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CANADIAN NUCLEAR SOCIETY bulletin

DE LA SOCIÉTÉ NUCLÉAIRE CANADIENNE

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- 25th Annual Conference
- NRU Life Management
- MDS Nordion Waste Program
- Nuclear Achievement Awards
- ACR Control Centre
- Early Fuelling Machine

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Please contact us at: R. L. (Bob) Hemmings
rhemmings@canatomnpm.ca

Montréal:
2020 University Ave
22nd Floor
Montréal, Québec
H3A 2A5
Phone: (514) 288-1990
Fax: (514) 289-9300

Mississauga:
2655 North Sheridan Way,
Suite 180
Mississauga, Ontario
L5K 2P8
Phone: (905) 829-8808
Fax: (905) 829-8809

Parent Companies:

AECON:
Aecon Industrial
3660 Midland Avenue,
Scarborough, Ontario
M1V 4V3
Phone: (416) 754-8735
Fax: (416) 754-8736

SNC-Lavalin:
SNC-Lavalin Inc.
455 René-Lévesques Blvd. West
Montréal, Quebec
H2Z 1Z3
Phone: (514) 393-1000
Fax: (514) 866-0266

EDITORIAL

Get It Right!!

"Meeting the Challenges" was the theme of the recent 25th CNS Annual Conference. The nuclear power industry and specifically Ontario Power Generation have been thrown a very definite challenge by the Ontario government when it approved proceeding with the rehabilitation of Unit 1 of the Pickering (A) generating station.

This is the acid test of the industry. The future of nuclear power in Ontario (and most probably Canada) will depend on the Pickering 1 rehabilitation being conducted on time, on budget. There can be no repeat of the egregious Pickering 4 saga.

Statements from OPG assert that lessons have been learned and much more planning has been conducted. Let us hope that is so. If this challenge is not met it is likely there will not be any more. This time OPG must "get it right"

The other pressing challenge is the MAPLE project for the production of radioisotopes. Now more than three years behind schedule this project has become an embarrassment and the continued delay a threat to the future of our radioisotope industry. New management oversight was announced this summer. Again the call is, this time "get it right".

Less immediately critical but still a challenge is reflected in the recently released report from the Nuclear Waste Management Organization based on "dialogues" with groups of people across the country. As might be expected, given the mis-information that has been spread for the past decade or more, the "public" is concerned about "nuclear waste" (spent nuclear fuel) and wants it put away with absolute safety.

There has been no effort to put the risk of spent fuel in perspective. There is little acknowledgement of the care taken in handling and storing spent fuel and no mention of the hazardous wastes thrown into landfills with no controls or monitoring.

The NWMO says it is seeking input from nuclear professionals. Although those who have submitted briefs have not been overly assured by the responses they have received it is essential that knowledgeable nuclear professional provide sound and balanced input to the NWMO. Otherwise the critics and the doom-sayers will carry the day and NWMO will definitely not , "get it right".

Fred Boyd

IN THIS ISSUE

First, we welcome Bryan White, the newly appointed Associate Editor and thank him for putting together the CNS News section.

This issue focuses on and draws from the **25th CNS Annual Conference** held in Toronto in June 2004. It begins with a report on the conference, highlighting the many important and interesting presentations in the plenary sessions

That is followed by a report on the **Canadian Nuclear Achievement Awards.** Those awards honour people who have contributed significantly to the Canadian nuclear program in various ways and have been recognized by their peers.

Then there are four of the technical papers presented, chosen quite arbitrarily as being of likely interest and to reflect the diversity of papers given at the conference. First is **Moving Along the Risk-Informed Path - Drivers and Challenges** which describes the [slow] movement in Canada towards a risk-informed basis for the regulation of nuclear power plants.

The next paper gives a research reactor perspective. **Application of Plant Life Management Program and Experience at NRU** describes the work towards extending the life of the 47-year-old NRU reactor at the Chalk River Laboratories.

Then we turn to an aspect of the design of the Advanced CANDU Reactor that we have not covered before in **Development of the Advanced CANDU Reactor Control Centre.**

The fourth technical paper selected from the conference comes from the non-power sector, describing one aspect of the isotope program, in **Development and Implementation of the Waste Diversion Program at MDS Nordion's Cobalt Operations Facility.**

The last paper is a historical note on the design of the fuelling machine for our first nuclear power plant, the prototype NPD, almost 50 years ago. **Design of On-Power Fuelling Machines** is a personal note by someone who was there.

There is a short **General News** section with our usual eclectic selection of items, followed, as has been the situation for the past several issues, with three **Obituaries,** a reflection of the aging of our nuclear program.

The **CNS News** is longer than in the past several issues, partially because of the Annual General Meeting but largely due to the input of Bryan White.

This issue was put together against a background of some personal and other challenges. Please excuse whatever deficiencies exist.

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Cover Photo

The cover photograph shows a view of the Darlington Generating Station looking towards Lake Ontario.

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The Canadian Nuclear Society
480 University Avenue, Suite 200
Toronto, Ontario, Canada, M5G 1V2
Telephone (416) 977-7620
Fax (416) 977-8131
e-mail: cns-snc@on.aibn.com

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CNS provides Canadians interested in nuclear energy with a forum for technical discussion. For membership information, contact the CNS office, a member of the Council, or local branch executive. Membership fee for new members is $75 annually, $44.00 for retirees, free to qualified students.

La SNC procure aux Canadiens intéressés à l'énergie nucléaire un forum où ilf peuvent participer à des discussions de nature technique. Pour tous renseignements concerant les inscriptions, veuillez bein entrer en contact avec le bureau de la SNC, les membres du Counseil ou les responsables locaux.
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Editor / Rédacteur
Fred Boyd
Tel./Fax (613) 592-2256
e-mail: fboyd@sympatico.ca

Associate Editor / Rédacteur adjoint
Bryan White
Tel./Fax (613) 584-4629
e-mail: bwhite_cns@sympatico.ca

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25th CNS Annual Conference – "Meeting the Challenges"

"Meeting the Challenges" was the theme chosen by the organizers of the ***25th Annual Conference of the Canadian Nuclear Society,*** held at the Marriott Eaton Centre Hotel in Toronto, June 6 - 9, 2004. They succeeded not only in presenting a thorough discussion of the challenges facing the nuclear power industry in Canada but also in meeting their own challenge by arranging and conducting one of the best nuclear conferences in the country for many years. And, as conference chairman, **Brian McTavish,** pointed out, this was all done by volunteers.

Close to 300 delegates attended the three-day event, which ran with almost clock-like precision, beginning with a reception on the Sunday evening. The conference proper began Monday morning with the first of several "plenary" sessions in which invited senior members of the Canadian nuclear community provided their particular insight. The plenary sessions filled half of the meeting time; Monday morning, Tuesday afternoon and Wednesday morning. The other half was filled with parallel technical sessions in which 85 papers were presented. *(The list of the technical papers will be put on the CNS website. A CD with all of the papers will be available from the CNS office.)*

As well as the opening reception, delegates enjoyed two luncheons, continental breakfasts, ample refreshments at the breaks and the Nuclear Achievement Awards banquet on the Tuesday evening. *(See the separate report on the awards.)*

The luncheon speaker on the Monday was **Marvin Fertel** from the Nuclear Energy Institute in the USA who gave a very "upbeat" message about the prospects for nuclear power in that country. "We expect to see new nuclear within 10 years", he stated. Public support in the USA has grown to 65% in recent polls, at least partly, he said, due to the good performance of US nuclear power plants over the past few years. He also acknowledged the leadership of the US Nuclear Regulatory Commission for proceeding with its risk-informed and risk-based regulations. The Department of Energy is providing financial support for pre-licensing. The major challenge is financing.

