Beare

Mr. Beare's nitpicking is appreciated – what doesn't wash off one's back can only make one stronger. He is quite correct to point out that "CANDU" was the name given to the Douglas Point reactor; however, in time it became applied, officially or otherwise, to all PHWRs of Canadian origin, including NPD and Kanupp (both designed by CGE).

CANDU's status as the "most comprehensively safeguarded commercial reactor on the planet" is a matter of record, whether this is by necessity or not. It also has the most depth in fast-acting shutdown capability – also by necessity, but that's beside the point. This does not mean that LWRs are any more proliferation resistant, of course, which is another story that can't be expounded here. I will note that CANDU spent fuel, contrary to popular belief, contains less plutonium per unit mass than LWR fuel, and is similarly of reactor grade.

Jeremy Whitlock

[Ed. Note: The following letter was submitted to the US Office of Science & Technology to be passed on to the President of the United States. The response to this letter is also provided on the next page.]

January 11, 2010

Dr. John P. Holdren
Director, Office of Science & Technology Policy,
Executive Office of the President
Washington, D.C.

Dear John,

We met in Palo Alto, California in 1970, while you were working on your doctorate at Stanford University and I was starting an engineering career in nuclear power. You visited my family in Switzerland in the 1980s, where I was working on Nuclear Power Plant Leibstadt. You have also answered questions over the years on applications of Einstein's equations that is much appreciated.

Nearly 40 years have passed. We are both still working to make genuine contributions through science and engineering for the lasting benefit of society and the planet.

Please hear our statement and pass it on to the President.

Peace on earth and preservation of the marvels of nature will not be achieved without a sound energy policy. This policy must include well-managed and well-governed slow- and fast-neutron nuclear power, recycling spent fuels and depleted uranium and possibly thorium. This was the goal of the founding scientists in the 1940s and still is the best way to a reliable and secure energy future.

But the world is leaving us behind. At present, 58 new nuclear plants (including two fast reactors, one in Russia and one in India) are under construction in 14 countries. Of these, 20 are in China, 9 in Russia, 6 each in India and South Korea. Only one is in North America, and that is resumed work on a plant that was mothballed in 1988 when it was 80% finished. France has just announced a $7 billion commitment for a "sustainable development" program that includes promotion of fourth-generation nuclear reactors — (three of which being fast neutron reactors) a technology in which the United States was once the world leader.

Our nation needs to proceed quickly — not twenty or fifty years from now — while the people who pioneered this science and engineering can still provide guidance to a new generation of scientists and engineers. There is no political, economic or technical justification for delaying the benefits that nuclear power will bring to the United States, while the rest of the world forges ahead.

We have two urgent recommendations.

First, we believe it's imperative to accelerate the licensing and building of slow neutron reactors, the kind now in use, commonly called thermal reactors or water-cooled reactors. For the last 30 years the LWRs in the United States and CANDU reactors in Canada have served us well. Nuclear plants also have the unique capability to convert swords into ploughshares. Under the 1993 US-Russian nonproliferation treaty, over 15,000 Russian nuclear warheads have already been disassembled, and their weapons-grade uranium converted to reactor-grade fuel, which is 2 currently supplying half of the US nuclear electricity being generated. This program is scheduled to continue into 2013.

While the performance and safety records of the existing reactors have been excellent, the evolutionary improvements in new slow neutron reactors will take both safety and efficiency to an even higher level.

Second, we note that development of fourth-generation nuclear reactors will be needed if nuclear power is to expand significantly beyond its present market penetration — an expansion that is so necessary if our descendants are to have ample energy over the coming millennia. Therefore, we strongly recommend reinstating the development and demonstration of the technology for recycling used fuel – a goal of fast fourth-generation nuclear reactors – as epitomized by the U.S.-developed Integral Fast Reactor (IFR). The IFR transforms used fuel from a "waste" to a major energy resource, and in so doing it happens to resolve a major public concern about nuclear power — the safe use of the long-lived radioactive byproducts. Further, IFRs can utilize excess weapons plutonium effectively and rapidly, while generating revenue instead of costs — a development consistent with Russian recommendations.

Work on the IFR technology was halted just as commercial viability was about to be demonstrated. While the operability of the reactor portion of the IFR was adequately established, a commercial-scale demonstration is needed to settle details of the fuel-processing phase and to refine cost projections. Russia, China, India, Japan, and South Korea have expressed interest in the technology of metal-fueled fast reactors, and would likely contribute to a demo plant in exchange for design and operations information.

Two signatories of this letter, Leonard J. Koch of Arizona and Dr. Evgeny Velikhov of Russia, are Global Energy Prize laureates. This award is characterized as the Russian equivalent of the Nobel Prize for outstanding research to solve the world's energy problems.

The concentrated energy in uranium provides 20% of the electricity in the United States today. We must expand that nuclear contribution rapidly if we are to maintain the welfare of our people, protect our environment, and preserve a leading international role in the safe global evolution of nuclear technology.

Respectfully,

John A. Shanahan
Civil Engineer
Colorado

Joseph M. Shuster
Chemical Engineer
Minnesota

Leonard J. Koch
National Academy of Engineering
Arizona

Theodore Rockwell
National Academy of Engineering
Maryland

cc. Dr. Steven Chu, Secretary Department of Energy,

SIGNATORIES

[Ed. Note: The list of signatories has been removed. It occupies 30 pages!]

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20502

March 5, 2010

Dr. John A. Shanahan
660 Detroit 51.
Denver, C 80206

Dear Dr. Shanahan and colleagues:

Thank you for your letter and your interest in the important topic of nuclear energy policy.

President Obama has said on many occasions that expanding our capacity to generate clean energy is crucial 10 our ability to combat climate change, enhance energy security, and increase economic prosperity. And in this connection he has directed his Administration to take steps to expand the safe, secure, and responsible use of nuclear energy.

You and your colleagues raised three issues in your letter.

First, you recommend accelerating the licensing and construction of light-water reactors. We agree. On February 16. President Obama announced that the Department of Energy had offered $8.33 billion in loan guarantees for construction of two new nuclear reactors in Georgia. The President said, "And this is only the beginning. My budget proposes tripling the loan guarantees we provide to help finance safe, clean nuclear facilities." The President recognizes that an increased contribution from nuclear energy will be necessary to meet some of the nation's most important challenges: "To meet our growing energy needs and prevent the worst consequences of climate change, we'll need to increase our supply of nuclear power. It's that simple."

Second, you note the shortage of isotopes for nuclear medicine. My office leads an interagency working group to address the shortage of molybdenum 99 (Mo-99), which is needed to produce the technetium 99m that is used in approximately 50,000 medical procedures per day in our nation . The U.S. government has been keenly aware of this problem and has taken several actions to reduce the impact of the global supply shortage on U.S. healthcare providers and patients. In cooperation with federal, international, and industry partners, we have taken steps to increase production, foster better communication between producers and end-users, and encourage effective management of the available supply. We are accelerating efforts to begin domestic commercial production of Mo-99 without the use of highly enriched uranium. The National Nuclear Security Administration (NNSA) is working with companies to demonstrate technologies for large-scale pro duction, including low-enriched uranium (LEU) targets, LEU solution reactors, neutron capture, and accelerators. NNSA has entered into cost-sharing agreements with Babcock and Wilcox (0 develop the LEU solution reactor technology and with General Electric-Hitachi to develop the neutron capture technology.

Third, you call for developing fourth-generation nuclear reactors to facilitate the long-term expansion of nuclear energy. The Department of Energy has an active research program in advanced rectors. This program includes the Generation-IV Next-Generation Nuclear Plant, a high-temperature gas-cooled reactor that could produce electricity with high efficiency and process heat for industrial purposes. The Department of Energy will also continue its participation in international activities considering the future of innovative nuclear power options. My office will continue to contribute to these discussions.

You mentioned the potential of the Integral Fast Reactor to address public concerns about nuclear waste. In January, the President directed the Secretary of Energy to establish a Blue Ribbon Commission on America's Nuclear Future. The Commission will conduct a comprehensive review of policies for managing the back end of the nuclear fuel cycle, including alternatives for the storage, processing, and disposal of civilian and defense used nuclear fuel and nuclear waste. The review will include an evaluation of advanced fuel-cycle technologies, including their cost, safety, resource utilization, and risks of proliferation and terrorism. The important work of the Commission is just getting underway, and I would not want to prejudge their conclusions by commenting on a particular option.

Thank you again for your interest in these important topics.

Sincerely,

John P. Holdren
Director

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Why it is in all our interests to seek investors in AECL and to do it quickly.

By Neil Alexander, President, Organization of CANDU Industries

Whether or not you believe that the Government should sell equity in AECL it is clear, now the announcement has been made, that the "sale" must proceed quickly. Nuclear power is going through a renaissance with about 50 new reactors in construction at the moment and hundreds more in the various stages of planning. Decisions about the reactor technology are being made now and Canadian technology is already being left behind.

AECL's competitors are either large state owned vertically integrated megaliths (such as AREVA and Atomstroyexport) or are commercial organisations that made arrangements to ensure sufficient capitalization before the renaissance began, like GE and Hitachi forming a joint venture. Another competitor, Westinghouse, originally American, was bought by BNFL in the UK before finding a secure and well capitalized home with Toshiba in Japan. Korea backed both by its Government and Samsung is a world leading technology provider and a newcomer with strong backing.

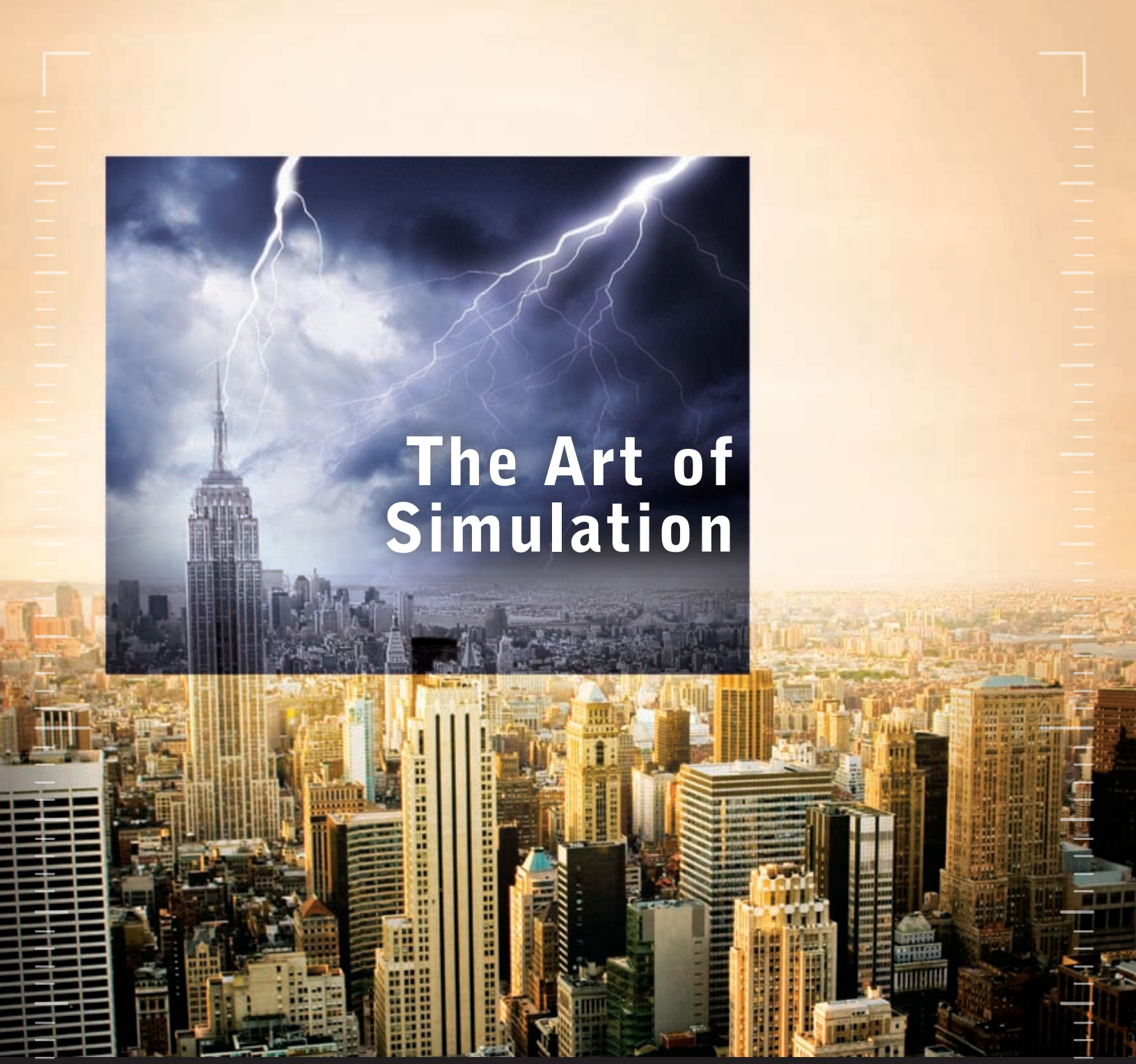
They have all removed uncertainty and offer their customers a very secure future. Certainty is one of the major features that a customer looks for when they are buying a nuclear reactor that will form the backbone of their electricity supply for 60 years. Uncertainty over AECL's future, uncertainty that existed for a long time before Minister Raitt made her announcement about the restructuring has crippled AECL's ability to compete. Anyone having any doubt about the crippling affects of this uncertainty should look to the Ontario situation where AECL submitted the only compliant bid and the best bid but still did not get an order primarily because of concerns about their future.

A quick and successful restructuring will put Canadian technology back on the world stage while technology decisions are still being made. Delay will remove that opportunity. Slowing the process to debate whether or not equity in AECL should be sold will extend the uncertainty, allow AECL's competitors to establish themselves in more markets and by the time AECL becomes credible again it will be too late. Modern reactors last for 60 years and that is a long time to wait to pick up the replacement order.

The value of equity in AECL will depend mainly on the opportunity value of future reactor sales. One of AECL's designs, the Enhanced CANDU 6 had a considerable boost with an announcement that the Chinese want to buy this design in order to use Thorium. This proves a much vaunted benefit of the design of this series confirming its niche market opportunity.

The mass market new design, the Advanced CANDU Reactor (ACR), still has no demonstration site and this introduces a considerable uncertainty for an investor devaluing the entire organisation. Ontario, as the leading potential purchaser of an ACR, could act constructively on behalf of all Canadians to confirm the technology selection arising from their RFP process and announce that they will negotiate with CANDU Inc as soon as its future has been confirmed.

Presently Canada's nuclear industry faces the prospect of becoming a footnote in history; with some swift and decisive action early we could restore ourselves to being world leaders. The Federal Government has started the process and we must support that. Let us hope the Provincial Government will recognize its opportunity and act swiftly as well. As Dalton McGuinty said in India recently "if you are talking Nuclear you are talking Ontario", hopefully he will understand his role in making sure it stays that way.



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IESO - less dispatching of nuclear if you please

By Don Jones

[Ed. Note: Operation of the grid is a difficult task of balancing generation against a fluctuating demand. Not only is total power a concern but grid frequency as well. The following (opinions of the author) sets out to explain how that delicate balancing act takes place. This article has been edited for length.]

CANDU reactors in Ontario currently provide 11 Gigawatts (GWe) to the grid, which in 2009 represented 55 per cent of demand. Ontario's best performing nuclear stations continue to operate at high capacity factors and are proving themselves to be very reliable base load performers.

However the spring and summer of 2009 was a difficult time for nuclear. There were long periods of surplus base generation (SBG) when the generation provided by nuclear, baseload hydro, and wind exceeded the demand. This was caused by the economic downturn, and not helped by periods of high wind generation, and resulted in Bruce B units being powered down or even shutdown leaving gas-fired generators to provide load following and some gas units to remain in hot standby in case the wind dropped. This was necessary because the present nuclear units are not designed for load following.

Load following here refers to a unit responding to a dispatch from the grid operator to incrementally move power up or down, typically +/- 2.5%.

New nuclear build in Ontario must be able to load follow, that is, to vary output up and down n accordance with dispatch instructions, just like they do in France, so that green house gas emitting gas-fired units can be shut down when demand falls and or when the wind blows. Indeed sometime in the 60 years or more life of new nuclear, gas may be less available and climate change and prolonged seasonal droughts could affect hydro generation resulting in a higher nuclear penetration on the grid. This makes it imperative for Ontario that new nuclear have strong load following capability. Without gas, wind will be more of a hindrance to the grid and to nuclear than it is now - see article, "Nuclear and Wind on the Ontario Electricity Grid", in the 2009 June edition of the CNS BULLETIN.

Load following here refers to a unit responding to a dispatch to incrementally move power up or down. In Ontario the Independent Electricity System Operator (IESO) has a very good idea a day ahead of when and how much the demand changes will be, and the generators on the grid are also told this so they are prepared when dispatched to make the scheduled power changes.

Load following should not be confused with load cycling. Load cycling refers to the scheduled powering down of a unit in the evening and the powering up again in the morning. While powered down the unit output remains constant, say at 70 percent of full power, until it begins to power up. It then remains at constant power until the next power down load cycle. If a nuclear unit can be dispatched incrementally when powering up or down for a load cycle it can be said to be load following. Load following is made up of relatively frequent and small power changes while load cycling could consist of one major power move a day. Dispatches on the Ontario grid are sent at 5 minute intervals, not necessarily to the same generator.

Erratic dispatches cause generators to change the direction of energy production for a short time. Unscheduled supply/demand mismatches on the grid can necessitate a unit changing direction, say going from an upward move to a downward move and then up again at short notice. Erratic wind generation could also lead to these dispatch reversals. Reversals might occur on units on the grid when another unit is powering up or down during an unscheduled load cycle or shutdown. A nuclear unit would need good load following capability to handle these reversals. The IESO is presently wrestling with the problem of dispatch reversals.

When supplying power to the Ontario grid the CANDU units have two plant operating modes, reactor-following-turbine mode and turbine-following-reactor mode. Load cycling was intended to be performed with the unit in the turbine-following-reactor mode. Load following could also have been done in this mode if the units had load following capability as well as in the reactor-following-turbine mode if operation were more stable in this mode. Small power variations, typically +/- 2.5 percent of full power from turbine governor action to stabilize the grid when operating in reactor-following-turbine mode is called primary frequency control and is not load following.

Any difference between generation and load on the grid shows up as a grid frequency deviation from the nominal 60 Hz.

If Ontario's CANDUs were in reactor-following-turbine mode they could contribute to grid frequency stability. In the reactor-following-turbine mode the steam generator pressure, which will change due to differences in reactor output and turbine-generator output, is kept at its setpoint by changing the reactor power setpoint, using the reactor regulating system, to accommodate changing turbine steam demands in response to grid conditions. Any difference between generation and load on the grid shows up as a grid frequency deviation from the nominal 60 Hz.

If a unit is operating at 97.5 percent of full power it can provide +/- 2.5 percent power variation automatically by turbine governor action, to help resist the frequency change in concert with other generators on the grid. The more units contributing to this grid stabilization, or primary frequency control, the less the power variation will be on each unit. The designated hydro or coal units, normally hydro, supplying automatic generation control (AGC)

service will then return the grid frequency to nominal by removing the frequency offset. Adjusting the turbine governor setpoint to remove the frequency offset is called secondary frequency control, or regulation, and would be performed manually or by AGC.

Fast acting AGC corrects the minute to minute differences in generation and load to balance the grid. The current AGC regulation service requirement from the IESO is for at least plus or minus 100 megawatts at a ramp rate of 50 megawatts per minute but this may be changed to allow other generators to supply this service. If CANDUs were designed to supply AGC they would have had to operate in the reactor-following-turbine mode. If the nuclear unit is operating in turbine-following-reactor plant operating mode it makes no contribution to grid stability.

In the turbine-following-reactor mode of operation the steam generator pressure is controlled at its setpoint by operation of the turbine governor valve when the reactor power setpoint is changed for any reason. In Ontario the CANDU units operate in this mode, and at the maximum allowable power. The operators say this mode gives more stable reactor operation and increases the probability of the unit remaining connected to the grid during major disturbances as well as generating more electricity and more income since the unit does not have to operate at a little less than its maximum output as it would have to do in the reactor-following-turbine mode.

The IESO is developing a Load Following Standard, SE-38, for dispatchable resources but this is on hold pending completion of SE-61, Exploration of Enhancements to Dispatch Methodology and Processes. Dispatching is a major issue right now with one of the concerns being excess dispatch volatility, that is, the number of dispatch instructions and dispatch reversals. Nuclear is regarded as dispatchable, although manoeuvring (load cycling) the present units requires a lot of preparation and presents considerable operational difficulties. During some so called negative pricing periods on the grid in the past, brought about by low demand and excess capacity, nuclear has preferred to remain at power rather than manoeuvre and had to pay for the "privilege".

The likelihood of SBG is expected to increase in the near future. To avoid the wear and tear on nuclear caused by manoeuvring and shutdown the IESO is proposing that curtailment of wind generation be considered if the nuclear units can mitigate the SBG situation only by taking the risk of not being available in future hours when they will be needed, for example, a deep reactor power reduction or a shutdown. This approach is not sufficient to avoid serious wear and tear and consequential increased maintenance outages of the nuclear units. Nuclear units must be the last units on the grid to be manoeuvred in times of SBG, period. Manoeuvring must not be allowed to affect the present excellent base load performance of Bruce B and Darlington and the reliability of the grid. Dispatch priority for SBG events must remain a major issue for the IESO.

The IESO has stated that Ontario's future generation supply mix will place an increasing reliability value on the flexibility of generating assets to provide load following capability, operating reserve and AGC. For a grid with a high penetration of nuclear but with limited load following capability, demand management may be an alternative. If hydrogen found greater use, generation it at times of low demand would enable nuclear units to keep operating at full power. Hydrogen could be used to fuel gas turbine generators or fuel cells, for example. Failing this, new nuclear must be able to load follow as well as load cycle and ideally provide AGC as is done in France. In the meantime the IESO should improve its dispatching to minimize the manoeuvring of its nuclear units.

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Producing Molybdenum-99 in CANDU Reactors

Jerry M. Cuttler, Cuttler & Associates Inc.

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

Abstract

This paper discusses the recent problems with Canadian supply of molybdenum-99 for medical diagnostic scanning. It proposes an alternate method that exploits the on-power refueling capability of CANDU reactors to produce large amounts of Mo-99. An extraction and refining plant near the used fuel bay of a multi-reactor station could process one standard fuel bundle per day (after irradiation for 5 days). This method avoids using enriched uranium. The plant might cost less than 50 million dollars and be constructed within several years. The radioactive residue would be managed in conjunction with the existing methods of used fuel management.

1. Introduction

During normal operation, the multi-purpose NRU research reactor in Chalk River Laboratories was producing about 30 percent of the world's supply of molybdenum-99 (Mo-99), a very important radionuclide because it beta decays ($T_{1/2}$ = 66 h) to technetium-99m (Tc-99m). The latter is used in diagnostic imaging with single photon emission computed tomography (SPECT) technology. Tc-99m is employed in about 80% of the nuclear medicine diagnostic procedures in Canada. Excellent information on this subject appears in the Report of the Expert Review Panel on Medical Isotope Production [1] that was commissioned by Natural Resources Canada.

NRU began operating in 1957 and started producing Mo-99 in the early 1970s. This heavy water reactor (thermal neutron flux: ~ 3×10^{14} n/cm^2/s) fissions highly enriched uranium (HEU) 'targets' for about a week. The targets, an alloy of uranium and aluminium, are transferred to a nearby processing facility where Mo-99† is extracted and transported to MDS Nordion in Ottawa. Concerns arose about relying on a 50-year-old reactor for this essential service. To address this anxiety, a project was started in the mid-1990s to build two dedicated MAPLE-type reactors with a facility to extract the Mo-99. Licensing, technical and economic problems were encountered while implementing this Dedicated Isotope Facility (DIF). In May 2008, the Government of Canada accepted AECL's decision to terminate this project. Realizing that the reliability of Canadian supply of Mo-99 is again a concern, the author began advocating that a *back-up* method of supply be developed that would utilize one of the many nearby CANDU power reactors. This would avoid the 10-year duration to build a new reactor and the very large project and operating costs that would be associated with such an endeavour.

CANDU reactors use natural uranium. During normal operation, robotic fueling machines load fuel bundles into one or two fuel channels every day. Over the years, many have thought about making Mo-99 in these power reactors; however, they were deterred by the complexity that would be added to the already challenging task of operating the reactors safely and efficiently.

Also, there was no economic incentive because Mo-99 production in the NRU reactor has been highly subsidized by the Government of Canada.* The decision to stop DIF construction created considerable Canadian and world anxiety about supply of Mo-99.

In early 2009, the author conceived the idea of putting MAPLE-type HEU targets (annular tubes) into a bundle with the same form, fit and function (same power rating) as a standard 37-element CANDU fuel bundle. It would involve the following steps: identify a willing CANDU operator, fabricate HEU target bundles, test the design and transport irradiated target bundles to the existing processing facility that extracts Mo-99.

2. NRU Shutdown and the Expert Review Panel

In mid-May 2009, a heavy water leak from the NRU calandria was detected and the reactor was shut down to investigate and repair the leak. Considerable outrage arose in the Canadian and worldwide medical community at the interruption in the supply of Mo-99, as reported in many media articles and broadcasts. At the annual Canadian Nuclear Society conference, 2009 May 31 to June 3, the author discussed the possibility of a back-up supply with personnel from a CANDU station operator, AECL and the nuclear regulator. This idea was neither dismissed nor endorsed. More information was requested.

The Government of Canada felt strong social and political pressures to address the problem promptly, and took a variety of actions on supply [2]. In mid-June, it established the Expert Review Panel on Medical Isotope Production (the Panel) to provide advice on the most viable options for securing a predictable and reliable supply of Tc-99m in the medium to long term [3]. At the time the Panel was announced, May 28, 2009, a call for Expressions of Interest (EOI) was put out to public and private sector organizations for submissions (by July 31) on alternative production of Mo-99/Tc-99m. The Proponent's Guide [4] was issued in early July. Twenty-two EOIs were received and assessed against five criteria that were established by the Panel. The author submitted an EOI that proposed producing Mo-99 in CANDU reactors along the lines outlined above.

† Mo-99 is a fission product with a cumulative yield of about 6%.

* Production of cobalt-60 in CANDU reactors has been profitable for plant operators.

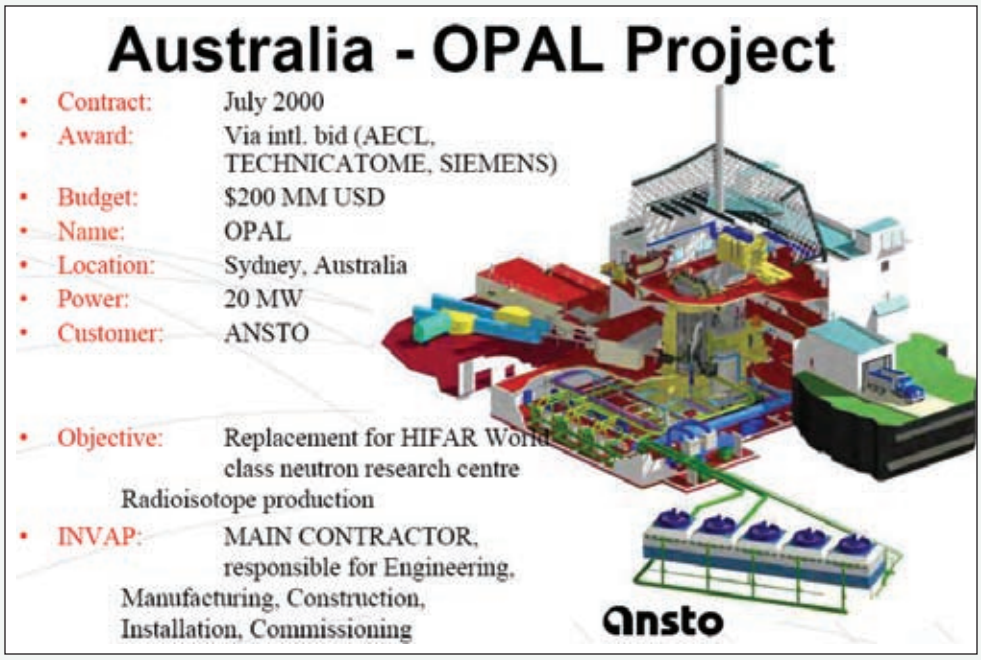

Figure 1. OPAL Project

The Panel's report was issued to the government on November 30, on schedule. The Report [1] describes the Panel's mandate, activities and processes. It covers the background very well: the nuclear history, starting with the use of radionuclides in medicine and Canada's role in this development. It outlines clearly the present structure of the worldwide Mo-99 supply system, which has been based mainly on the output from five government-owned and funded multi-purpose research reactors that were put into operation in the period from 1957 to 1966. They are located in Canada, Europe and South Africa. Consequently, the costs paid by the refining, packaging and distributing companies do not reflect the real costs of Mo-99 production, and this sets a low price for the Mo-99 that is supplied to the world medical community. The people of Canada have been subsidizing one-third of the world's supply. The Report discussed the market trends and how the future directions might change, depending on the duration of the shortage.

As a result of the interruption in the Canadian supply, the price has increased and the distribution of Mo-99 has changed in response to market demand. There has been significant diversion to North America. The increased cost and reduced availability of the radioisotope has challenged the world medical community, and it has adapted. In many cases, diagnostic examinations using Mo-99 have been cut back (deferred or cancelled). Different arrangements have been made, including performing essential diagnostic examinations using alternate techniques, some of which are identified in the Report. The interruption has had adverse health consequences.

The Panel assessed the options for Mo-99 production, identifying the two classes of technology, reactor (fission option) and accelerator (photo-fission, Mo-100 transmutation and direct Tc-99m using a cyclotron). The comparison looked at cost, timeline (to first production) and capacity (fraction of Canadian demand). The other factors addressed were sustainability and security, technical feasibility, business implementation, timeliness, regulatory issues and benefits to Canadians. The Panel reviewed all of the EOI proposals, but did not discuss each specifically. The report pointed out that options that depend on HEU could be viable only in the short to medium term.

The Report recommended replacement of the NRU reactor. The Panel believes that "a multi-purpose research reactor represents the best primary option to create a sustainable source of Mo-99, recognizing that the reactor's other missions would also play a role in justifying the costs." This option would cost between 500 million and a billion dollars. It would take about ten years to implement. (Priority for reliable Mo-99 production would compromise the other missions of this reactor for research.) The Panel also recommended support for an R&D program for cyclotron-based Tc-99m production. It advocated better use of Tc-99m supply through the use of newer medical imaging SPECT technologies and investment in positron emission tomography, to reduce the demand for Mo-99. Further discussion was provided on linear accelerator options and the DIF infrastructure at Chalk River Laboratories.

3. Workshop on Medical Radionuclide Production

In parallel with the Panel's activities, the Canadian Nuclear Society (CNS) organized a workshop on medical radionuclide production that was held in December in Ottawa [5]. All the participants in this event (that featured 15 presentations) gained a much better knowledge and appreciation of some of the methods and technologies being deployed in Canada and abroad to produce Mo-99 and carry out different types of diagnostic scans.

The U.S. demand and dilemma was explained in an excellent presentation from Sandia National Laboratories [6]. The radionuclide Tc-99m is used in about 13,000,000 medical diagnostic procedures each year in the U.S. Mo-99 consumption is 5000 to 7000 curies (6-day) per week.* This translates to 38,000 to 53,000 production curies per week, allowing one day for processing and shipping (specific activity > 5000 Ci/g of Mo-99 required). U.S. usage of Mo-99 has been increasing by 3 to 5 % per year. All major production uses HEU targets with the HEU supplied by the U.S. Concern about weapons proliferation is causing a change from HEU (93% U-235) to LEU (19% U-235) supply within 5 to 7 years (four times more target material to be irradiated).

* A 6-day curie is the amount of Mo-99 (τ = 95 h) activity that remains after 6 days (144 h) of decay.