Although there was no conference luncheon on the second day Women in Nuclear (WIN) held a combined workshop and luncheon on the Tuesday, which many of the male delegates attended.

The Wednesday luncheon was organized by the Young Generation Nuclear (YGN) who invited **Duncan Hawthorne,** CEO of Bruce Power to speak. He titled his talk, *"The Aging Industry: Planning for Succession: Bruce Power's Future Growth Prospects"*. Reflecting back he noted that the nuclear industry around the world went into a freeze after Chernobyl. The result at Bruce is typical with a workforce of average age 49 and 1,000 eligible for retirement within three years. "We must not steal from each other", he warned, but attract young people by convincing them that there is a good career in nuclear power. He asked people to speak about their careers and then mentioned, almost casually, that he had begun as an apprentice before getting the opportunity to attend university.

Turning to the prospects at Bruce, Hawthorne stated that they were looking at the refurbishment of Bruce units 1 and 2 but would proceed only if they could get 25 years additional life. The Bruce site is big enough to consider new-build but transmission is a major question.

Plenary Sessions

Plenary I - The Security of Supply Challenge

The opening plenary session had the theme *"The Security of Supply Challenge"* and began with a presentation by **Dan Rochester,** of the Independent Market Operator (IMO), which he titled *"The Electricity Market and Ontario's Demand/Supply Picture"*. He began with noting that for 90 years Ontario had a publicly owned comprehensive electrical utility in the Hydro Electric Power Commission of Ontario and subsequently Ontario Hydro before it was broken into Ontario Power Generation and Hydro One when the provincial government decided to open the electricity market. Originally planned for 2000 that occurred in 2002 just before a very hot summer, which strained the generation capacity (several nuclear units were still down) and led to escalating prices. In November that year the government capped the domestic price at 4.3 cents/kwhr, a move that ended up costing the provincial treasury $860 million. Then in August 2003 there was the large blackout across NE United States and Ontario.

Rochester referred to several recent reports or statements: the report of the Electricity Conservation and Supply Task Force in January 2004, the "Manley" Review of OPG in March and the statement on the vision by Ontario Minister of Energy, Dwight Duncan

IMO has published its "Outlook" on its website. If the coal fired plants are shut down as proposed by the provincial government the system will be short by 6,000 MW in 2008, By 2014 IMO predicts that the province will need between 8,800 and 11,600 MW of new generation capacity. Further,

new transmission is required, he said, with the Toronto area already becoming critical.

If nuclear is to provide part of the answer it must overcome a number of challenges, Rochester said, including: public anxiety, higher capacity factors, easier maintenance, shorter outages, and more load flexibility. Also, he noted, with all plants being of the CANDU design there is the danger of a common-mode failure affecting all or most of the plants.

He closed with a "Haiku" (Japanese verse form with 17 syllables.). *Coal power closing, we could soon be in the dark, help us please build now.*

Next was **Pierre Charlebois,** from Ontario Power Generation, who spoke on *"Planning for Life Extension Consideration at OPG"*. All of OPG's nuclear plants are at their "mid-life", he commented. End of life will come when major components reach their end of fitness for service. Darlington and Pickering B will reach that point between 2012 and 2014.

It is essential, Charlebois said, to have a number of factors in place: a defined and predictable regulatory process; confidence in the plant assessment; demonstrated viable business prospective; competency in management of large complex projects; predictable performance. He acknowledged that OPG's performance on Pickering 4 had diminished stakeholder confidence. "Who is pushing for nuclear?", he asked in closing.

Andrew Johnson provided a perspective from Bruce Power when he spoke on *"Plans to Meet the Future Supply Challenge"*. After noting that Bruce Power was the only private nuclear power company in Canada he offered his own predictions for the future. Allowing for conservation and renewables he said Ontario would need 5,000 MW of new generating capacity by 2008 and 15,000 MW by 2015. The choice will be between gas and nuclear, and there is a compelling story for gas, he stated. A 1,000 MW combined cycle gas turbine plant can be built in less than three years at a cost of $830 million. Although the refurbishment of the Bruce units would offer lower energy costs, the capital requirement would be double that of a new gas plant. Investors like a fast return on their money, he pointed out.

Nevertheless, the opportunity for new nuclear was never better. The challenge is convincing investors that we can get it right on project time, cost and scope, and can get it right on operational performance, he said in closing.

The view from New Brunswick was provided by **Rod White,** of NB Power, who began by noting that the restructuring of NB Power into five operating companies under one holding company has been deferred until October 2004 to allow for the creation of a NB System Operator.

NB Power has three major projects under consideration: refurbishment of Coleson Cove; refurbishment of Point Lepreau; construction of a new international transmission line. The first is underway. Much preliminary work has been conducted on the refurbishment of Point Lepreau. Robin Jeffrey submitted his report in April 2004 which was generally positive. Assuming that the decision to proceed is made in October 2004 as scheduled, construction would start in the spring of 2005 and the refurbishment outage would run from April 2008 to September 2009.

René Pageau, of Hydro Québec, spoke on *"The Quebec Scene"*. He began by noting that Hydro Quebec has three major components: Hydro Québec Distribution (which provides local distribution); Hydro Québec TransÉnergie, which builds and operates the transmission lines; and Hydro Québec Production, which generates the power. The distribution organization provides the load forecast and the production group proposes how to meet the demand. By 2008 new generation will be required.

Gentilly 2 had an extended outage from September to December 2003. Restart was delayed because of the difficulty of repairing the feeder pipe to channel G09. Several damaged rotor blades in the turbine were replaced.

Refurbishment of the plant is still planned for 2010 - 2011. An assessment of the plant has been completed; a safety evaluation done and the environmental impact study was issued in early 2004. Public hearings on the EIA will be held in the fall of 2004. Several issues need to be resolved before authorization will be given to proceed on the refurbishment. These include: adequate long-term solution for feeders; agreement with the Canadian Nuclear Safety Commission on safety improvements; and demonstration that the refurbishment can be completed within budget and on schedule.

The last presentation in the opening plenary was on a different topic. **Robert Pollock,** of COGEMA, spoke on the question, *"Will there be a future uranium supply shortage?"* He began by noting that the spot price for uranium had climbed 75 % since mid 2003, but the increase in the value of the Canadian dollar against the US dollar had off set much of that gain for Canadian producers.

The Athabaska Basin in northern Saskatchewan currently provides about one third of the world's uranium production . The output from McArthur River Mine, the world's largest, highest grade, uranium mine, was significantly lowered in 2003 because of the water inflow problem. He noted that exploration and development investment had been very low over the past decade.

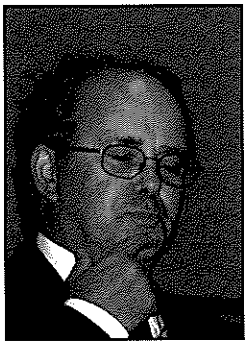
He showed some illustrations of the water inflow problem at McArthur Lake and described some of the mining techniques at other mines. The regulatory process, involving both the provincial and federal governments, is complex, he commented, but harmonization efforts are underway. Some non-governmental groups are still trying to challenge the licence for McArthur River.

On the question of resources, he pointed out that it depended on the price. At $20 (US) / lb U3O8 it is estimated that there is enough for about 40 years of current consumption. At $50 this increases to 70 years. However, it is a long, expensive process to verify a deposit and construct a mine. Whether or not there will be a shortage depends very much on the price, he concluded.

Plenary session II

The second plenary session, Tuesday afternoon, was divided into two subjects: *"Future Challenges"* and *"Communication Challenges"*

Plenary session IIA - Future Challenges



Ron Mottram

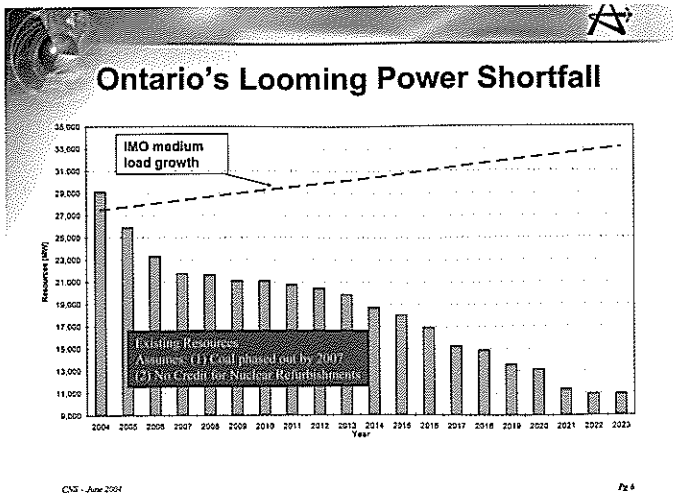
This session opened with a report *Bruce A Restart Projects 3 and 4: Lessons Learned* by **Ron Mottram** of Bruce Power. He described the task as an aggressive project to restart two units [Bruce A units 3 and 4] that had been laid up for over five years. Although there had been comprehensive environmental assessment, a revised safety case, training of staff and upgrading of safety and other systems, the scope became expanded by new regulatory security requirements following September 9, 2001. He noted that although six months behind their original schedule the two units were synchronized to the grid within three months of each other in October 2003 and January 2004.

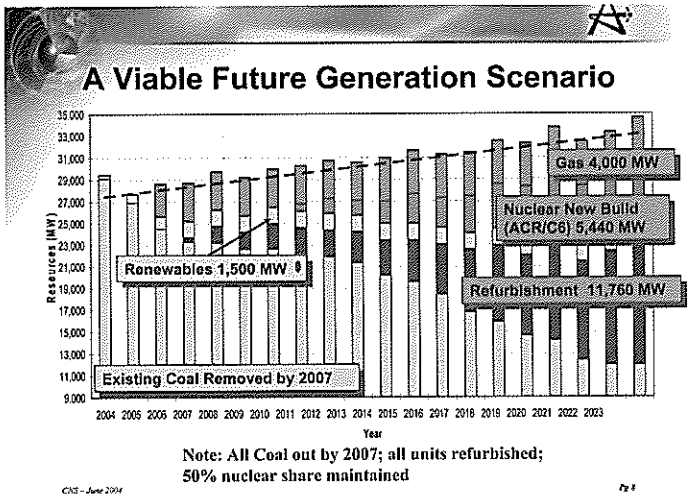
Successes and challenges fell into four broad areas, he said, structure and resources, governance and process, project and contract management , project support. On the first the slow release of staff from the rest of the site and the scarcity of specialists cause delays. However, the introduction of multi-function teams and high staff commitment, including strong support from the unions, were major factors in the success. Interface arrangements made with the Canadian Nuclear Safety Commission minimized regulatory problems. New governance procedures were developed. Having both American and Canadian contractors led to some ambiguity in applicable codes.

Overall, he said, the restart was a success. The lessons learned, from both positive and negative events, are being incorporated into Bruce Power's operation and possible future initiatives.

Ken Petrunik, of Atomic Energy of Canada Limited, provided a positive argument for nuclear in his presentation entitled *The Nuclear Option: An Essential Energy Ingredient for Ontario.* Nuclear is back on the agenda, he stated, quoting Ontario Premier Dalton McGuinty, US President Bush, and others. Recent polls showed that the majority of Ontarians supported new nuclear on existing sites. He showed a graph similar to the one presented earlier by Dan Rochester of IMO showing the looming large shortfall of generation capacity compared to demand if coal-fired units are phased out by 2007 according to the current Ontario government policy.

Then he presented a graph showing how the gap could be met through refurbishment of 11,760 MW of nuclear and 5,440 MW of new-build nuclear, along with 1,500 MW of





renewables and 4,000 MW of gas-fired generation

He went on to point out the environmental benefits of nuclear, show that waste is well managed and argue that CANDU technology has performed well and has been delivered successfully in Korea, China and Romania. The new Advanced CANDU Reactor (ACR) will provide superior economics, he pointed out, and most of the benefits from design and construction would accrue to Ontario. He outlined a "new build model" in which vendors and partners would assume much of the initial economic risk of a project, but, he said, governments must help mitigate the risks associated with the first unit.

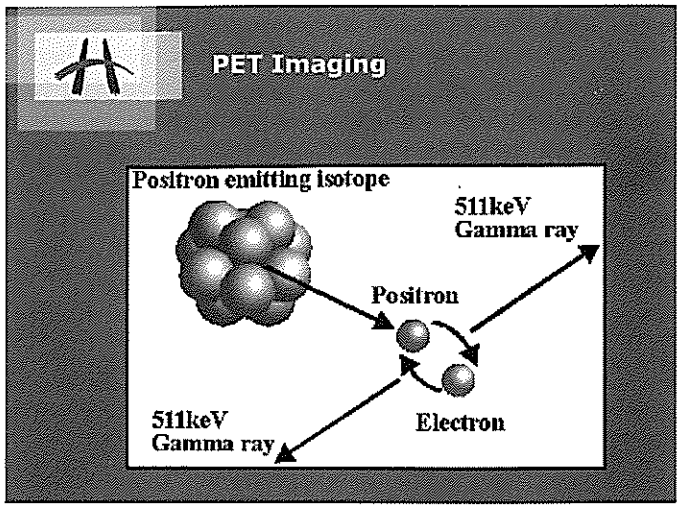
A view from the USA was provided by **Gene Grecheck,** of Dominion Energy Inc., the utility that is promoting the pre-licensing of the ACR in the USA. H began by noting how the performance of nuclear plants in the USA had improved, from capacity factors about 60% in the 1980s to about 90% now. The US financial community now accepts nuclear operation but still questions capital costs and regulatory uncertainty, he commented. That increase in capacity factor has produced increased electricity equivalent to 26 new 1,000 MW plants, but, he said, the limit had been reached. All recent new generation in the US has been gas-fired. The US Nuclear Regulatory Commission is moving forward with