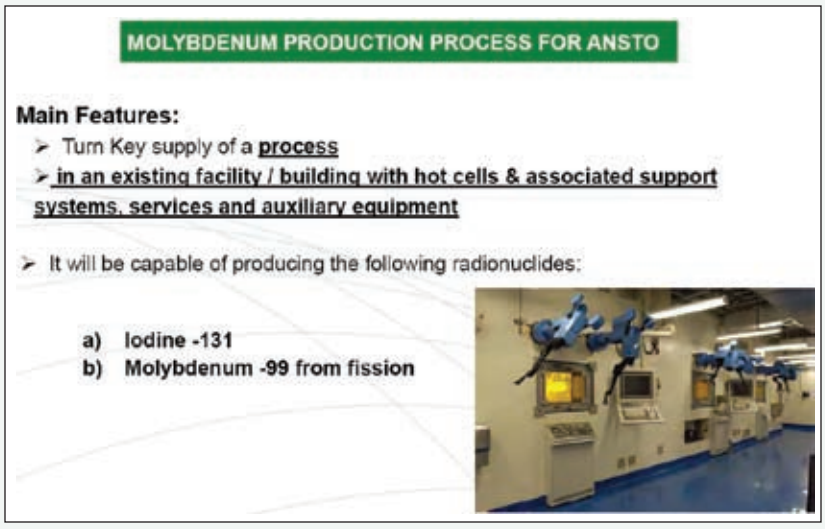

Figure 2. INVAP Mo-99 Production Facility at the OPAL Reactor

A fission source of about 1.1 MW of continuous power in the targets would supply the nominal U.S. demand—about 2.2 MW (78 to 106 kCi/week) for the world demand [6].

4. Better Concept for Producing Mo-99 in CANDU Reactors

Since a CANDU fuel channel holds 12 bundles and outputs about 6.5 MW of power, four fuel bundles are a fission source of about 2.2 MW and could supply the world Mo-99 demand. The U-238 component in the fuel would not contribute significantly to the Mo-99 production in a short irradiation and would remain in the residue after Mo-99 extraction. More Pu-239 would be produced in natural uranium targets than in HEU/LEU targets; however, the total alpha-emitter concentration (considering the U-234 in HEU/LEU) would not be significantly higher for the short irradiation [6].

Because 1% of the Mo-99 produced decays away every hour, it is very important to locate the extraction and refining plant beside the reactor. The penalty is significant for off-site processing due to the time lost in target transport and the transport container expense. Batch processing, weekly removal followed by a week of processing, gives only 50% of the product that could be produced from daily extraction (of one fuel bundle) and daily processing. Time is also a factor in product quality; specific activity (curies/g) decreases with time after irradiation [6].

The radioactive residue from processing four bundles per week, or 210 bundles per year, could be managed along with the approximately 6000 used bundles that are removed every year from each power reactor. There would be no need to ship HEU/LEU and no concern about the unused U-235 accumulating at the site.* The energy from the targets would generate power. Producing Mo-99 in a multi-reactor station would avoid supply interruptions due to maintenance shutdown.

* A one-week irradiation in a CANDU uses only ~ 10% of the HEU (much less in LWR), so the waste is still HEU.

If construction of a Mo-99 processing plant at a CANDU station is considered, who could build it; how much would it cost and how long would it take to complete?

5. On-Site Processing Plant

An excellent presentation on this subject was delivered by INVAP of Argentina [7]. This company recently completed the OPAL Reactor Project (Figure 1). It included the Radioisotope Production Facility (Figure 2). The facility produces many important radionuclides, such as Mo-99, which is extracted from LEU uranium-aluminium alloy targets. The project was completed on schedule. The budget amount ($200 million) suggests that the cost of just the processing plant at a CANDU station would be a small fraction of this amount. The design of the plant would be similar to the OPAL one, even though the targets would be different, uranium-oxide pellets in a zirconium alloy cladding. The process to extract Mo-99 from such targets is well known, so the expected construction time for a repeat plant would be several years.

6. Conclusion

Producing very large quantities of Mo-99 in CANDU reactors would be feasible and relatively inexpensive. The main requirement—the construction of a plant beside the used fuel bay of a multi-reactor station that would process one normal fuel bundle per day after five days of irradiation. The Mo-99 output would be very reliable and would be sold to existing distributors.

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Practical Examples of how Knowledge Management is Addressed in Point Lepreau Heat Transport Ageing Management Programs

J. Slade[1], T. Gendron[2], G. Greenlaw[1]

[Ed. Note: The following paper was presented at the 30th Annual Conference of the CNS.]

Abstract

In the mid-1990s, New Brunswick Power Nuclear implemented a Management System Process Model at the Point Lepreau Generating Station that provides the basic elements of a knowledge management program. As noted by the IAEA[3], the challenge facing the nuclear industry now is to make improvements in knowledge management in areas that are more difficult to implement. Two of these areas are:

- Increasing the value of existing knowledge, and
- Converting tacit knowledge to explicit knowledge (knowledge acquisition).

This paper describes some practical examples of knowledge management improvements in the Point Lepreau heat transport system ageing management program.

1. Introduction

For over a decade, the nuclear industry has been developing knowledge management approaches and strategies, primarily due to concerns about the loss of expertise with the age demographics of the experienced workforce. Nuclear power plants now use basic programs to capture, store, and retrieve information/ knowledge, which are identified under the following knowledge management elements by the IAEA in Reference [1]:

- Plant policies and procedures
- Work control system
- Document control
- Corrective action tracking
- Configuration management
- Human resource management
- Training and qualification
- Communications
- Learning from Operating Experience
- Company intranet

The Point Lepreau Generating Station developed these basic program elements too, although not specifically for the purpose of knowledge management. After a period of poor performance in the mid-1990s, New Brunswick Power developed the current Management System Process Model to improve Point Lepreau station management and achieve station performance objectives [2]. This process model includes a tiered framework of interlinked Executive, Core and Support Processes, illustrated in Figure 1.

The current focus of nuclear industry effort in knowledge management is to improve the value of these programs [1]. Many aspects of plant operation lend themselves to effective knowledge management because the activities can be codified using explicit knowledge. However, knowledge management in plant ageing management presents some unique challenges, not unlike those faced by the medical industry. For example, diagnoses and management of (human and structural components) ageing-related degradation often requires:

- Complex analyses using highly sophisticated instrumentation and technology
- Input from several technical disciplines
- Latest understanding of ageing phenomena and treatment technology from research and operating experience (case studies)
- Specialists that are not readily available when the degradation phenomenon is not common
- Experience-based judgement (tacit knowledge) by the specialist
- Working under time pressure to avoid continuing decline in condition, physical discomfort and ultimately death for human patients, and costs for utilities, particularly when diagnoses are on the critical path of an outage.

In addition, structural materials, like the human body, sometimes respond to environments and treatments in unanticipated ways.

In the past decade, serious degradation of key Point Lepreau heat transport system components [3] led New Brunswick Power to improve its ageing management practices in areas that have also been identified by INPO[4] [4] and the IAEA as areas for knowledge management improvement. In addition to the general shortage of technical resources in the nuclear industry, other specific drivers for NBPN to advance ageing management/ knowledge management practices are because Point Lepreau are:

- A single unit station with limited technical expertise in the area of materials degradation.
- Physically remote from most of the industry from which it draws technical support.
- A leading CANDU unit in terms of operating hours and has been the first to experience and manage some degradation mechanisms.

This paper provides practical examples of how New Brunswick

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Executive Processes		Core Processes							
		Operate		Maintain		Equipment Reliability		Design Configuration	
DM-1	Direct and Manage the Business	OP-1	Control and Monitor Station Equipment	MA-2	Provide Planning and scheduling Services	ME1	Establish Maintenance Programs	MS01	Develop Modifications
DM-2	Manage External Relationships	OP-2	Control Chemistry	MA-3	Perform Maintenance	ME-2	Monitor and Manage System Health	MS-2	Implement Modifications
DM4	Assess and Improve Performance	OP-3	Control Effluents					MS-3	Maintain Design and Safety Basis
DM-5	Manage Processes	OP-4	Fuel the Reactor						

Support Services

SU-1 Provide Human Resources	SU-5 Provide Emergency Preparedness Services	SU-9 Provide Documents and Records
SU-2 Provide Environmental Services	SU-6 Provide Security Services	SU-10 Provide Financial Services
SU-3 Provide Training	SU-7 Provide Information Technology Services	SU-11 Provide Facilities
SU-4 Provide Personal Safety Services	SU-8 Obtain and Maintain Licenses	SU-12 Provide Materials and Services

Figure 1: High-level map of the management processes at Point Lepreau.

Power improved its heat transport system ageing management practices by improvements in knowledge management. Specifically, means to increase the value of existing knowledge and to convert tacit knowledge to explicit knowledge are illustrated.

2. Increasing Value of Existing Knowledge

Nuclear power plantss have a large amount of data and explicit (documented) information available to them that can be useful for ageing management (operational data, safety report, procedures, design drawings, external operating experience, research results, etc.). Much of the original information was in hard copy documents, drawings, and microfiche. With the advancements in information technology in the past few decades, a lot of this information is now available via the Point Lepreau data historian, intranet browser, web-links to EPRI[5], COG[6], etc., and more recently, presented with some analysis within the SMART CANDUTM support applications [5]. Despite this wealth of information, a piece of useful knowledge has not been always easy to find nor available in a format that was easy to apply to ageing management.

For example, a few years ago, it was observed that responsible engineers were not using existing life management plan documents. The most common reasons cited were that plans were excessively lengthy and contained superfluous information, information was not presented in a format that was recognized as useful, and other important practical information was missing. As a result of these issues, critical technical information was not always considered in ageing management planning and sometimes, important planned activities were not being performed [3].

Based on feedback from utility staff, several improvements were made to more effectively implement technical information into ageing management activities. This section describes two examples where critical knowledge held by experts and stored within volumes of documented material was identified and presented in ageing management plans in a format that was easy for responsible engineers to use.

2.1 Identification of Relevant Degradation

Point Lepreau ageing management plans now succinctly describe active and potential degradation mechanisms that, if not managed effectively, can result in an unacceptable level of risk to reactor safety and reliability. This knowledge is condensed from operating experience, plant process and chemistry monitoring data, design and materials information, and research results into the following value-added form [6]:

- *Key factors affecting degradation.* The key factors driving degradation can often be identified even if the fundamental details of a degradation mechanism are not known. An example is given for PLGS feeder pipe cracking in Table 1. The development of mitigation strategies is highly dependent on the potential to reduce or eliminate one or more key factors.
- *Identification of locations most susceptible to the degradation.* Knowledge of the presence of key factors in different system locations and during different operating conditions is required to establish the likelihood of degradation for these cases.
- *Evaluation of Operating experience.* Relevant internal and external operating experience is summarized briefly and illustrates

4 INPO - Institute of Nuclear Power Operations
5 Electric Power Research Institute
6 CANDU Owner's Group

Table 1: Factors Contributing to Point Lepreau Feeder Cracking

Primary Factors	Secondary Factors
Stress:	
Residual Stress: Based on physical evidence from spare bends and cracked feeders.	**Operating Stress**: Low amplitude cyclic stresses and other operational stresses postulated to increase susceptibility. No physical evidence.
Material:	
Cold Work/Hardness: Factors associated with observed cracks.	**Ovality and Impurities**: Postulated, based on operating experience and literature.
Environmental:	
Temperature: Cracks only in outlet feeders where temperature is 40˚C higher than in inlets. Consistent for creep cracking which is highly dependent on time at temperature (usually >310˚C).	**FAC-Generated Hydrogen**: Consistent with all crack locations; proposed to contribute to crack susceptibility. **Oxidizing Species and Impurities**: Based on literature and test results showing SCC in mildly oxidizing hot water (>100-150˚C), exacerbated by anionic impurities.

possible current and future condition of components. Previous to this initiative, important positive operating experience, such as inspection results that did not detect feeder cracks or garter spring movement, was not always given adequate consideration in assessing the likelihood of degradation.

- *Statement of the management concern if the degradation is not adequately managed.* This section identifies qualitative consequences of degradation (e.g. perforation of the pressure boundary or unplanned shutdown for repair) but quantitative information could also be used. This section is important to establish the risk of degradation and the risk reduction of an activity employed to manage it.

2.2 Simplification of Explicit Knowledge on Risk Reduction Strategies

Generally, the risk reduction strategies used at a plant to manage ageing are a combination of different activities that are multi-disciplinary and cross-functional. Very often these strategies benefit one component or system but might have an adverse affect on others; this is exacerbated when the affected systems are managed by different responsible engineers. One means to ensure the risk reduction strategies are understood within the organization is to raise awareness of their importance with the responsible engineers. This is done using easy reference tables in ageing management plans that link specific operations and maintenance activities to system-level and component materials degradation management strategies [6]. Examples are given for flow-accelerated corrosion in Table 2.

3. Converting Tacit[5] Knowledge to Explicit Knowledge

Tacit knowledge is subconscious or instinctual knowledge based on experience, which has not been captured (explicitly) in written form. INPO [4] describes tacit knowledge as involving:

- Effective thought processes and know-why of the reasons for completing tasks
- Organizational understanding of how work is accomplished and the interactions and relationships necessary for effective navigation within the organization
- Historical knowledge regarding important events and the bases for decisions made in the past

INPO defines the capture and documentation of important tacit knowledge (to explicit knowledge) as knowledge acquisition. At Point Lepreau, pre-determined response plans (described in Section 3.1) have been so effective for ageing management knowledge acquisition that Point Lepreau would like to use this approach more widely. However, knowledge acquisition typically is very difficult [1, 4]. One reason it is difficult in ageing management is that much of the underlying scientific and technical information currently does not lend itself to this purpose. This is discussed in Section 4.

3.1 Pre-Determined Response Plans to Findings

Pre-determined response plans for possible findings from planned inspection and maintenance activities have been a very effective feature of the ageing management program. They capture on paper the analysis and judgment by experts of results that have not yet been obtained and provide them to responsible engineers that may not have the expertise or knowledge to perform this function. Knowledge of potential results that may challenge the current basis for safe operation early in an outage allows for prompt initiation of activities (e.g., inspection scope expansion) that will decrease the likelihood of an outage extension. Following pre-determined response plans also increases credibility with Management and Regulators and reduces the risk of errors in judgement during time-challenged, critical-path activities.

Response plans are developed using the results of operational assessments from the previous inspection. Probabilistic assessments are particularly useful for developing response plans [7] because they allow sensitivity analysis of several parameters using best estimates. Table 3 shows an example from the 2007 feeder

5 In this paper, the term tacit knowledge also includes the concept of 'implicit' knowledge described in IAEA documents.

Table 2: Table Used to Show the Link Between the Degradation Mechanism, System-Level Issues, Management Options, and Risk-Reduction Activities.

(a) Example fom the Heat Transport System Ageing Management Plan for Flow Accelerated Corrosion

Ageing Management Plan Strategy			
Degradation Mechanism	**Major Affected Components**	**Relevant System-Level Issue**	**Management Options**
Flow Accelerated Corrosion	Outlet Feeders	Coolant temperautre increase	Inspection & Repair, Chemistry Control
		Decreased fuel cooling margins	
		Increased radiation fields	
		System chemistry limits	
	Large diameter outlet piping and headers	N/A	
	Steam generator internals	N/A	

(b) Example from the Feeder Piping Ageing Management Plan for Flow Accelerated Corrosion

Primary Strategy to Manage Degradation			
Degradation Mechanism	**Affected Components**	**Management Option**	**Management Activities**
Flow Accelerated Corrosion	All outlet locations, especially tight radius bends & adjacent to Grayloc Hub	Inspection	Wall thickness measurements
		Repair	Replace components projected to thin below minimum acceptable thickness
		Chemistry Control	Control pHa to lower end of specification (10.2-10.4) to minimize FAC rate

Table 3: 2007 Outage Response Plan for Feeder Piping Crack Inspection.

Cracked Feeders in 2007	Max. Crack Length	Condition Assessment Valid	Impact on Inspection and Maintenance Strategy
Reportable Inside or Outside Surface Cracks in Outlet Tight Radius Bends:			
0-6	~25mm	Yes	No supplementary activities or changes to the plan required. Remove requirement for crack inspection during an unplanned shutdown.
>6	~25mm	Review required	No inspection scope expansion. Prior to reactor restart, assess the validity of the condition assessment.
>0	>30mm	Review required	No inspection scope expansion. Perform NDE to characterize indications after feeders are removed. Depending on the severity of the cracks, destructive examinations to assess the validity of the condition assessment may be required prior to reactor restart.
Reportable Cracks in Other Locations:			
0	N/A	Yes	No supplementary activities or changes to the plan required.
>0	N/A	No	If cracks are found on an inlet bend, expand scope to all inlet first and second bends; operational assessment required prior to reactor restart.
>0	N/A	Review	If circumferential cracks are found in a thinned region required adjacent to the Grayloc hub, expand scope to other at-risk locations.

ageing management plan [6]. The information that is obtained during feeder crack inspection is: approximate crack length, crack location, and the number of cracked feeders. The table lists potential inspection findings for these crack characteristics that would challenge the basis for inputs (initiation frequency, crack growth rate, key factors initiating cracks) used in the previous operational assessment. This information was used to identify actions required during and immediately following the outage.

4. Concluding Remarks

New Brunswick Power has made improvements to the Point Lepreau ageing management program out of necessity to deal with serious component degradation and a lack of readily available expert technical resources. The improved processes have many elements of a successful knowledge management program. Examples of knowledge acquisition (converting tacit to explicit knowledge) and increasing the value of existing knowledge by making it easily available in a practical and useful format were described. The improvements to ageing management have led to measurable reductions in plant incapability, unplanned maintenance, and rework.

New Brunswick Power would like to apply these improvements more broadly to the ageing management program to assist staff in decision-making and planning without heavy reliance on external experts. However, the nature of the available information limits, to some degree, the feasibility to convert tacit to explicit knowledge. Research and engineering studies often focus on defining conservative acceptable operating conditions to minimize ageing rather than demonstrating available margins. If defined acceptable conditions are breached, guidelines (explicit knowledge) are often unavailable and expert judgments (tacit knowledge) are often required to determine appropriate actions.

A few areas that may warrant the research investment to convert tacit knowledge to explicit knowledge are:

- Fatigue usage for life extension,
- Response plans for:
  - Heat transport system operating chemistry transients,
  - Steam generator tube deposit analysis results, and
  - Selected system lay-up chemistry transients.

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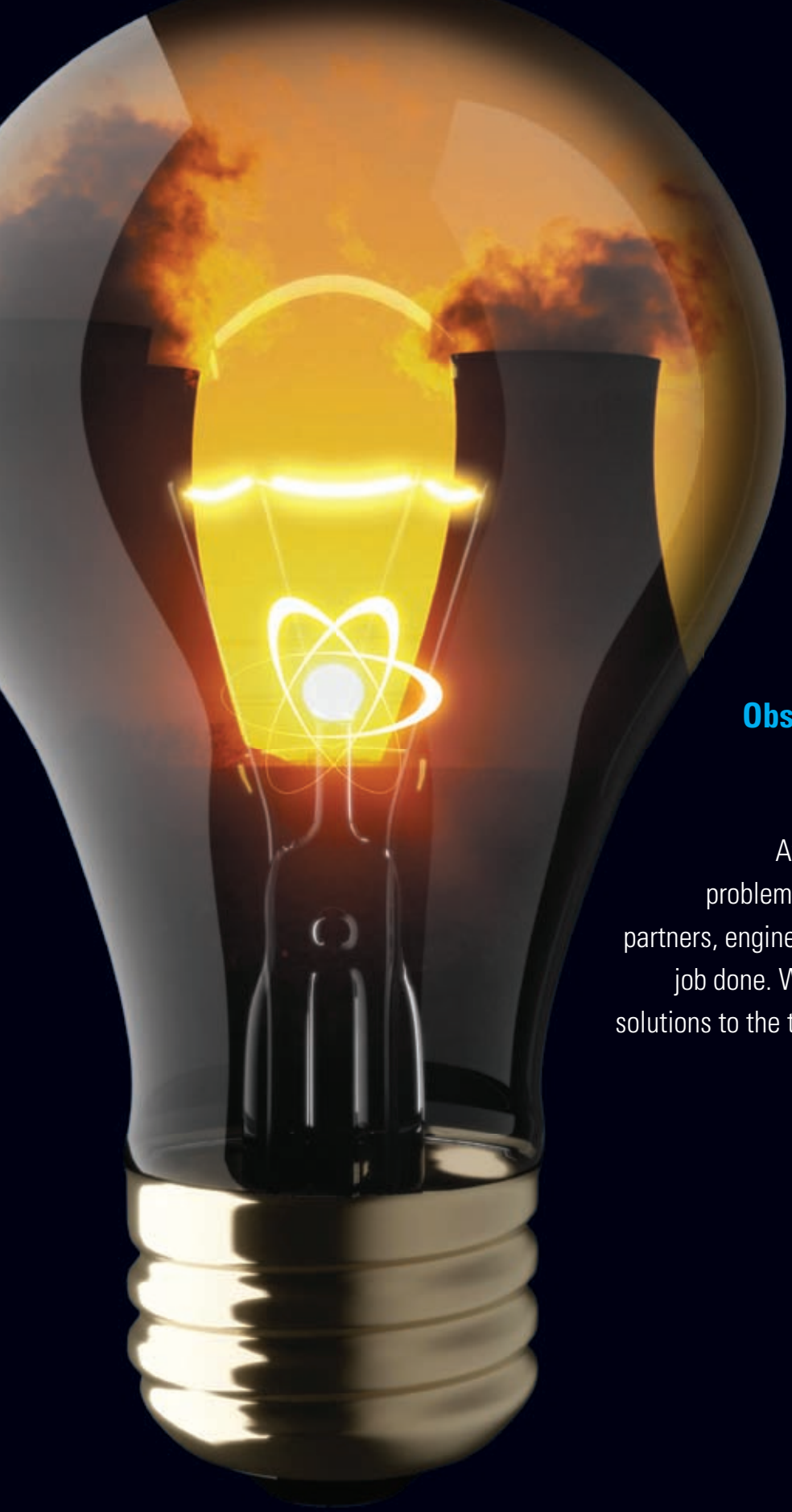

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Government of Canada Response to the Report of the Expert Review Panel on Medical Isotope Production

Ed. Note: On March 31, 2010, Christian Paradis, Minister of Natural Resources, released the Government's response to the report of the Expert Review Panel on Medical Isotope Production. It is self-explanatory.

Introduction

Recent supply disruptions have highlighted the fragility of the supply chain that delivers essential medical isotopes to patients globally. A new and more reliable way of supplying isotopes to Canadians needs to be found. That is why the Government of Canada established the Expert Review Panel on Medical Isotope Production (the Panel) in June 2009.

The Government recognizes the relatively long lead times associated with the development of any new source of medical isotopes. To ensure that appropriate action is taken now for the long term, the Government tasked the Panel with reporting to the Minister of Natural Resources on its assessment of the most viable options for securing supplies of technetium-99m (Tc-99m) for the Canadian health care system over the medium and long term and the actions that may be required by governments and others to facilitate realization of these options.

The Panel reported to the Minister of Natural Resources on November 30, 2009. Since then, the Government has been carefully considering the recommendations of the Panel within the context of the broader nuclear and health care landscape.

What follows is the Government's response to the Panel's thoughtful, comprehensive and insightful report, including actions that are planned based on its recommendations.

Background

Tc-99m, which is obtained from the decay of its parent isotope molybdenum-99 (Mo-99), is the most widely used medical isotope for medical imaging and accounts for approximately 80 percent of nuclear medicine diagnostic procedures. Tc-99m performs a critical role in the diagnosis of heart disease and is also used in cancer diagnosis through bone and organ scans.

Radio-isotopes (isotopes) naturally decay into more stable substances over time, some more quickly than others (the decay is what allows the diagnostic image to be captured). The half-life of an isotope is the time required for a quantity of radioactive material to decay to half of its initial amount. Given the relatively short half-life of Mo-99 (66 hours) and the even shorter half-life of Tc-99m (six hours), it cannot be stockpiled for later use. To ensure continuous availability, Mo-99 must be produced frequently, which adds to the complexity of the supply chain.

Historically, virtually all of the commercial supplies of Mo-99 have been produced via fission in nuclear reactors. Furthermore, since the United States (U.S.) does not produce Mo-99, the North American market has traditionally been heavily dependent on Atomic Energy of Canada Limited's (AECL) National Research Universal (NRU) reactor for the production of Mo-99, and subsequently for its supplies of Tc-99m.

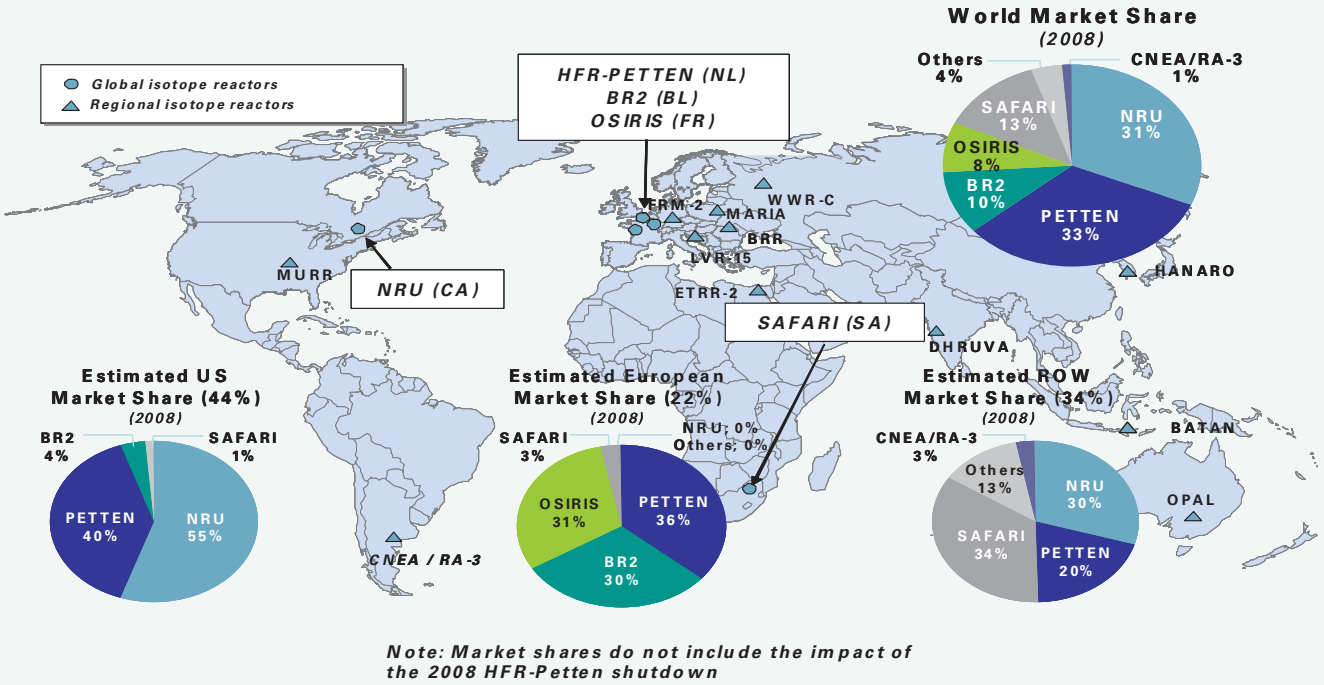
In Canada, home to the NRU reactor located in Chalk River, Ontario, the medical isotope supply chain has been complex and has involved a combination of both public- and private-sector organizations. The supply chain typically functions as follows. Highly enriched uranium (HEU) targets (obtained from the U.S.) are irradiated in the publicly-owned NRU reactor and processed for Mo-99 extraction. The raw Mo-99 supplied from the NRU is then sent to MDS Nordion, a private-sector company in Kanata, Ontario, for further processing and purification. Once MDS Nordion has purified the Mo-99, it is then shipped to Tc-99m generator manufacturers in other countries. Most of the product is shipped to U.S. private-sector Tc-99m companies that manufacture the generators and then sell to Canada through their Canadian subsidiaries.

Although Canada is the largest Mo-99 producer in the world when the NRU is operational, the supply chain is international and involves a number of other private sector players. A failure at any point in the supply chain can impact security of supply.

Moreover, nearly all of the world's supply of Mo-99/Tc-99m is met by five aging nuclear research reactors, with the NRU reactor providing approximately 30 to 40 percent of that supply. The other major isotope-producing research reactors are located in the Netherlands, South Africa, Belgium and France. However, some small but important additions to the supply chain are slowly emerging and are discussed below.

Recent outages of a number of these isotope-producing research reactors have highlighted the vulnerabilities in the current global supply chain, which are likely to remain for some time.

Security of supply is not a function of reactor reliability alone. It is also a function of processing capacity and availability, geographic alignment between processors and reactors, transport, handling and efficient use of the product. Historically, supply chains have been linear and somewhat independent, giving rise to the risk of complete breakdown if there is failure in one link of the supply chain (i.e., the single-point-of-failure risk). It should be noted that the relations among all players in the supply chain have been evolving since the outage of the NRU, and many of the issues noted above are being examined and improved upon.



Note: Market shares do not include the impact of the 2008 HFR-Petten shutdown

Figure 1: 2008 Global Market Shares

Additionally, Canada has taken a leadership role internationally, working with its international partners to draw attention to the fragility of global medical isotopes supply and to mobilize international approaches to the problem. At Canada's instigation, a High Level Group (HLG) on the Security of Supply of Medical Radioisotopes was created under the auspices of the Nuclear Energy Agency of the Organization for Economic Cooperation and Development to bring together key international participants in the supply and demand chain.

Within the HLG, a consensus was reached on the need to improve the coordination of reactor schedules, increase transparency, improve the efficiency of the distribution system, and provide timely notification of available supplies to the medical community.

Significant efforts have been made by suppliers and the international community to limit the public's exposure to upcoming shortages in 2010. For example, Belgium has added a cycle to its reactor schedule, South Africa will continue to operate at elevated levels, France has agreed to delay a scheduled outage, and Australia is working diligently to get new product into the international market in 2010. Further, on February 17, 2010, there was an announcement that the MARIA reactor in Poland expects to be supplying 7 to 10 percent of the world market for the first time by late March 2010.

Additional efforts to respond to the recent supply disruptions have been focused on mitigation strategies and communications, with regular updates provided to the medical community to allow it to plan and adjust as necessary. With strong engagement by Health Canada, the medical community has adapted its practices, utilizing isotopes more efficiently and finding alternatives for a number of procedures.

The Report of the Expert Review Panel on Medical Isotope Production

The Panel found that a **sustainable** supply of Tc-99m would have the following characteristics:

1. "be viable for the foreseeable future, likely for at least 15 to 20 years, and may include options that begin producing in the short to medium timeframe but that promise to remain viable;
2. comprise options that could each meet a meaningful portion of the Canadian demand, but that would not necessarily be exclusively Canadian-based and may or may not serve the U.S. or other markets;
3. have a sound business model that may or may not include government involvement; and
4. be free of highly enriched (weapons-grade) uranium because of Canadian and global commitment to non-proliferation." (Panel, 2009)

The Panel also found that a **secure** supply of Tc-99m would:

5. "improve redundancy at all points in the supply chain to avoid the single point of failure risk associated with a linear supply chain;
6. use diverse technologies to hedge against a failure that could arise if all suppliers used the same technology;
7. collocate irradiation and processing facilities to minimize decay losses and avoid shipping losses and risks; and
8. ensure sufficient capacity to accommodate short-term outages of some sources." (Panel, 2009)

Establishing these parameters for sustainable and secure supply helped to frame how the Panel assessed the likelihood of various technology options contributing to a stable isotope supply in the long term. These parameters will also help the Government of Canada frame the issue.

Building on this framework, the Panel provided the following general recommendations:

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; and,
4. recognize that HEU options are viable only in the short to medium term.