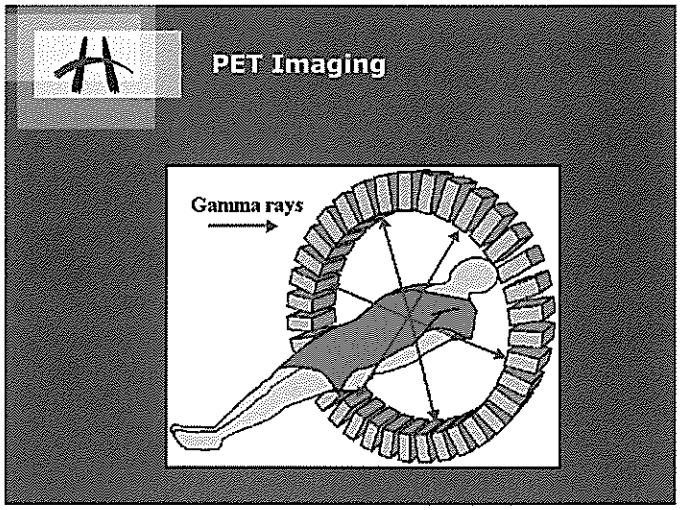
Dr. Karen Gulenchyn

design certification, early site permits, and combined (construction and operation) licences.

The last presentation of the session was on a completely different topic, *Positron Emission Tomography,* by **Dr. Karen Gulenchyn** of the Hamilton Health Sciences Centre. She began with a brief history of PET, beginning with the first artificial production of N13 in 1934 through the synthesis of radiopharmaceuticals and the parallel development of instrumentation. She illustrated the basic nature of PET with the following illustrations.

The most commonly used radiopharmaceutical is F_{18}Flouro-2-deoxyglucose (FDG) which is taken up by cancer cells. She followed with several images of scans of various cancers. Canada, she noted, had not yet approved FDG for clinical use, even though 23 other countries have.





Plenary Session IIB - Communication Challenges

This part of the second plenary session began with **Elizabeth Dowdeswell,** of the Nuclear Waste Management Organization, providing an *Update from the NWMO,* by video since she was not able to attend in person. She noted full-day dialogues had been conducted in 12 communities across the country by the Canadian Policy Research Network involving about 500 people. The broad common theme was the desire for safety, transparency, accountability, and a holistic approach. She said that the report by CPRN would be issued this summer.

A team of experts has assessed the three options identified in the Nuclear Fuel Waste Act: deep geological repository; centralized storage; and reactor site extended storage. Their report is also scheduled to be issued in the late summer of 2004 and will be an important part of NWMO's "Document Two". She closed by inviting CNS members and others in the nuclear community in participate in the web-based discussion.

(Although Ms. Dowdeswell's presentation is not included in the Conference CD both the text and the video are available at the NWMO website.)

Another update was provided by **Murray Elston,** of the Canadian Nuclear Association, in a presentation entitled *What's Happening at the CNA: Current Priorities.* He began with quick reviews of the nuclear industry in Canada and the electricity situation in Ontario. Echoing some previous speakers he noted while that refurbishment of existing nuclear plants can provide some of the needed additional capacity new nuclear plants are essential.

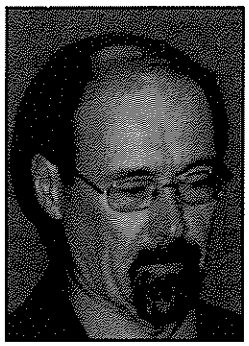
He continued with identifying the reduction of greenhouse gas and other toxic emissions through the use of nuclear compared to fossil-fuelled plants. After noting the good record of new CANDU plants in Korea, China and Romania he moved on to mention Canada's involvement with the Generation IV studies of future designs. After emphasizing that uranium is the fuel of the future he closed by noting that progress is being made on the nuclear waste issue and regulatory concerns.

The last presentation of this session was by **Rick Austin,** mayor of Port Hope, who spoke on *The Port Hope Low-Level Radioactive Remediation Project: Building Community Acceptance at the Local Level.* He reminded the audience of the historical radioactive waste throughout Port Hope from the early radium operations of Eldorado Mining. The Atomic Energy Control Board began the remedial work in the 1980s until the federal government took over the project. The major challenge in achieving public acceptance is building trust and that can be done by getting on the job and doing it right, he said.

Plenary Session III

The third plenary session, held Wednesday morning, was also divided into two parts: *Industry and Technical Challenges* and *Meeting the People Challenges.*

Plenary Session IIIA - Industry and Technical Challenges



Andy Oliver

The first speaker in this session was **D. Popescu** of SN Nuclearelectrica SA, Romania, substituting for Ioan Rotaru, who spoke on *Status of Cernavoda Unit 2 NPP and Challenges of Initiating Work on Unit 3.*

He began by providing some context of the economic and electricity situation in Romania. With a population of 21 million Romania has a GDP of $1,640/capita and electricity consumption of 2,500 kWh/capita. It expects to join the European Union in 2007 and is moving towards privatization, including electricity. The following graph shows the current and predicted electricity generation in the country.

Projects for the period 2004 to 2015 include:

- 500 MW hydro
- 1,400 MW Cernavoda Units 2 and 3
- 2,825 MW rehabilitation of existing coal units
- 660 MW new lignite units
- 1,135 MW gas turbines

The large vertically integrated company has been divided into six thermal producers, one hydro, and one nuclear.

Popescu then reviewed the history of nuclear in Romania beginning with an agreement with Canada in 1977 and the contract for Cernavoda 1 in 1978. First concrete was not poured until 1982 and by 1989 the unit was only 45% completed. Following the change of government a new contract with AECL and Ansaldo was signed in 1991 and the unit went into service in 1996. The capacity factor to date is 88%. Fuel for the plant is manufactured in Romania and the defect rate has been very low.

Construction of Cernavoda Unit 2 is well underway with start-up scheduled for early 2007. A feasibility study has been conducted for Unit 3 and a project company created. The study proposed a public-private partnership and the selection of a financial advisor. An Action Plan with AECL, Ansaldo and KHNP is underway to confirm costs, schedule, and definition of the model for implementation of the project.

Steve Bushby, of Natural Resources Canada, gave an overview of *Canada's Role in the Generation IV Initiative.* Generation IV refers to future reactor designs using advanced technology that would be highly economic, have enhanced safety, produce minimal waste and be proliferation resistant. There is a multi-country Generation IV International Forum (GIF) to coordinate the work in the ten countries involved. Canada is particularly interested in the potential of steam-cooled water reactors and Romney Duffey of AECL Chalk River, is chairman of the SCWR study group.

Supplying the slightly enriched fuel planned for the Bruce reactors and the future ACR was the subject of the presentation *The Challenges of Developing an SEU Program* by **Andrew Oliver** of Cameco Corporation, Port Hope, substituting for Robert Steane.

He noted that the Low Void Reactivity Fuel proposed for the Bruce reactors has very slightly enriched fuel (1%) in the outer elements. ACR fuel will be about 2%. He then provided a quick overview of the enrichment processes and the fuel manufacturing at Cameco's Port Hope facility.