The Government of Canada finds the general recommendations to be useful in evaluating options under consideration. Like the Panel, the Government believes that a reliable, resilient global supply chain cannot be overly dependent on any one source, Canadian or otherwise. The global community must continue to work together to make every effort to improve the resiliency of the global supply.

The Panel's recommendation regarding HEU is in line with Canada's commitment to non-proliferation. Also, the Government recognizes the potential impacts of pending U.S. legislation that would see the eventual elimination of HEU exports from the U.S., thereby cutting off supplies of the raw material needed for Canadian and global production of Tc-99m by traditional methods.

Overview of the Government's Priorities for Secure Isotope Supply

Despite the efforts being made in the short term to secure isotope supply and to support health care system mitigation measures, the Government of Canada recognizes that these are not all sustainable. Investment is needed now for work that will increase the security of isotope supply in the medium to long term. Based on the Panel's advice, the Government is taking action to ensure that continued and alternative supply options are available. The NRU's licence will expire in 2011, and there are no concrete plans internationally that would ensure replacement of the NRU reactor's production in the short to medium term. This is why investments are being made to relicense the NRU to 2016. However, it is not the intention to have the NRU produce isotopes beyond 2016. Investment in non-reactor-based production is intended to support development of non-federal supply options that will serve well beyond 2016.

The Government of Canada has asked AECL to make return to service of the NRU its top priority, and the federal budget has provided money for AECL's ongoing operations including relicensing activities. Moreover, the Government has developed an action plan to increase the security of medical isotope supply for Canadians in the longer term based on i) encouraging new long-term supply of medical isotopes by investing in research and development to prove new technologies with commercial potential, ii) supporting resiliency and effective health system management by optimizing the use of available supplies and alternatives, where appropriate, and iii) continuing to work with the international community to coordinate outages and production of medical isotopes.

The Government of Canada is looking to transform the way Canada produces medical isotopes, and in particular Tc-99m, so that Canadian production is on a sound commercial footing without government support; production is scaled to the needs of Canadians; it is sustainable in terms of environmental impacts, health, safety and security; and Canada remains a global technological leader. We believe that this transformation will best serve the needs of Canadians for a secure supply of medical isotopes in the medium and longer term. Canada's NRU reactor has satisfied a significant portion of world demand for Mo-99; by producing at this scale, Canadians have been left to shoulder a disproportionate amount of the nuclear waste burden associated with reactor-based isotope production. This includes the significant costs associated with long-term management of the waste. The Government favours a new paradigm in which Canadians benefit from Canadian-based isotope production, supplemented if necessary from the world market, and supply is sustainable because of reduced waste and improved economics.

Canada has been at the forefront of medical isotope technology since the first cobalt-60 teletherapy units were used in Saskatchewan and Ontario in 1951. Canada's technological leadership can be maintained and enhanced as we move to a new and more sustainable model of isotope production based on Canadian needs. The Expert Review Panel has pointed to promising new technologies for the future production of Tc-99m. These technologies are being used today for other purposes. The cyclotron and accelerator technologies advocated by the Panel are ones in which Canada is already an established leader, including for the production of PET isotopes and for scientific research. Investing in research, development and demonstration (RD&D) to test the viability of these technologies for commercial production of Tc-99m can only enhance Canada's technological leadership, as well as enable a focus on meeting Canadian needs more sustainably.

By developing supply options that are scaled to Canada's needs, Canada will be creating new intellectual property and new businesses. Canada will be putting in place options that could benefit smaller international markets that have not been able to justify the "big investments" for "big production" that are required for reactor-based production. Non-reactor-based production would potentially allow smaller nations the opportunity to consider domestic production of Tc-99m for the first time, and would establish Canada as a technology leader in new and emerging technologies.

From a regulatory point of view, the Government is preparing the path forward to enable new sources of medical isotopes to be licensed in a timely manner while ensuring the highest standards of safety and security. The regulatory departments and agencies will work proactively to ensure efficient and effective regulatory processes. In particular, the Canadian Nuclear Safety Commission (CNSC) is planning to work with proponents of these alternative technologies to ensure regulatory requirements are clearly understood well in advance of the need to seek regulatory approvals.

Detailed responses to the Panel's technology-specific recommendations are given below.

Specific Recommendations and the Government's Responses

Expert Panel Specific Recommendation 1: Make policy decisions on the requirement for a new research reactor.

Panel Recommendation

We recommend that the government expeditiously engage in the replacement of the NRU reactor as we believe a multi-purpose research reactor represents the best primary option to create a sustainable source of Mo-99, recognizing that the reactor's other missions would also play a role in justifying the costs. With the National Research Universal (NRU) reactor approaching the end of its life cycle, a decision on a new research reactor is needed quickly to minimize any gap between the start-up of a new reactor and the permanent shutdown of the NRU. If the decision is to not build a new research reactor, the issue of securing supply of Tc-99m will have to be revisited in light of how cyclotron/accelerator options are advancing, and what new foreign sources of isotopes have materialized.

Government of Canada Response

The Panel expressed support for a new reactor, while emphasizing that what is most important in the short term is making a quick decision on this issue so that the market can adjust appropriately. The Panel's support for a new multi-purpose research reactor was based on a belief that this was the least technologically risky approach. However, the Panel recognized that a new research reactor was a very expensive piece of infrastructure that could not be justified based on isotope production alone.

From a purely isotope perspective, outside the considerations of the other missions of a research reactor, the Government finds that the very high costs and very long lead times make this a less attractive option than others. Based on the experience of other countries, it would likely take a decade or more to bring a new research reactor on stream. Also, the significant fixed costs and production capacity would be disproportionate to Canada's isotope needs and could not be recouped from the market. Waste liabilities associated with long-term reactor-based isotope production would be significant and again difficult to fully recover. Moreover, while production of medical isotopes using HEU targets is well established, there remain technical challenges associated with yields using low enriched uranium (LEU) targets, and the volume of waste would increase significantly.

A research reactor is only one piece of the linear supply chain that exists today. Replacing one piece of a linear supply chain, such as simply replacing the NRU with another reactor, would do little to develop the diversity and redundancy that the Panel believed were critical for ensuring security of supply. The lesson learned is that more should be done to create cross-linked and distributed supply chains that are not as vulnerable to single-point failures. An announcement that a new research reactor would be built in Canada to produce medical isotopes would discourage investment in alternative sources of supply, both in Canada and in other countries. The supply chain would continue to remain vulnerable to the single-point-of-failure problem that exists today, and generators would likely be manufactured outside of Canada. Also, purchasing "off-the-shelf" reactor technology from a foreign vendor would do little to maintain Canada as a leader in isotope technology.

A research reactor serves many missions. The need for a new reactor for these other purposes would need to be based on a thorough assessment of the missions, including neutron scattering and R&D for the nuclear industry, and consideration of the appropriate sharing of costs among the many users and beneficiaries of such a facility. This assessment is outside the scope of this response.

Expert Panel Specific Recommendation 2: Support an R&D program for cyclotron-based Tc-99m production.

Panel Recommendation

We recommend that the cyclotron option for direct production of Tc-99m, which has many attractive features, be explored further. Although this option requires significant R&D, the infrastructure and know-how to undertake that work is readily available in Canada, so costs associated with the R&D remain relatively low. Assuming technical viability, the infrastructure necessary to demonstrate this approach in selected centres across Canada is already in place. Indeed, Canada has an opportunity to be a leader in this area and strengthen its existing related businesses.

Government of Canada Response

The cyclotron option holds considerable promise for significant advantages over other alternatives. Several cyclotron facilities are already in place across Canada. These cyclotrons are already producing and distributing other medical isotopes, some of which have even shorter half-lives than Tc-99m.

This option would introduce a more distributed network of supply hubs that would eliminate the single point of failure problem that makes today's supply chain so vulnerable.

An important consideration from cost-savings and environmental perspectives is that this option would largely avoid nuclear waste issues.

Investment in the development of this option is low risk because even if the Tc-99m production technology does not prove successful, or if demand for Tc-99m diminishes over time, the facilities would continue to be useful for other missions, namely, producing positron emission tomography (PET) medical isotopes.

Another feature of the cyclotron approach is that it has the prospect of being economically viable without the need for ongoing government support. The Government of Canada sees this as a necessary evolution as government support in several countries have impeded healthy market development and created a vulnerable supply chain based on a limited number of producers using aged facilities.

It is important to recognize that significant research and development is needed to fully prove out this method and to demonstrate that high-quality Tc-99m can be produced at

reasonable cost using cyclotrons. At its current stage of development, there are uncertainties around the quantity and purity of the product that can be produced, and the cost and availability of the required raw material.

The Government plans quick action to provide $35 million for research, development and demonstration of non-reactor-based technologies for the production of Tc-99m, including cyclotrons. The proposed program would fund a range of activities from applied research up to and including demonstration activities to expedite the progression of the cyclotron and linear accelerator technologies from the lab to the market. The linear accelerator option is discussed further below in the section entitled Other Considerations.

A funding program is being developed and the Government expects to issue a competitive request for proposals in the spring of 2010.

Expert Panel Specific Recommendation 3: Achieve better use of Tc-99m supply through advanced medical imaging technologies

Panel Recommendation

We recommend deployment of newer single photon emission computed tomography (SPECT) technologies (software and hardware), as well as investment in positron emission tomography (PET) technology, to reduce demand for Tc-99m now and over the longer term, which would reduce the impact of future shortages of reactor-produced isotopes.

Government of Canada Response

The Government of Canada recognizes the importance of increased efficiency in the use of Tc-99m as well as diversification of imaging technologies and isotopes, as a means of reducing reliance on Tc-99m. The investments outlined below, as announced in Budget 2010, will support the medical community and governments in continuing to provide effective and appropriate medical imaging services, as approaches to medical isotope supply and other factors within the broader health care system evolve over time.

In line with the federal role in leading and fostering research and innovation, the Government of Canada will support the further diversification of advanced medical imaging technologies, and encourage the development of new or alternative isotopes by creating a Medical Imaging Clinical Trials Network (CTN). An investment of $5 million/year over two years, led by the Canadian Institutes of Health Research (CIHR), will help establish the Medical Imaging Clinical Trials Network as the first Network within CIHR's Strategy for Patient-Oriented Research. It will be informed by excellent research funded to date on medical imaging, including the CIHR/Natural Science and Engineering Research Council of Canada (NSERC) Medical Imaging Workshop Report written October 2009.

Establishing a multidisciplinary research Medical Imaging Clinical Trials Network will facilitate the rapid translation of advances in medical imaging into applications useful to health professionals in patient diagnosis and treatment, and the life sciences industrial sector for the benefit of the economy. Compared with funding individual research initiatives, networks offer the added benefit of: creating a critical mass of international scientific expertise; linking relevant support and other centres of researchers; coordinating overall research activities of the network; linking to community-based care programs; and facilitating continuity in research.

The Government of Canada will also support its health care system partners in optimizing the use of available Tc-99m and alternative imaging technologies where appropriate. To this end, the Government of Canada will invest $3 million over two years for the development of tools, protocols and standards for improved efficiency and effectiveness in health system management of medical imaging. As noted by the Panel, the health care community has worked hard to put mitigation strategies in place during recent periods of supply disruption. While not all of these strategies are sustainable or desirable over the longer term, there have been real efficiency gains and clinical learnings that should not be lost.

This initiative will support a leading national organization to engage experts, provider communities, provinces and territories, health technology and health service organizations to build on the networks, guidelines, and practices that have been established, synthesize various lines of evidence, and draw on innovations, research and lessons learned. The materials produced, which would harness and further develop learnings to date, will inform decision making at all levels, including decisions about the efficient and effective imaging technologies now and over the longer term.

Other Considerations

Expert Panel Consideration 1: Linear accelerator options

The two linear accelerator options have limited prospects for multi-purpose use, require significant R&D, and may not have significant cost advantages over reactor technologies. Nonetheless, a modest R&D investment could be considered as a hedge against the risk of failure of other options. Of the two linear accelerator options, we prefer the technology based on Mo-100 transmutation since the projected economics appear better, and it largely avoids nuclear waste management issues.

Government of Canada Response

The Panel found that the Mo-100 transmutation technology was the more attractive of the two linear accelerator options. Like the cyclotron technology, the Mo-100 transmutation technology is non-reactor-based, avoiding many of the challenges associated with constructing and operating reactors. Especially significant for the Government is the avoidance of significant nuclear waste management issues, thereby reducing cost and minimizing environmental impact.

However, the Government recognizes that there are important differences between these two methods:

— The cyclotron option would produce Tc-99m directly, without first generating Mo-99. Because the half-life of Tc-99m is short (six hours), producing Tc-99m directly means that processing, distribution and storage times must be very short. This may limit the range of distribution for

this product, making the cyclotron option a more localized and regional solution.

— The Mo-100 transmutation option would be based on one or two facilities in Canada and may require a new type of generator technology; whereas the cyclotron option would be based on a distributed network of regional facilities.

— Relying on one or two accelerators may result in the same supply chain vulnerabilities that exist today, based on potential for single point of failure.

Overall, the linear accelerator and cyclotron options are at a similar stage of development, and questions remain regarding economic projections, technical challenges, ease of regulatory approval and market acceptance.

Despite the uncertainties, the Government notes that the Panel found that the cyclotron and the Mo-100 transmutation options are both potentially attractive because they have the potential to be economically viable without the need for ongoing government support.

There is merit in having the two technologies compete to stimulate the best ideas and to stimulate the best commercial prospects. Also, given that they are at a similar stage in terms of development, the Government finds it prudent to invest in both technologies until the viability of each is better understood. Ultimately, one or both of these non-reactor technologies may find a place in the market.

As mentioned earlier, a $35 million funding program is being developed, which would invest in the research, development and demonstration (RD&D) of non-reactor-based technologies for the production of Tc-99m. This program would consider proposals for RD&D activities for the cyclotron or Mo-100 transmutation options.

Expert Panel Consideration 2: the MAPLEs

Panel Observations

Cost and timeline estimates associated with the commissioning and licensing of the MAPLE reactors varied widely. Although it may be possible to bring them into operation, the business case is such that even if the facilities could be licensed immediately at no cost, the ongoing revenues from isotope sales would be insufficient to cover the ongoing operating expenses, particularly with the anticipated reduced throughput from future conversion to LEU targets. A dedicated isotope facility based on a private sector cost-recovery model would be a good solution, assuming a private-sector organization would be willing to accept the full commercial risk associated with this model.

Government of Canada Response

In 2008, the Government of Canada accepted the decision of the Board of Directors of AECL to discontinue the Dedicated Isotope Facility project (also known as the MAPLEs).

The Government of Canada notes the Panel's assessment that there are considerable challenges associated with the DIF/MAPLEs project, including economic, technical and regulatory challenges. The Government will not invest additional public funds into this project. In line with the Panel's recommendation, the Government will remain open to considering private sector proposals that would cover full costs, liabilities and risks without further public investment.

Conclusion

Supplies of Tc-99m will remain fragile in the short term. Continued dependence on the world's five aging, government-funded nuclear reactors for production of Tc-99m is unsustainable.

The Government of Canada has asked AECL to make return to service of the NRU its top priority, and the federal budget has provided money for AECL's ongoing operations including relicensing activities. Moreover, the Government has developed an action plan to increase the security of medical isotope supply for Canadians in the longer term based on i) encouraging new long-term supply of medical isotopes by investing in research and development to prove new technologies with commercial potential, ii) supporting resiliency and effective health system management by optimizing the use of available supplies and alternatives, where appropriate, and iii) continuing to work with the international community to coordinate outages and production of medical isotopes.

More specifically, and in response to the Panel's recommendations, the Government of Canada will encourage new long-term supply of medical isotopes by implementing a number of concrete measures.

The Government will invest $35 million in research, development and demonstration to encourage the commercialization of non-reactor-based technologies for the production of Tc-99m. The program will advance technologies at the leading edge of isotope technology development and will help Canada remain a leader in the area of isotope technology. If successful, these technologies would deliver innovative solutions on a scale commensurate with Canada's needs and would result in reduced nuclear waste.

Also, the Government of Canada will support increased efficiency in the use of Tc-99m and diversification of imaging modalities, in order to promote resiliency and enable effective health system management. Targeted investments will include $3 million for the development of tools, protocols and standards and $10 million to create a clinical trials network to help move research on isotopes into clinical practice.

The Panel has provided a very insightful and comprehensive report, which has guided the Government's consideration of all available options. The Government of Canada wishes to thank the Panel for its hard work, and believes that with the implementation of these measures, Canadian supply of medical isotopes in the long term will be commercially viable, more secure, and more reliable.

GENERAL news

(Selected by Fred Boyd from open sources)

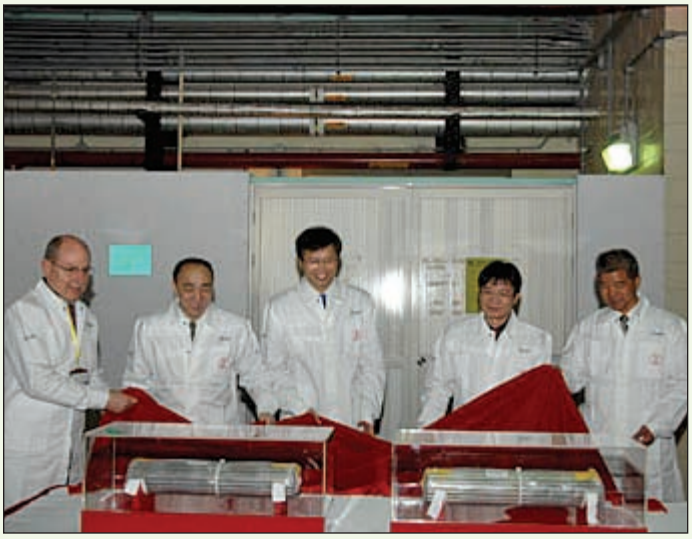
Qinshan CANDU directly uses recovered uranium fuel

The first-ever fuel bundle to directly use recovered uranium from light water reactors was successfully placed in the Qinshan CANDU Unit 1 on 22 March 2010.

A ceremony to commemorate the event was held at the Qinshan site and was attended by senior Chinese government officials along with representatives from AECL and its Chinese partners Third Qinshan Nuclear Power Company (TQNPC), Nuclear Power Institute of China (NPIC) and China North Nuclear Fuel Corporation (CNNFC).

Over the next six months, a total of 24 Natural Uranium Equivalent (NUE) fuel bundles will be inserted into two separate fuel channels at the Qinshan Unit 1 reactor in Haiyan, China. NUE fuel is made by mixing recovered uranium from spent fuel of light water reactors with depleted uranium from enrichment plant tails. The irradiation of all 24 NUE bundles will be completed in approximately 12 months.

The commercial demonstration of NUE fuel in the CANDU reactor is the final phase of a three-phase joint research project between AECL and its three Chinese partners, TQNPC, NPIC and CNNFC. The project was initiated in 2008 to explore the use of recovered uranium from light water reactors in a CANDU reactor and to prove that it is the simplest, most cost-effective and environmentally-friendly process to utilize alternative fuel sources.



Two of the 24 NUE fuel bundles destined for the Qinshan CANDU Unit 1 reactor were unveiled March 22, 2010 in China. Taking part were from left: Tony De Vuono, Sr. VP & Chief Technology Officer, AECL; HUANG Guojun, Vice-Chairman of Science & Technology Committee, China National Nuclear Corporation; LI Junjie, Deputy Director-General, China Atomic Energy Authority, Ministry of Industry and Information; WANG Zhongtang, Director-General, Shanghai Regional Office, Ministry of Environmental Protection; LIU Chuande, Chairman of the Board, Third Qinshan Nuclear Power Company Ltd.

In December 2009, an expert panel of representatives from China's leading nuclear academic, government, industry and R&D organizations unanimously recommended that China consider building two new CANDU units to take advantage of CANDU's unique capabilities in utilizing alternative fuels.

The existing Qinshan Phase III nuclear power plant includes two 728 MWe CANDU 6 PHWR reactors designed by AECL and built in cooperation with TQNPC. The two CANDU units are ranked among the top performing nuclear power stations in China.

TQNPC (Third Qinshan Nuclear Power Company Ltd) is the owner and operator of the Third Qinshan Nuclear Power Plant at Haiyan County of Zhejiang Province, which has two CANDU 6 reactors in operation since 2003.

CNNPC (China North Nuclear Power Company Ltd.) is a fully owned subsidiary company of CNNC, is one of China's leading nuclear fuel processing and manufacturing companies and owns and operates a plant for producing CANDU nuclear fuel bundles for the Third Qinshan Nuclear Power Plant, located in Baotou, Inner Mongolia Autonomous Region, China.

NPIC (Nuclear Power Institute of China) is a fully owned subsidiary institute of CNNC. It has comprehensive research, development, design and testing capabilities and facilities in support of the development of pressurized light-water reactor power plant technology, especially in the design of nuclear steam supply systems.

Yucca Mountain officially terminated

In early March 2010, the US Department of Energy filed a motion with the US Nuclear Regulatory Commission to withdraw its application to build and operate the huge Yucca Mountain nuclear waste repository.

Yucca Mountain was designated as the national repository for high level nuclear waste b when the Nuclear Waste Policy Act was amended in 1987. It is located in a desert on federal land adjacent to the Nevada Test Site about 130 km northwest of the Las Vegas metropolitan area. On March 5, 2009, Energy

Secretary Steven Chu told a Senate hearing that the site was no longer viewed as an option for storing reactor waste

Originally the Department of Energy was to begin accepting spent fuel at the Yucca Mountain Repository by January 31, 1998. However, legal challenges, concerns over how to transport nuclear waste to the facility, and political pressures resulting in underfunding of the construction, led to a series of delays.

NRU progress

AECL reports that 51 per cent of the repair activities and associated post-repair examinations on the NRU reactor vessel have been completed.

At the time of writing the latest weld repair had been successfully completed.. It proved to be the most complicated and difficult repair undertaken to date. AECL is evaluating the lessons-learned from this latest repair and will be applying them to the remaining repair sites. The vessel repair team is transitioning to the final repair sequence with two repair sites remaining.

The remaining two repair sites present unique challenges that require first-of-a-kind technical solutions. To ensure that the repair process itself does not cause damage to the vessel an additional level of preparation is necessary to program the welding sequences and to qualify the welders.

Earlier NRU was projected to return-to-service during the second half of May 2010. AECL is currently revising the return-to-service schedule based on the experience obtained from the latest repair, as well as recommendations stemming from the expert review conducted earlier this week.

Progress can be followed on the special website AECL has created to provide updates on the repair. NRUCanada.ca

All NPPs peer reviewed

In February the World Association of Nuclear Operators (WANO) announced that all of the world's 447 nuclear power plants, in over 30 countries, have been peer-reviewed by teams it has organized.

The peer review program was begun in 1993. It provides plant operators with an opportunity to share and learn from worldwide experience on safe and reliable operation. Carried out at the request of an operator a typical peer review involves in-depth observation of all aspects of plant operation during a two-week visit by a team of exert from other WANO members. the objective is to have each unit reviewed every six years.

AECL to advise on Cernavoda 3 and 4

In February 2010 Atomic Energy of Canada Limited (AECL) announced the signing of a major contract with SC EnergoNuclear S.A. (EnergoNuclear) to assess the technical and commercial viability, and planning of the Cernavoda Nuclear Power Plant (NPP) Units 3 and 4 investment project in Romania, currently in the pre-project phase.

The scope of the contract is for AECL to provide consulting services in the nuclear safety and engineering field in order to define what is required to complete the Cernavoda NPP Units 3 and 4 project. More specifically, AECL will undertake activities such as design, authorization and assessment of the existing infrastructure and safety conditions.

Cooperation between Romania and Canada in the nuclear energy field reflects a strong history based on the CANDU 6 design for Units 1 and 2, which are already in operation. Further cooperation between EnergoNuclear and AECL is confirmation of the commitment to performance and safety, as evidenced by Units 1 and 2, and of the desire to achieve the same criteria of safety and confidence for Units 3 and 4.

Canada's CANDU technology has contributed to Romania's healthy nuclear industry, and has proven to be an important economic asset for the country. CANDU technology also enhances energy self-sufficiency as both nuclear fuel and heavy water are produced by Romania.

"This contract is a significant step towards the completion of Units 3 and 4," said Dan Ionescu, General Manager of EnergoNuclear S.A. "Units 1 and 2, in service since 2007, already provide 20 per cent of Romania's electricity supply and have produced significant economic benefits, high value jobs and industry spinoffs. Once complete, the new units will substantially increase our nuclear energy capabilities, and provide significant new economic and employment opportunities in the region."

EnergoNuclear SA is owned 51 per cent by Romanian-utility Nuclearelectrica SA along with joint venture partners Czech utility CEZ, France's GDF-Suez, Italy's Enel, Germany's RWE Power, Spain's Iberdrola and steel producer ArcelorMittal. The company was established in March 2009 to undertake the construction, commissioning and operation of two new reactors at the Cernavoda nuclear power plant in Romania.

Cigar Lake mine dewatered

In February 2010, Cameco reported the completion of the dewatering of the underground development. Crews re-entered the main working level of the mine 480 metres below the surface. Safe access to the 480 metre level was established and work to inspect, assess and secure the underground development has begun. This work will be followed by restoration of underground mine systems and infrastructure in preparation for resumed construction activities.

The 2008 inflow that forced temporary suspension of the dewatering of the mine has been stopped. An inflatable seal was placed between the shaft and the source of the inflow was then backfilled and the entire area sealed with concrete and grout.

Dewatering of shaft 2 in April and remediation of the shaft was completed in May 2009. Dewatering of shaft 1 was begun in October and crews entered the shaft in November. Work focused on refurbishing shaft 1 – installing the ladderway, replacing mechanical and electrical components and extending the in-shaft pumping system.

The company states that it expects to complete work to secure the underground before October 2010, depending on the condition of the mine.

Cigar Lake's construction licence was amended effective January 1, 2010, to extend the term for four years and to cover dewatering, remediation and construction activities, including completion of shaft 2 and surface construction.

Last Bruce B unit gets power increase

On March 11, 2010 reactor power on Unit 8 was raised to 93 per cent. Unit 8 is the last of the Bruce B Units to get a boost in output following fuel-loading modifications that allow operators to raise reactor power from 90 to 93 per cent. The last time Unit 8 operated at 93 per cent was August, 1995.

The increase was made possible by the completion of a process called core re-ordering which involves changing the direction in which fuel is inserted into the core. The resulting 25 megawatt

increase will provide enough electricity to power 25,000 homes or a city roughly the size of Owen Sound, ON.

When Bruce Power assumed operational control of the site in 2001, the Bruce B units were held at 90 per cent of their design capability or 'nameplate rating'. This was to ensure that under some postulated accident conditions involving a loss of coolant, appropriate safety margins were maintained to ensure the safe shutdown of the unit. Following a thorough review of core re-ordering, the Canadian Nuclear Safety Commission approved the power increases.

Power was raised on Unit 6 in April of 2004, on Unit 7 in May 2007 and on Unit 5 in January, 2008. Core re-ordering on the Bruce A Units was completed several years ago.

Darlington Refurbishment decided

In mid February 2010, Ontario Power Generation (OPG) announced plans for the refurbishment of the four units at the Darlington site and a multi-million investment in the Pickering B station to ensure continued safe and reliable performance for 10 years.

OPG will proceed with a detailed planning phase for the

mid-life refurbishment of the Darlington Nuclear Generating Station with work expected to start in about 2016. The business decision to move forward with an investment in Darlington comes after very positive outcomes of initial studies on the plant's condition and continued strong operating performance. The next phase of the process will include an Environmental Assessment, an Integrated Safety Review and an Integrated Improvement Plan that will define the scope, cost and schedule of the refurbishment project.

OPG will also invest $300 million to ensure the continued safe and reliable performance of its Pickering B station for approximately 10 years. Following this, OPG will begin the longer term decommissioning process as refurbishment for Pickering B station will not be pursued. Extensive safety, environmental and equipment reliability studies conducted at the station concluded the Pickering plant can continue to operate safely and reliably to meet the province's energy needs through to 2020. OPG has indicated to the Canadian Nuclear Safety Commission that later this year it will file a Continued Operation Plan that takes Pickering B to its end of life.

In planning the Darlington refurbishment, OPG will build on the accomplishments and lessons learned during the Pickering A restart and the Pickering safe storage project. The restart of Pickering Unit 1 was completed on time and on budget, and the safe storage project for Units 2 and 3 is currently tracking on budget and on time for completion this year. This phase of the Darlington refurbishment will also reflect the same thorough process undertaken for the Pickering B Environmental Assessment and Integrated Safety Review.

OPG continues to proceed with work that supports the construction and operation of a new nuclear station located at the Darlington site. The Environmental Assessment and site licence work for a potential new build will continue in parallel with the above investment activities.

Leslie Rupert Haywood

HAYWOOD, Leslie Rupert - Peacefully, on Sunday, February 14, 2010, at South Muskoka Memorial Hospital, in his 91st year in the loving company of his three daughters, Linda McLaren of Pembroke, Carol Powell of Huntsville and Lois Haywood of Chelmsford. His sister Marjorie Cooper of Oshawa, his grandchildren, Sherilyn, Eric, Jennifer, Ryan, Meredith and Sylvia and his great grandchildren, Aowyn, Lukas and Sylvan will miss him. Les was a pioneer in the development of nuclear power generation having been employed in the CGE Civilian Atomic Power Department (Peterborough) from its inception to 1962 and, as Vice-President of Atomic Energy of Canada, in charge of the Chalk River Nuclear Laboratories for some years. Born and raised in Saskatchewan, Les has travelled the world and lived a full and generous life. His professional contributions and his woodworking and craft hobbies will be remembered by many. Interment, arranged by COMSTOCK FUNERAL HOME & CREMATION CENTRE, 356 Rubidge Street, Peterborough, will be in Peterborough at Little Lake Cemetery alongside his beloved late wife Joyce Vivian Haywood. If so desired, in lieu of flowers, donations may be made to the Five Counties Children's Foundation, Peterborough, Ontario. Online condolences may be made at www.comstockfuneralhome.

Michael Garner Taylor

MICHAEL GARNER TAYLOR, a former Vice-President at Atomic Energy of Canada Limited, died suddenly and tragically on March 27, 2010, at Lac Poisson Blanc, Quebec, at the age of fifty eight.

Michael Taylor was appointed Vice President, Corporate Affairs at AECL in the spring of 2001. His mandate oversaw several portfolios including external relations, corporate policy, planning and communications. He retired from AECL in August 2006.

Prior to joining AECL, he was the principal of M.G. Taylor & Associates, an organizational development consultancy providing strategic change management and policy advice to clients across Canada. His clients included the Department of National Defence, Health Canada, Export Development Corporation (EDC) and Centrepoint Technologies in Ottawa's high tech sector.

In 1983, he was appointed Director of Corporate Management Services for the National Capital Commission (NCC) in Ottawa. Earlier as Director of Operational Services, he participated in its property management organization in reducing costs and improving efficiency for the organization.

Michael began his career with the Export Development Corporation in 1977 as a Policy and Planning Analyst. His tenure at EDC as employee and advisor included the development and implementation of the organization's business planning process and modernizing its mandate via amendment or the Export Development Act.

Born in England, Michael moved with his family to Canada as a child. He received his Bachelor's of Environmental Science at the University of Waterloo (1975) and completed his Master's in Public Administration from Carleton University in Ottawa (1976).

Michael lived in Ottawa but spent much time in west Quebec pursuing his love of the outdoors.

A gathering of friends and family was held at the Central Chapel of Hulse, Playfair & McGarry, Ottawa, on Wednesday, March 31, 2010.

CNS news

Eric Williams named EIC Fellow

At the 2010 Awards Dinner of the Engineering Institute of Canada, **Eric Williams,** former President of the Canadian Nuclear Society and currently serving as Treasurer, was named a Fellow if the EIC.

The EIC is a society of 11 engineering-related societies, including the CNS. Nominations for EIC awards are made by the member societies. Eric is just the second CNS member to be nominated and honoured by the EIC.

The citation noted particularly his "outstanding leadership in the development of standards and programs for improved fire protection in nuclear power plants".