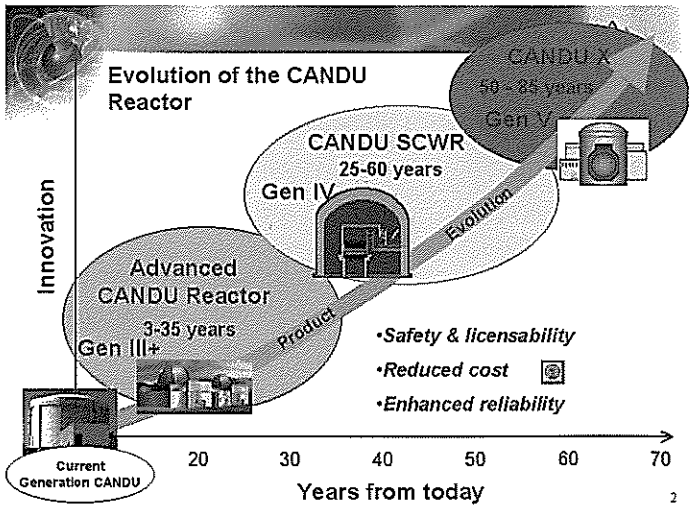
Purchasing very low enriched uranium is not economically attractive, Oliver said, so the program is based on blending higher enriched uranium (5% or more) with natural uranium.

Paul Fehrenbach, of Atomic Energy of Canada Limited, began the last presentation of the session, on *Future Technical Challenges for CANDU,* by showing a slide of the possible future evolution of CANDU over seven decades.

The major challenges, he said, are in advanced fuel and material performance. He went on to show the evolution of CANDU fuel from the 19 element NPD fuel to the current Canflex and low void reactivity fuel and the proposed fuel for the Advanced CANDU Reactor. Then he gave a similar history of pressure tubes and feeders.

In summary he presented the following solutions:

- better materials (fuel channels, feeders)
- modify the environment (e.g. chemistry)
- design solutions such as ACR SCWR
- better knowledge, analysis tools and data
- life management and health monitoring through PLiM and SMART CANDU technology



Plenary Session IIIB: Meeting the People Challenges

Mohan Mathur, of the University Network of Excellence in Nuclear Engineering, began this session with an outline of *The UNENE Initiative and the World Nuclear University.*

He began by noting data from the USA showing the cumula-

"Badge-Draw" Winners at CNS Annual Conference

At the end of the 25th Annual CNS Conference, on June 9, 2004, 5 prizes were drawn from among badges returned by Conference attendees.

The winners:

- Grant Minor of Nuclear Safety Solutions won a CNS membership good to the end of 2005.
- Ravi Mahadevan of Valcor Engineering Corporation won a CNS membership good to the end of 2005.
- Parisa Sarah Sabouri won a copy of the book "Canada Enters the Nuclear Age".
- Raheel Hameed of Zircatec Precision Industries won a copy of the book "Canada Enters the Nuclear Age".
- Mohan Mathur of the University of Western Ontario won 1 complimentary night at the Toronto Marriott Eaton Centre Hotel.

Congratulations to all the winners!

Gagnants de prix au tirage des porte-insigne à la Conférence annuelle de la SNC

À la fin de la 25ième Conférence annuelle de la SNC, le 9 juin 2004, 5 prix ont été tirés au sort parmi les porte-insigne retournés par les participants à la conférence.

Voici les gagnants des prix:

- Grant Minor de Nuclear Safety Solutions a gagné une adhésion à la SNC jusqu'à la fin de décembre 2005.
- Ravi Mahadevan de Valcor Engineering Corporation a gagné une adhésion à la SNC jusqu'à la fin de décembre 2005.
- Parisa Sarah Sabouri a gagné une copie du livre "Canada Enters the Nuclear Age".
- Raheel Hameed de Zircatec Precision Industries a gagné une copie du livre "Canada Enters the Nuclear Age".
- Mohan Mathur de l'Université de Western Ontario a gagné 1 nuit gratuite à l'hôtel Toronto Marriott Eaton Centre.

Félicitations à tous les gagnants!

tive demand for nuclear professionals growing from 10,000 in 2002 to 50,000 in 2007. In contrast university enrollment in nuclear programs in the USA fell dramatically from 1980 to 1999..A similar situation exists in Canada, he said, commenting, "The Canadian nuclear industry, over two decades, neither invested in university-based research nor hired graduates".

UNENE is an alliance of Canadian nuclear industry, principally Ontario Power Generation, Bruce Power and AECL, and the following universities: McMaster, Queen's, Toronto, Waterloo, Western Ontario, and UOIT. Industry contributions are matched by grants from the federal government. For the first five year program industry has committed about $9 million. Several "chairs" have been created, supported by industry and NSERC. A program of part-time studies has begun with 20 students currently enrolled.

He then turned to the World Nuclear University, which was created in September 2003 by the World Nuclear Association, World Association of Nuclear Operators, International Atomic Energy Agency and the Nuclear Energy Agency of the OECD. There are 23 country partners, including Canada. The goal is to advance nuclear science and technology worldwide through transnational cooperation.

Terrance Slobodian, of Canada's newest university, University of Ontario Institute of Technology, followed with the story of *Establishing Nuclear Engineering at UOIT.*

He began by noting that UOIT is located in Oshawa, between the Pickering and Darlington nuclear plants.

In its first year UOIT has 900 students in six faculties. By 2010 it is expected this will grow to 6,500. The School of Energy Systems and Nuclear Science is within the Faculty of Engineering and Applied Science. The School planned for 50 students in its first year but has 110. It is predicted that by the school year 2006 - 2007 there will be between 600 and 650 undergraduates and 25 graduates. The School offers four programs: B.Eng. in nuclear engineering; B.Sc. in radiation science; B.A.Sc. in nuclear power; and B.Eng. in energy systems engineering.

Before inviting George Bereznai, Dean of the School of Energy Systems and Nuclear Engineering, to join him in answering questions, Slobodian invited investment by the nuclear industry in the university. "The benefits will come back to you", he said in closing.

The last plenary presentation was by **Mark McIntyre,** of Atlantic Nuclear Services Ltd., representing the Young Generation Nuclear, who gave a report on the very successful International Youth Nuclear Congress that was held in Toronto in May. Over 300 young nuclear professionals from around the world participated in this event, which combined technology and fellowship. *(A full report on IYNC 2004 was in the previous issue, Vol. 25, No. 2, of the CNS Bulletin.)*

This successful conference was organized and run by a sizable committee of volunteers headed by John Luxat, now at McMaster University. Krish Krishnan chaired the technical program and Ken Smith headed the group arranging the plenary sessions. Ian Wilson spearheaded sponsorship. Other members were: Martyn Wash. Mike Gabbani, Eric Williams, Roman Sejnoha, Jim Harvie, Jad Popovic, Ben Rouben, Kathie Memory, Bob Hemmings, Dorin Nichita, Walter Thompson, Ed Hinchley, Jeremy Whitlock and Denise Rouben.