He was recognized for his many years of service with the CNS and for his involvement in many other activities. For several years he was president of Paddle Canada, an umbrella organization for the many canoeing groups across the country. In 2008 he organized a trip of a number of voyageur canoes from the Rockies to Thunder Bay to celebrate the 200th anniversary of the historic trip by David Thompson, one of Canada's major explorers.

Eric was the chair of the program committee for the EIC's *2nd Climate Change Technology Conference* held in Hamilton in May 2009 and largely responsible for the success of that event.

Joining Eric at the affair were his wife Lynda Gay, daughter Larisa and friend Greg Cheshire, and CNS colleagues, Krish Krishnan, Adriaan Buijs and Fred Boyd.

Eric Williams (R) receives his certificate as Fellow of the Engineering Institute of Canada from EIC president Marc Rosen at the EIC Awards Banquet in Ottawa, 27 February 2010.

CNA president at CNS Council

Denise Carpenter, the recently appointed president of the Canadian Nuclear Association, attended the meeting of the CNS Council in Toronto on March, 2010 and ended up staying for the full meeting.

During a short presentation she spoke about the move at the CNA to develop a new strategic plan. The process has been agreed, she said, and the actual development of the plan will get underway very soon.

She spoke of developing even better relations between the two organizations, emphasizing that she considered the CNS as the most appropriate source of scientific and technical information. It appeared that she already developed a rapport with CNS president Dorin Nichita, who, through the formal arrangement developed at the time of incorporation of the Society, is a member of the CNA Board.

CNA president Denise Carpenter and CNS president Dorin Nichita express the positive relations between the two organizations at the CNS Council meeting 5 March 2010 in Toronto.

CNS Council prepares Brief for new research reactor

The CNS Council is nearing the finalization of a document for submission to the government in support of a new research reactor to continue the scientific and technical contributions of NRX and NRU.

The brief focuses primarily on the need for a high-power research reactor to support research and development needed for future development of nuclear power plants. It will complement a report submitted by the Canadian Institute for Neutron Scattering last year. That report emphasized the need for a strong neutron source to continue the research and applications that members of CINS have pursued over the past decade at NRU.

The CNS report supports the primary recommendation of the Expert Panel set up by the Minister of Natural Resources Canada last year to advise on future production of medical isotopes that a multi-purpose research reactor was the best option .

CNS Council hopes to have the report finalized for ratification at its April meeting.

CNS Council considers restructuring

Over the past few months a committee of the CNS Council has been working on a Strategic Plan for the society. This has been presented to the extended Council and will likely be adopted at the April 16, 2010 meeting.

This exercise had its beginning with a report by Murray Stewart and Bob Hemming two years ago which looked primarily at the operational structure of the society. It recommended engaging an Executive Director, initially part-time. There was considerable apprehension among members of Council and no decision was made.

In January 2009 a Special Session was held to which all members of the extended Council (including chairs of branches, divisions, committees) were invited. That all-day session looked at the broad question of the goals of the society and how best to achieve them.

Although the discussion continued, little definitive progress was made until near the end of the year when a sub-group was appointed to specifically draft a Strategic Plan. Under the somewhat reluctant coordination of Eric Williams the group produced a combined Strategic Plan and 5-year Business Plan which was discussed at the Council meeting of March 5, 2010.

Again, the central proposal is the appointment of an Executive Director, initially part-time. It has been observed that every other similar organization has such a position. To cover the additional cost plans were developed for additional major meetings, the primary source of income for the society.

If adopted by Council it will be presented for ratification at the Annual General Meeting which will be held in Montreal on May 26, 2010 during the Annual Conference.

Another focus has been on strengthening the Branch structure and a call has already gone out for assistance in that area.

If, as a CNS member, you have questions or concerns, contact one of the executive or member of Council. See the back page of the Bulletin for names and contact information.

Call for Nominations for CNS Council for 2010-2011

Nominations are sought for election of officers and members of the governing Council of the *Canadian Nuclear Society* for the 2010 - 2011 period.

Following is the relevant excerpt from the By-laws of the Society, article 6(d)::

"The elected members of Council shall be elected each year at the Annual General Meeting of the Society, with the exception of the outgoing President and first Vice-President, who automatically (without re-election) become respectively the Past President and President for the next term of Council. Every Council member shall be eighteen (18) or more years of age, and shall be an individual member in good standing of the Society."

The Annual General Meeting of the Society will be held on Wednesday May 26th 2010, from 16:15 to 17:45, in the Hilton Montreal Bonaventure Hotel, in conjunction with the Annual Conference of the Society.

CNS members who are interested in serving as Members-at-Large of Council are invited to submit their own nominations in writing or by email to Jim Harvie, Past-President, by April 15, 2010, at the address below. Nominations of someone else requires the agreement in writing of the nominee. Members who wish to run for the positions of: Secretary, Treasurer, or 1st or 2nd Vice-President require endorsement by two other CNS members.

Depending on the number of nominations, an election or an acclamation of the 2010-2011 Council will take place at the Annual General Meeting. While nominations from the floor are allowed at the meeting, it is preferable to have nominations submitted in advance, to facilitate arrangements for an election should one be necessary.

There are usually 8-10 Council meetings per year and are generally held in the Toronto area. Many employers in the industry support employees who volunteer to participate on the CNS Council by reimbursing travel expenses and accepting business time spent on Council business. Employed nominees should discuss this with their employers. Members who are not otherwise reimbursed for their travel expenses may claim out-of-pocket costs in accordance with the CNS Travel Policy.

Jim Harvie
1611 Trans-Canada Highway, Cumberland, Ontario K4C 1H5
613-833-0552 • jdharvie@rogers.com

Canadian Nuclear Society
Société Nucléaire Canadienne
480 University Avenue, Suite 200, Toronto, Ontario, Canada M5G 1V2
Tel: (416) 977-7620 Fax: (416) 977-8131
E-mail/Courriel: cns-snc@on.aibn.com

CNS Scholarship for PhD Graduate Research

The Canadian Nuclear Society is pleased to offer a scholarship to promote nuclear science and engineering in Canadian universities.

This scholarship is designed to support *a PhD level full time graduate student entering their second or third year of graduate research in nuclear science and engineering at a Canadian University*.

One award of $10,000 per year for a total of two years is available

The scholarship will be awarded to a PhD candidate for a specific research project related to nuclear science and engineering. There must be a faculty member supervising the research.

The awards will be applied as partial payment of each student's earnings during the two year period. Note that funding for the second year is conditional on satisfactory progress in the first year of the award.

Awards will be based on the academic standing of the student and the merit of the proposed research. An independent panel, appointed by the CNS, will review submissions and make award decisions.

Guidelines for submission

The faculty member responsible for the research must be a CNS member in good standing.

The student must be enrolled in a PhD graduate degree program at a Canadian University and be a member of the CNS.

The research duration must be at least two years remaining.

Applications should be prepared by the students and include:

- Student CV and grades (undergraduate and graduate)
- Research Proposal including the thesis topic, objective and relevance to nuclear science and engineering in Canada, details of the research approach and the schedule for completing the research work including the submission of a full-length peer-reviewed paper within 6 months of the end of the award (maximum 4 pages, in 12pt, MS Word document).
- A letter of support from the thesis supervisor stating the quality of the student and that the approach is sound.

Submission procedure

The application must be sent by e-mail to:

Dr. Glenn Harvel
University of Ontario Institute of Technology
Faculty of Energy Systems and Nuclear Science
e-mail: Glenn.Harvel@uoit.ca

Deadlines

- Submission deadline: April 22, 2010
- Notice of Awards: May 10, 2010 (all applicants to be informed). The official award presentation will be made during the student awards ceremony at the CNS annual conference in Montreal.
- 1st Installment: September 1, 2010
- 2nd Installment: September 1, 2011

Deliverables

A paper is to be presented at the 2011 CNS/CNA Student Conference.

A full length peer-reviewed conference paper or journal paper covering the work is to be published within one year after the end of the award.

Questions should be addressed to:
e-mail: cns-snc@on.aibn.com

Canadian Nuclear Society
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480 University Avenue, Suite 200, Toronto, Ontario, Canada M5G 1V2
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E-mail/Courriel: cns-snc@on.aibn.com

Bourse de recherche au doctorat de la SNC

La Société nucléaire canadienne est heureuse d'offrir une bourse afin de promouvoir la recherche en science et génie nucléaire dans les universités canadiennes.

Cette bourse doit servir à supporter financièrement un(e) *étudiant(e) au doctorat de deuxième ou troisième année à inscrit à temps plein dans une université canadienne et travaillant sur un sujet relié à la science ou au génie nucléaire.*

Une bourse de 10,000$ par année sera accordée pour une période totale de 2 ans

Cette bourse sera attribuée à un(e) candidat(e) au doctorat pour un travail de recherche relié à la science ou au génie nucléaire. Un professeur d'une université canadienne reconnue doit être responsable du projet.

La bourse servira à compléter l'aide financière qui sera versée à l'étudiant(e) pour la période visée. Le renouvellement de la bourse pour une deuxième année est conditionnel à un avancement adéquat de travail au cours de la première année.

Les critères pour l'attribution de la bourse sont la qualité du dossier académique de l'étudiant et du projet proposé. Les candidatures seront étudiées par un jury indépendant, nommé par la SNC, qui attribuera les bourses.

Critères d'éligibilité

L'étudiant(e) doit être inscrit(e) à un programme de doctorat dans une université canadienne et membre de la SNC. Le professeur responsable du projet doit être un membre de la SNC.

L'échéancier du projet de recherche doit couvrir une période minimale de deux ans.
La demande de bourse doit contenir :

- Un CV et les relevés de notes de l'étudiant(e)
- Une description du projet incluant une discussion de la pertinence du projet pour la science ou le génie nucléaire au Canada, une présentation de objectifs du travail et un échéancier (maximum 4 pages, 12pt, document MS Word).
- Une lettre de recommandation du directeur de thèse.

Procédure de soumission

Les dossiers doivent être transmis par courriel à :

Dr. Glenn Harvel
University of Ontario Institute of Technology
Faculty of Energy Systems and Nuclear Science
e-mail: Glenn.Harvel@uoit.ca

Dates importantes

- Date limite de soumission: 22 avril 2010
- Annonce des résultats: 10 mai 2010
  (tous les postulant(e)s seront informé(e)s)
- Premier versement 1 sept. 2010
- Second versement 1 sept. 2011

Rapports

L'étudiant(e) doit soumettre et présenter un article à la Conférence étudiante de la SNC et de l'ANC en 2011.
L'étudiant(e) devra rédiger et soumettre un article dans une revue ou une conférence avec comité de lecture au plus tard un an après la date d'échéance de la bourse.

Adressez vos questions par courriel à:
cns-snc@on.aibn.com

OTTAWA Branch – Mike Taylor

Thanks to the generosity of the Canadian Nuclear Safety Commission the Branch and the CNSC held a joint lunch time meeting in the CNSC hearing room on January 29, 2010. The speaker was Dr. Gina Strati of AECL, who gave an excellent presentation on the tooling and techniques used to effect repairs to the NRU vessel. The meeting was very well attended (~ 100 people) by a mixture of branch members, CNSC staff and some members of the public. The Ottawa Branch provided a light lunch for attendees. This exercise was generally regarded as an all round success. It was informative, social, and gave the Ottawa Branch an opportunity to present itself to the potential membership from the CNSC. We are looking at a continuation, possibly as an annual event.

With CNSC VP Terry Jamieson (R) looking on, Mike Taylor, chair of the Ottawa Branch, presents a gift to special speaker, Gini Strati, after her presentation to a CNS Ottawa / CNSC joint meeting 29 January 2010.

Branch cooperation

In late February 2010, three branches, Chalk River, Ottawa, Sheridan Park, joined together to sponsor a visit of Dr, Duane Bratt, a professor at Mount Royal College in Calgary and a very active member of the Alberta Branch. His topic was the nuclear debate in Alberta and Saskatchewan.

Ignoring the personal challenge Duane visited and gave interesting and insightful presentations at the three branches over just a two day period, February 25 and 26. Arriving in Ottawa late on February 24, he drove to Chalk River the next morning, gave a presentation at noon-time in the library of the Chalk River Laboratory then drove back to Ottawa for a presentation to the Ottawa Branch that evening. The next morning he flew to Toronto and gave a noon-time talk at Sheridan Park before returning to Alberta that evening.

Each of the branches reported good attendance at his talks and positive reaction for the insight he provided to the "western nuclear initiative". The cooperative arrangement was organized by Ron Thomas, program chair of the Ottawa Branch.

Duane Bratt (R) poses with Ron Thomas, program chair of the Ottawa Branch, after Duane's presentation to the branch February 25, 2010.

Branch Improvement Committee

The discussions within the CNS Council on a strategic plan for the Society have re-emphasized the importance and value of local branches. While some Branches are quite active others are not, depriving members in there areas of the local functions that provide information and fellowship.

To determine how best to reactivate dormant branches and how best for the Society to provide assistance, CNS Council has decided to create a special committee under the leadership of Syed Zaidi, current Chair of Branch Activities.

If you would like to help in this exercise, please contact Syed at: smh@zaidi.net

New Members

We would like to welcome the following new members, who have joined the CNS in the last few months, up to 2010 March 8.

Georges Abdul-Nour, Université du Québec à Trois-Rivières
Jacklyn Marie Adomeit, University of Calgary
Mohammad Mateen Ahmad
Saieed Ahmed, Ontario Power Generation
Mahmood Akkawi
Richard Neil Alexander
Salam K. Ali, Ontario Power Generation
Dallas Andrew, OPG
Shafi Andseta, XCG Consultants Ltd.
Vahid Askari
Sarbjyot Bains
Michael Graham Benham, Acuren Group Inc.
Nathan Benkhe, Algonquin College, Pembroke, ON
Tushar Bishnu
Rob Blackwood, Bruce Power
Kevin P Boyle, CANMET- Materials Technology Laboratory
Susan Patricia Brissette, Bruce Power
Todd Campbell, Promation Nuclear Ltd
Cybele Celina, AECL
Dimitrie Cepisca, Sulzer Pumps
Edwin Lap Hin Chen, AMEC NSS
Rameshwar Choubey, AECL
Vinod Chugh, AMEC NSS Limited
Kirk Clark, OPG
June Connell, Point Lepreau Generating Station
Lauren Elizabeth Corkum, OPG
Cody Rayne Crewson, University of Calgary
Brian Crook, UOIT
Diane Lynn Cunliffe, Algonquin College
Arjun Das, AECL
Ram Davloor, Bruce Power
Samir Desai, OPG
Rick Didsbury, AECL
Mark M. Doroudian, ESI Group
Ruxandra Dranga, AECL
Aninda Dutta Ray
Noémic Duvivier, AECL
Adam Fajner, University of Calgary
Arkell Farr, Nuvia Canada
Robert Fedosejevs, University Of Alberta
Malgorzata Figiel, OPG,IMCS
Julie Filion, AECL
Barbu Fodor, AECL
Veronica Foster, Candesco
Keith Fruzzetti, Electric Power Research Institute
David Garber, AREVA NP Canada Ltd

Nous aimerions accueillir chaudement les nouveaux membres suivants, qui ont fait adhésion à la SNC ces derniers mois, jusqu'au 8 mars 2010.

Robert Lawrence Garth, University of Calgary
Scott Albert Gateman, UOIT
Scott Edwin Gies, Algonquin College
Paul Gillespie, AMEC NSS
Zi Wen Gong, University of Calgary
Steve Green, Promation Engineering Ltd
Daniel Robert Hagerman, UOIT
Marc Hammell
Terry Harasym, OPG
Rahul Harisinghani, AECL
Marwan Hassan, University of New Brunswick
Kate Heckman, McMaster University
Stephen Hibbins, AECL
Aaron Lane Hinman
Mohamed Salah Hussein, Royal Military College of Canada
Roxana Hutanu, AECL
Ima Ituen, McMaster University
Solly Karivelil, AECL
Junaid Ahmed Khan, OPG
Michael Killeavy
Sergiy Kondratyuk, Candesco
Bernice Marie Lanigan, NB Power Nuclear
Kelly Leblanc, Algonquin College
Igor Leonardovich, UOIT
Gang Li
John Lu, OPG
Erroll Lundy, OPG
Bernard Majarais, Project Manager & Systems Engineering
Tom A. Malkiewicz, OPG / IM&CS
Ruben Dario Marini, CNSC
Lennard McGoey, OPG-IM&CS
Mitchell Millar, Algonquin College
Hossein Mivehchi, Ryerson University
George Mizuno, Promation Nuclear Ltd
Khatereh Mohajery Moghaddam
Curt Nason, Point Lepreau Generating Station
Greg Naterer, University of Ontario Institute of Technology
Kitsten Fiona Newman, University of Calgary
David Huu Nguyen, CNSC
Laura Susanna Obrutsky, AECL
Katie Paplinskie, Algonquin College
Paul Pidhirny, Algonquin College
William Pilkington, AECL
Alexanne Pizycki, E.S. Fox Ltd
Glen Anthony Pridham
Bradley Rawlings, UOIT

Kelly Annette Reid, Ontario Power Generation
Joe Renaud, AECL
Michel Robitaille, OPG
Natalie Pauline Sachar, Trent University/AECL
Nabil Elais Saliba, Structural Analysis and Reliability Specilist
Christian Thomas Sanzo, Algonquin College
Michelle Seguin, University of Calgary
Uncharat Setthanan
Brian Shanks, Point Lepreau Generating Station
Clayton Shebec, UOIT
Hao Shi, Queen's University
Eddison Shoon, OPG
William Jeff Siddall, Merrick
Raymond Sommer
Sam Safaei Sooreh, UOIT
Keith St. John
Colleen Stegmaier, NorthernEEnt
Gordon Andrew Tapp, AECL
Nathan Paul Tedford, Hatch Ltd.
Oscar Zhe Tian
Andrew Todd, Algonquin College
Stephanie Tracy, Kinectrics Inc.
Pierre F. Tremblay, Ontario Power Generation
Zin Tun, Canadian Association Of Physicists
Alexandre Viktorov, CNSC
Michael Wade, Merrick & Company
Kai Wang, University of Calgary
Mergo Whalen, Algonquin College
Ian William Wilcox, UOIT
Adam Winchester, Bruce Power
Bill Anthony Woytiuk, University of Calgary
Sudduf Wyne, Ontario Power Generation
Tao Yan, University of Calgary
Liufang (Jenny) Zhou, AECL

Membership Note

If you have not yet renewed your CNS membership for 2010, it will be cancelled very soon or may have already been cancelled by the time you read this.

In order to maintain your CNS membership in good standing, you can now conveniently and securely renew on-line and receive your receipt immediately! It is a very fast and convenient process. Just log on to https://www.signupmaster.com/cns-membership and follow the very easy steps.

If you sign up for automatic renewal, the CNS Office will do the work for you each year in good time, so you will never miss the discounted early-bird renewal rate, without lifting a finger! If you are not yet signed up for automatic renewal, but would like to take advantage of this convenient service, please get in touch with the CNS office at 416-977-7620 or cns-snc@on.aibn.com.

Also, remember to always keep your individual CNS ID number handy. You will need it to identify yourself as a CNS member when registering for a CNS Conference or Course, to receive the member rate! Your ID number is shown on your annual CNS membership card. You may like to keep this in your wallet. The CNS ID number is now also shown on certificates to new members.

Note to CNS student members and past student members: As long as you are a CNS member in good standing in the year that you graduate, you are entitled to a half-price regular CNS membership in the 2 years following your graduation. It is worth it to maintain your CNS student membership in good standing throughout your studies!

Ben Rouben
Chair, Membership Committee

Note d'adhésion

Si vous n'avez pas encore renouvelé votre adhésion à la SNC pour 2010, votre adhésion sera bientôt annulée, ou peut-être sera-t-elle déjà annulée au moment où vous lirez ceci.

Si vous voulez garder votre adhésion à la SNC en bon ordre, vous pouvez maintenant facilement et en toute sécurité renouveler en ligne et recevoir votre reçu immédiatement ! Renouvelez dès maintenant ! C'est vraiment très facile et rapide. Branchez-vous au https://www.signupmaster.com/cns-membership et suivez les instructions.

Si vous vous inscrivez au renouvellement automatique, le bureau de la SNC fera le travail pour vous à temps chaque année, et vous profiterez ainsi toujours des prix réduits de renouvellement, sans vous préoccuper ! Si vous n'êtes pas encore inscrit(e) au renouvellement automatique, mais aimeriez profiter de ce service très commode, veuillez contacter le bureau de la SNC à 416-977-7620 ou à cns-snc@on.aibn.com.

Et souvenez-vous de toujours garder votre numéro de membre à portée de la main. Vous en aurez besoin pour vous identifier en tant que membre quand vous vous inscrirez à une conférence ou à un cours de la SNC ! Votre numéro de membre de la SNC apparaît sur votre carte annuelle de membre. Ce serait peut-être un bonne idée de garder la carte dans votre portefeuille. Le numéro de membre apparaît maintenant aussi sur les certificats des nouveaux membres.

Note aux membres étudiants de la SNC : Si vous êtes membre de la SNC quand vous recevez votre diplôme, vous avez droit à un escompte de 50% à l'adhésion comme membre standard pendant 2 ans après avoir été diplômé. Ça vaut la peine de rester membre de la SNC pendant toutes vos études !

Ben Rouben
président du comité d'adhésion

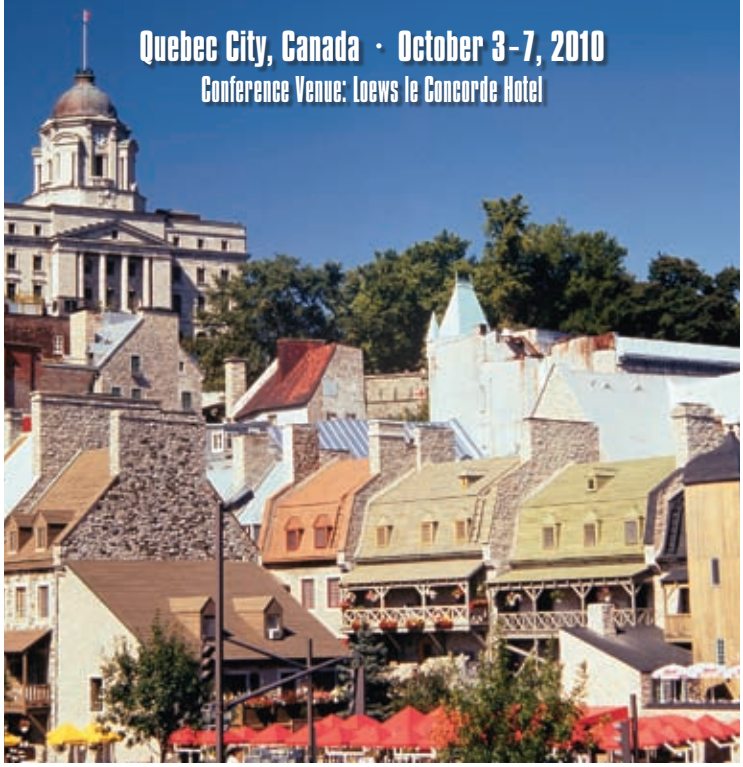
NPC 2010

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

Guidelines for full Paper preparation and submission were provided during author notification and are available through the conference website via the link at **www.cns-snc.ca**.

Milestone Dates

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

Invitation to Sponsors & Exhibitors

Opportunities are available for Conference Sponsorships and Exhibit Booth Spaces. Contact the Event Administrator for details.

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).

Join us in Montréal for our 31st Annual Conference!

Atoms for Power, Health and the Environment

CNS 2010 SNC MONTRÉAL

Atomes pour l'énergie, la santé et l'environnement

May 24 - 27, 2010

Hilton Montréal Bonaventure

Be part of the energy

Canadian Nuclear Society / Société nucléaire canadienne

Join the growing membership of the Canadian Nuclear Society

Visit/Visitez www.cns-snc.ca

McMaster University
ENGINEERING

TENURE-TRACK FACULTY POSITION
NUCLEAR ENGINEERING

The Faculty of Engineering at McMaster University invites applications for a tenure-track faculty position in the area of Nuclear Engineering. 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 as well as contributing to the Faculty's strategic initiatives in sustainable engineering.

The applicant should have expertise in the field of nuclear engineering, with a focus on nuclear fuel cycles, advanced reactor applications, or nuclear reactor performance. 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 and accelerator labs. McMaster University has also received new funding from the Canada Foundation for Innovation (CFI), the Ontario Research Fund and the Natural Sciences and Engineering Research Council totaling approximately $50 million in infrastructure in the areas of nuclear power generation, fuel cycles and advanced reactor designs. This position will build upon faculty expertise in nuclear engineering, nuclear safety, thermalhydraulics, reactor physics, and nuclear materials as well as the existing facilities within the Brockhouse Institute for Materials Research, the McMaster Institute for Energy Studies, the McMaster Institute for Applied Radiation Sciences and the Centre for Probe Development and Commercialization.

Applicants must have earned a Ph.D. in Engineering, Applied 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.

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:

Department Chair
Department of Engineering Physics, McMaster University
1280 Main St. West
Hamilton, Ontario, L8S 4L7, Canada.

This position is available as of July 1, 2010 and will remain open until the position is filled. Applications by e-mail will not be accepted.

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.

CALENDAR

2010

Apr.25-28 — **2nd Canada – China Workshop on Supercritical Water-Cooled Reactors (CCSC-2010)**
Toronto, Ontario
website: www.cns-snc.ca

May 9-14 — **PHYSOR 2010, "Advances in Reactor Physics to Power the Nuclear Renaissance"**
Pittsburgh, PA, USA
website: http://www.physor2010.org

May 17-21 — **ICONE-18 18th International Conference on Nuclear Engineering**
Xi'an, China
website: www.icone18.org
email: icone18@ans.org.cn

May 24-27 — **31st Annual Conference of the Canadian Nuclear Society and 34th CNS/CNA Student Conference**
Montreal, Québec
website: www.cns-snc.ca

June 13-17 — **ANS Annual Meeting**
San Diego, CA, USA
website: http://www.ans.org/meetings

June 20-22 — **NEO 2010 Nuclear Education & Outreach Conference**
Calgary, AB
website: www.cns-snc.ca

Aug. 15-18 — **Uranium 2010 – 3rd International Conference on Uranium; 40th Annual Hydrometallurgy Meeting**
Saskatoon, Saskatchewan
Call for papers
website: www.cns-snc.ca

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

Oct. 3-10 — **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
email: Ken Phillposa phillposak@aecl.ca

2011

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

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

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

Marriott Toronto Downtown Eaton Centre
Toronto, Ontario, Canada
September 11-14, 2011

The Canadian Nuclear Society (CNS) is pleased to announce the upcoming conference on **Waste Management, Decommissioning and Environmental Restoration for Canada's Nuclear Activities,** to be held in Toronto, September 11-14, 2011. An equipment and services exhibition is planned to be held as part of the Conference.

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. It will serve to improve communication among specialists, managers, and other stakeholders in these activities, and to foster collaborations to the benefit of the Canadian nuclear industry as a whole.

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.

The conference will also provide the opportunity to visit one or more Canadian facilities actively engaged in nuclear waste management, decommissioning and/or environmental restoration.

The dates of the conference happen to coincide with the renowned Toronto International Film Festival, providing the opportunity for conference delegates to participate in screenings of feature length films, some of which are World-International- or North American-premieres.

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,
- 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, and,
- Transportation.

Conference Organizers

Colin Allan
General Chair (AECL, retired)
Email: allanc@aecl.ca (after October 30, 2009)

Alan Melnyk
Chair, Technical Programme Committee, AECL
Email: melnyka@aecl.ca

Elizabeth Muckle-Jeffs
Conference Administrator
The Professional Edge
1027 Pembroke Street East, Suite 200
Pembroke, ON K8A 3M4 Canada
Tel. North America toll-free: 1-800-868-8776
Tel. International: 1-613-732-7068
Fax: 613-732-3386
Email: Elizabeth@TheProfessionalEdge.com

Deadlines

Abstract submission: **2010 October 4**
Notification of acceptance: **2010 November 12**
Receipt of final full papers: **2011 May 13**

Information about the Call for Papers and other Conference details are available online at **www.cns-snc.ca**

CANADIAN NUCLEAR SOCIETY ®
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This Conference is being organized by the Canadian Nuclear Society in cooperation with the International Atomic Energy Agency, and is co-sponsored by 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 (AREN).

Will the Real Nuclear Renaissance Please Stand Up?

by Jeremy Whitlock

Good evening and welcome to Nuclear Hotstove. On tonight's show - the Nuclear Renaissance: is it real? My first guest has seen the industry through many ups and downs over his four decades in the business, and he's here tonight to talk about the future, or at least the next four decades. Please welcome P.H.T. Stillwater…

Good evening

So, Mr. Stillwater. The Nuclear Renaissance. Is it real?

Absolutely. The world will be knocking at nuclear's door in a big way, within 10-20 years. And nuclear will step up. It's ready to give 110%. Sustainable development, peak oil, climate change, severing the Arab pipeline. You name it, nuclear's ready to get back in the game.

Hm. 10-20 years. It seems to me we were hearing this 10-20 years ago, were we not? I mean, the Eagle Alliance, "America is Ready"… what happened to all that?

America was ready, my friend, but our green friends saw to it that progress was shut down at every turn.

By "green friends"… you of course mean…

You got it: money. The almighty dollar. Nobody wanted to risk one to build a plant. But the market is ready now. America is strong. The market is bringing it.

The "market"? With billions of dollars in federal loan guarantees…

Invested by our shareholders, the people of America. The market is speaking.

And the industry is listening?

You betcha. We're ready to go. In 10-20 years.

Okay then. Well, my next guest thinks sooner than that. Please welcome Garter Alloy. What say you, Mr. Alloy?

Yowza, I say throw some water on me! This renaissance is hot! We're wheels up baby!

All right, so according to you the nuclear renaissance is well underway?

Fifty new-builds underway that is, and over a hundred more over the next ten years. I'm talking nuclear engineering students outnumbering professors again… It's on!

Well let's take a look. Some of those new-builds are actually completion of deferred projects of course, or refurbishments of old reactors. Are we on the cusp, or just a slow ramp?

It's a fast ramp to prosperity and clean air, my friend. Our cusp runneth over. And it's not just the old industry waking up – it's a renaissance. That means "rebirth", you know. New designs, more efficient, more secure, stronger, modular…

The Pebble Bed Modular Reactor doesn't seem to be coming out of the womb, as it were. The next generation designs are twenty years from commercialization. If you'll pardon the pun, is talk of a renaissance of new technology just a lot of high-temperature gas at the moment?

Look, this industry has burst out of the gates, and it's saving the world as we speak. China alone will build 20-30 plants in the next 10 years. Add that to a hundred more new-builds elsewhere on the planet.

Is that possible? Can it be sustained?

It's all about the financing, but don't forget it's a different industry now – the cash flow is planet wide. Global credit – how sustainable is that?

Hm, I think we should talk. But not now, because now we're going to hear from Garbled Efforts, President of the Canadian Coalition for Anti-Nuclear Irresponsibility. Mr. Efforts… er… why are you dressed as the Grim Reaper…?

This so-called nuclear renaissance hasn't happened, can't happen and won't happen. It's not a renaissance; it's a reno-SÉANCE. It's a moribund industry pathetically trying to conjure up its dead. The people have spoken, and they don't want deadly nuclear power!

Okay, fascinating stuff. So, the hood and the scythe…

Ask not for whom the bell tolls; it tolls for nuclear power.

Great. Now, what about -

Bong, bong, bong …

…Yes, but what about the new-builds already underway? There were none a few years ago, so is that not a renaissance already?

A mere blip. Unsustainable.

What about climate change? I mean, even Michael Douglas, the producer and star of "The China Syndrome", says nukes are needed now.

Climate change, shmimate shmange. Nukes aren't needed. Jane Fonda was the real star of that movie. Bong, bong, bong…

Okay, well that's about all the time we have. Three different views - one a little bit more different than the others I suppose. Join us next time on Nuclear Hotstove, when we ask the burning question: Why is Canada still burning diesel fuel in the arctic?

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