The many sponsors made the conference financially feasible. They were: AECL, Anric Enterprises, Babcock & Wilcox Canada, Bruce Power, Cameco Corporation, Canadian Nuclear Association, Canatom NPM Inc., Canberra, Fox Constructors, Framatome ANP, GE Canada, Hydro Québec, MDS Nordion, Nuclear Safety solutions, Ontario Power Generation, OCI, Power Workers' Union, Society of Energy Professionals, Wardrop, Zircatec Precision Industries.

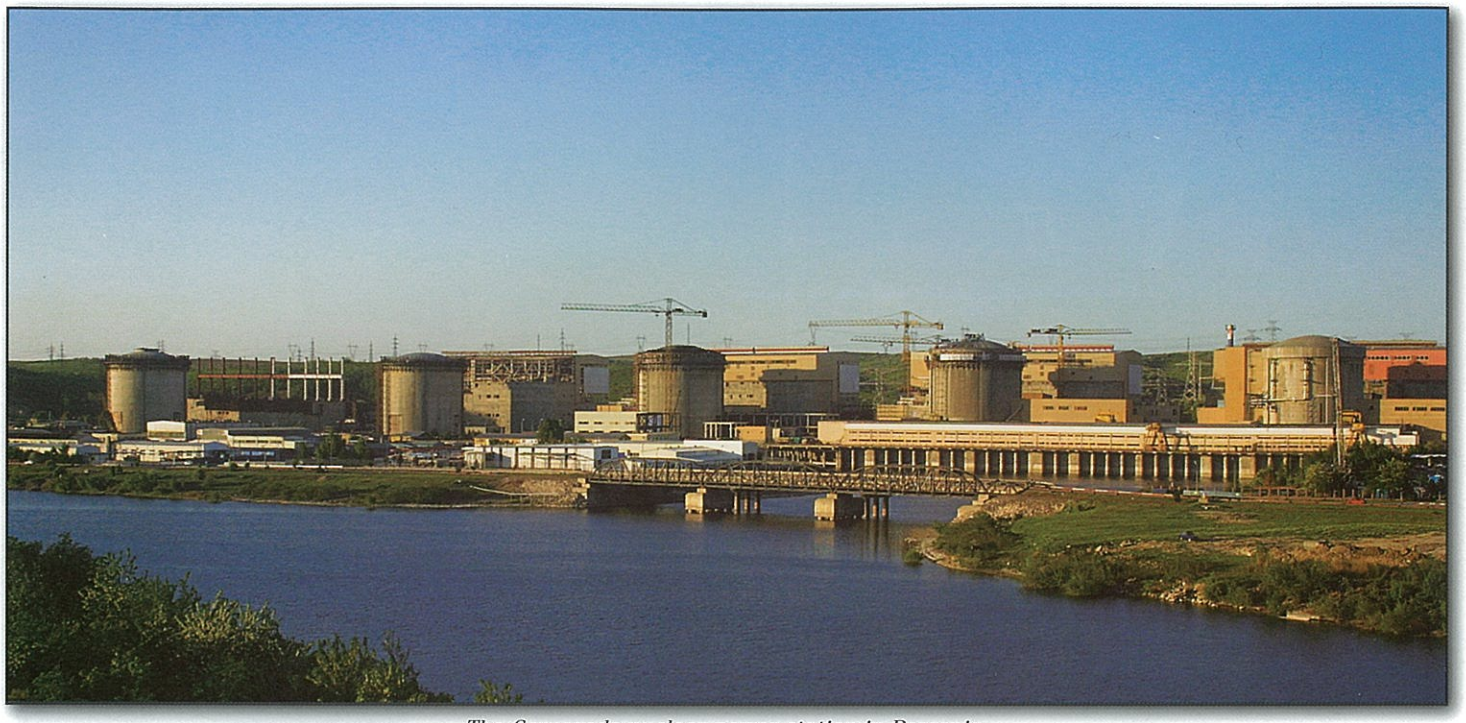
Next year's CNS Annual Conference will be held at the same locale, June 5 - 8, 2005.

Several past presidents gathered during the conference. Back row, left to right: Peter Stevens-Guille, Paul Fehrenbach, Ian Wilson, Ben Rouben, Krish Krishnan. Front row, left to right: Jerry Cuttler, Ken Smith, Hong Huynh, Jeremy Whitlock

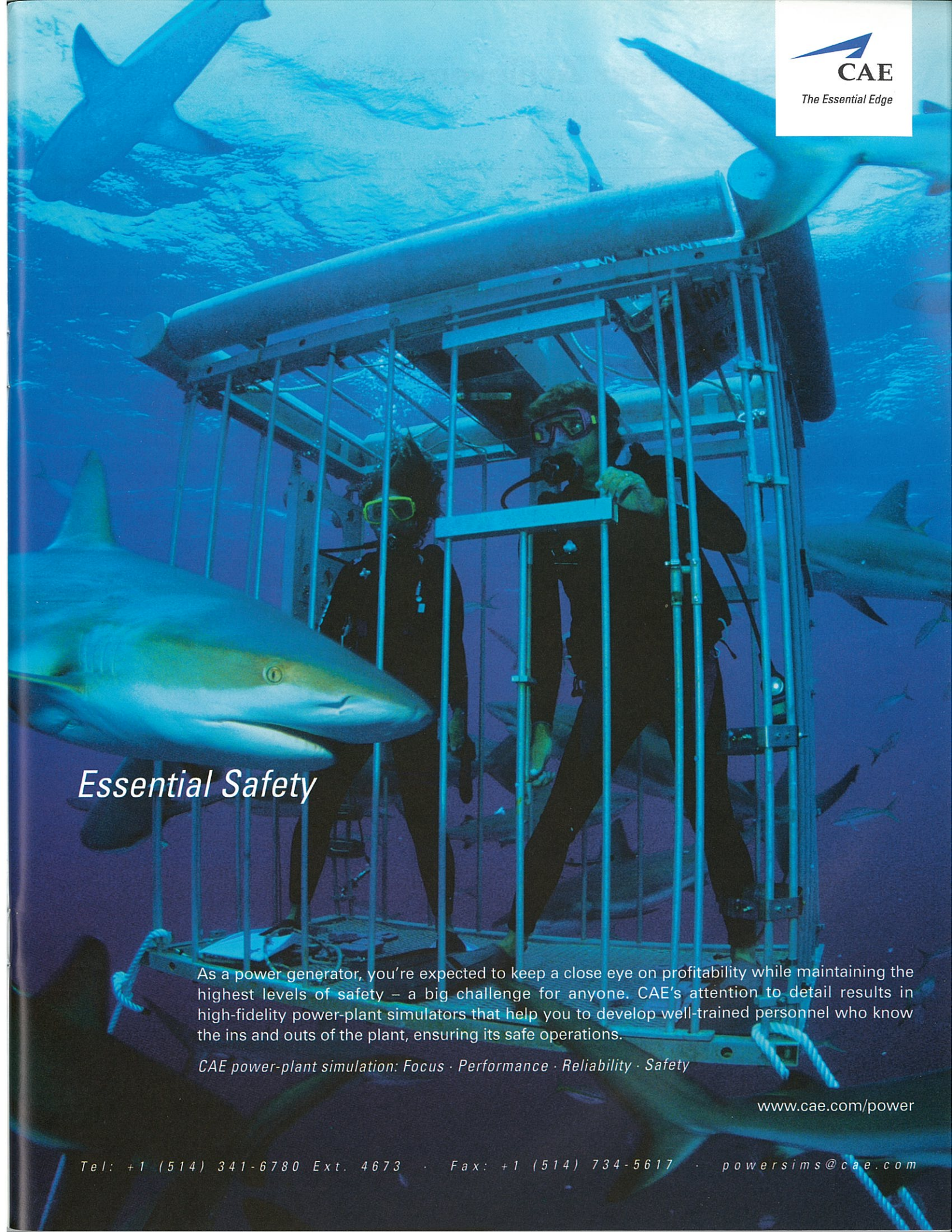
Brian McTavish opens the Conference while participants of the opening plenary session look on. Left to right: Andrew Johnson, Pierre Charlebois, Dan Rochester, James Rippon, Pat Tighe.

Sandra Popatello, Ontario Minister of Community and Social Services chats with Jad Popovic at a reception held by WIN (Women in Nuclear) during the CNS Annual Conference.

Scenes From Conference



The Cernavoda nuclear power station in Romania.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Canadian Nuclear Achievement Awards

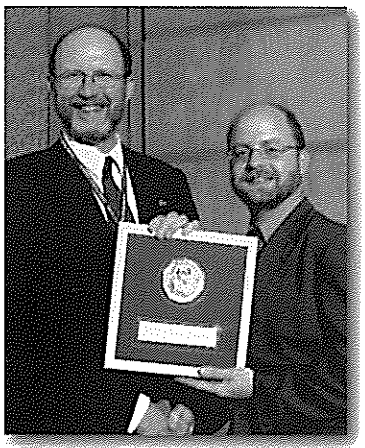
For the past three years the Canadian Nuclear Society and the Canadian Nuclear Association have joined in honouring individuals and groups who have made significant contributions to Canadian nuclear science and technology or the Canadian nuclear program. A 14 member joint committee, chaired this year by Ed Price, formerly of AECL and a CNS Past President, makes the determination of winners based on submissions from CNS and CNA members

The presentation of the awards for 2004 took place at the Awards Banquet held Tuesday, June 8, 2004, at the Marriott Eaton Centre Hotel in Toronto, during the 25th CNS Annual Conference.

Following are the award winners with the official citation for their awards.

W. B. Lewis Medal -

The W. B. Lewis Medal recognizes Canadian scientists or engineers who have demonstrated a level of technical competence and accomplishment in the field of nuclear science and engineering as exemplified by the late Dr. W.B. Lewis during his involvement in the Canadian nuclear energy program, 1946 to 1973. The 2004 Medal went to Dr. Michel Pettigrew.



Jeremy Whitlock, outgoing president of the CNS, presents the W.B. Lewis Medal to Michel Pettigrew.

Dr. Michel Pettigrew

Professor Pettigrew is a recognized authority in flow-induced vibration and the associated frictional and fretting wear. He has also made significant contributions in studies of vibration of rotating machinery and of elastic-plastic deformation of structures. He has published extensively on these subjects, and is well known for the clarity of his presentations.

Professor Pettigrew received his B.Sc.A. (Hons) from École Polytechnique in Montréal and obtained a Diploma in Applied Mathematics as an Athlone Fellow at the University of Sheffield in the UK. He obtained an M.Sc. in Mechanical Engineering at the University of Birmingham. He then joined AECL Chalk River, where he had a successful career spanning 35 years. He worked on flow-induced vibration, initially of CANDU fuel bundles and then of heat-exchanger tubes. The latter, in particular, involved years of laboratory testing to understand the flow and vibration response of tubes in highly complex configurations. His work led to quantitative models of the fretting-wear rate of various tube and support-material combinations, and to the development of a suite of computer codes to predict tube-vibration behaviour.

On retiring from AECL in 2000, Michel Pettigrew was appointed as the Chair of Fluid Structure Interaction at École Polytechnique, funded by B&W Canada, AECL and NSERC. In a short time, he created a centre of excellence, attracting renowned researchers and graduate students to tackle complex engineering problems

Ian McRae Award of Merit

The Ian McRae Award of Merit honours an individual for outstanding contributions, other than scientific, to nuclear energy in Canada. The 2004 award went to Duncan Hawthorne, President and CEO of Bruce Power.

Allan Kupcis, CNA chairman, presents the Ian McRae Award of Merit to Duncan Hawthorne.

Duncan Hawthorne

Duncan Hawthorne, President and CEO, Bruce Power, has emerged as one of the most respected and influential leaders in the Ontario electricity sector. He displayed outstanding ability to articulate a vision, overcome adversity and provide dynamic and innovative leadership that has encouraged the enthusiastic support of the staff and the local communities at a crucial time for the Canadian nuclear industry.

With an honours degree in control engineering and an MBA from Strathclyde Uni-versity in Glasgow, Duncan Hawthorne has held senior positions in major power engineer-ing companies in the UK and North America.

When Bruce Power's parent company faced severe financial problems, Duncan Hawthorne ensured that Bruce Power would not only survive the crisis with new owner-ship, but also emerge stronger than before. He became a pivotal figure in

a complex, multi-million dollar deal that satisfied the diverse needs of two public companies, two trade unions, a giant pension fund and governments on two continents. Duncan Hawthorne attracted an all-Canadian consortium to replace British Energy in a new-look private/public partnership.

He set and met many ambitious targets to improve the Bruce B station, which played a major role in helping Ontario through a very difficult 2003. Having met the challenge of returning Bruce A Units 3 and 4 to service, Duncan has refocused his team to the business case for restarting Units 1 and 2, refurbishing the four Bruce B units, and determining the feasibility of a new reactor on the site.

Outstanding Contribution Award

The Outstanding contribution Award recognizes Canadian-based individuals, organizations or parts of organizations that have made significant contributions in the nuclear field, either technical or non-technical. There are two categories of the award, one for individuals and another for organizations or parts of organizations.

There were three winners in 2004, Dr. John Luxat, Dr. Brien Stewart and Kenneth Talbot

CNA chairman Allan Kupcis presents an Outstanding Contribution Award to Brien Stewart.

CNA chairman Allan Kupcis presents an Outstanding Contribution Award to John Luxat.

Dr. Brien Stewart

Brien Stewart received a Ph.D. in chemical engineering at the University of British Columbia. He joined Ontario Hydro in 1971. Following his early career with OH's Central Nuclear Services, including an assignment at Chalk River in the development of heavy-water processes, Brien moved to Nuclear Systems, Design and Development and was a major player in the success of the Darlington Project from its early inception through to full operation. Brien's leadership was outstanding in resolving several major technical issues experienced during commissioning and early operation of the Darlington plant. One was the resolution of the licensing issues associated with the software for the two shutdown systems, which was essential to obtaining Darlington's operating license. Another was the resolution of the fuel-bundle fretting and end-plate cracking problems. Both of these were crucial issues in Darlington's early years, and Brien's team leadership in resolving these problems was vital in bringing the units to full-power operation.

Brien made a significant and lasting contribution to the overall staffing strategy within Ontario Hydro through his lead role in the Joint Redeployment Planning Team. Brien also made a very important contribution to the return of Pickering Unit 4 to service. As Director of Engineering, he led the implementation of many design upgrades and the fulfil-ment of many outstanding regulatory commitments.

CNA chairman Allan Kupcis presents an Outstanding Contribution Award to Ken Talbot.

Kenneth Talbot

Ken Talbot, Executive Vice President and Chief Engineer, Bruce Power, has served the nuclear industry nationally and internationally with great distinction. Most recently, he played a very strong leadership role in achieving the rapid return to service of Bruce Units 3 and 4 after a six-year lay-up, and in the continued excellent performance of Bruce B.

With an honours degree in mechanical engineering in the UK, he immigrated to Canada in 1970. Following training at Ontario Hydro's NPD, Ken was transferred to help start up Pickering A. He took on positions of increasing responsibility and his appointment as Pickering B Commissioning Manager won wide approval because of his intimate knowledge of CANDU systems, the high standards he set for himself and his appreciation of the efforts of others. He also managed the operational aspects of retubing and rehabilitating Pickering Units 1 and 2. From 1988 to 1991, he was Manager, Corporate Program (Nuclear) for Ontario Hydro. In 1995/6, Pickering had major operational difficulties, resulting in the shutdown of all eight reactors. Ken Talbot was sent there, and he motivated the employees in their efforts to return the units to service.

He left Ontario Power Generation in 1997 to provide consulting services internationally. In 2001, Ken was asked to help form and help lead Bruce Power.

Ken was CNS President in 1988/9, and, throughout his career, he has been making important contributions to the CNS, the ANS and international nuclear industry organizations.

CNS Fellow

CNS members who have been designated "Fellows of the Canadian Nuclear Society" belong to a membership category

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CSA N285 (series) General Requirements	Sept 27-28, 2004	2
CSA N286 (series) Quality Assurance Requirements for Nuclear Power Plants	Dec 20-21, 2004	2
ASME B31.1 Power Piping-Design and Fabrication	Feb 7-8, 2005	2
CSA B51 Part 1 - Boiler, Pressure Vessel and Pressure Piping Code	Feb 9, 2005	1
ASME Section III Quality Assurance NCA 4000 / NQA-1	Jan 17-18, 2005	2
ASME Section III Quality Assurance Applications Workshop NCA 4000/NQA-1	Jan 19, 2005	1
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ASME Section III Design of Class 1 Components	Sept 20-21, 2004	2
ASME Section III Design Requirements for Nuclear Piping and their Supports	Oct 18-19, 2004	2
ASME Section III Subsection NF Supports	Spring 2005	2
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Mr. Richard W. Barnes, P. Eng., is the Senior Engineer at ANRIC Enterprises Inc. He leads a team of dedicated professionals who provide the most up-to-date information to ANRIC's clients.

Mr. Barnes and the expert staff possess extensive knowledge and experience in the design and construction of CANDU Nuclear Power Plants gained through substantial involvement with various aspects of power reactor projects. As a member of ASME, Mr. Barnes is on the Main Committee of the Boiler and Pressure Vessel Code and Chair of the Subcommittee on Nuclear Power. He is also Vice Chair of the N285 Technical Committee and Secretary of the N286 Technical Committee. Mr. Barnes is recognized internationally through his involvement in the development of both ASME Codes and CSA Standards.

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established by the Society in 1993 to denote outstanding merit. One Fellow was named for 2004, Dr. Parviz Gulshani.

Jeremy Whitlock, outgoing president of the CNS, presents Parviz Gulshani with a certificate naming him as a Fellow of the Canadian Nuclear Society.

Dr. Parviz Gulshani

Parviz Gulshani obtained a B.Sc. in physics from the University of Western Ontario and a M.Sc. and a Ph.D. in nuclear physics from the University of Toronto. After post-doctoral research at McMaster University, he joined AECL, where he began work on thermalhydraulics and safety analysis. He has worked in model development and in the areas of flow stability, flow regime for decay-heat removal, thermosyphoning, header-refill and feeder-refill behaviour, among others. Parviz developed models which led to the understanding of thermalhydraulics phenomena, and which were applied in safety assessments and in process-system modifications in the CANDU 6 reactors. He also contributed to model development and safety analysis carried out by AECL for RBMK reactors. He has also worked on MAPLE-reactor safety analysis in the last few years.

Parviz Gulshani has also contributed significantly to the Canadian Nuclear Society. He served as Chairman of the Sheridan Park Branch of the CNS from 1999 to 2004. Under his leadership the Branch continued as one of the most active, with an excellent record of seminars year after year. Parviz was an elected member of CNS Council for several years. He has served as Chairman of the Intersociety Committee, and was instrumental in the CNS joining the Engineering Institute of Canada. Parviz's contribution in all these capacities has played an important role in the continuing success of the CNS.

Education & Communication Award

The Education/Communication Award was established by the Canadian Nuclear Society in 1997. This award recognizes the recipients for "significant efforts in improving the understanding of nuclear science and technology among educators, students and the public ". The 2004 award went to Clair Ripley

Clair Ripley

Clair Ripley has been for many years on the front lines of communicating the peace-ful applications of nuclear science and technology in Canada and in particular in the Atlan-tic Provinces. He has been an essential developer and organizer of science and nuclear-related education programs. Clair has

CNS Past President presents the Education and Communication Award to Clair Ripley

conducted the education outreach program sponsored by Atomic Energy of Canada Limited since 1993. The efforts necessary to achieve success have included workshops, scholarship programs, speaking engagements and con-ference organization. His specific achievements include journalist seminars, developing a nuclear unit for high school curricula and the organizing of regular workshops for Atlantic Canada science teachers.

Clair's outreach programs have built strong links among industry, government, teachers and academia on the importance of science education and the value of nuclear science and technology. His work in nuclear science communications has been supplemented by a long history of activity in community organizations and support groups.

Clair is a man of warmth and courtesy. He is a role model for communicating the value of science and nuclear technology to both the public and to the education community.

R. E. Jervis Award

The R. E. Jervis Award recognizes excellence in research and development carried out by a full time graduate student in nuclear engineering or related fields described below. The Award was established in 1992 by former students of Professor Robert E. Jervis of the University of Toronto, and the CNS, to honour his achievements. In the past the Award was administered by the University of Toronto but is now sponsored and administered by the Canadian Nuclear Society. The 2004 winner was Bill Santos

CNS Past President Jeremy Whitlock presents the R.E. Jarvis Award to Bill Santos.

Bill Santos

Bill Santos is awarded the R. E. Jervis Award for his research into the influence of film formation/corrosion product deposition processes on the dissolution of nuclear fuel under permanent waste-disposal conditions.

Bill's work involved a determination of the redox-dependence of film formation processes on uranium dioxide using a combination of electro-

chemical and X-ray photoelectron spectroscopic techniques. His results allow separation of the oxidation of UO2 into a hole-injection process to produce Uv containing UO2+x, important to the processes that drive dissolution and a deposition process to produce a UV1-containing solid that blocks the dissolution process.

In addition, his work is demonstrating that acidity can develop under the corrosion products, and he is looking at the influence of groundwater on the process. He is finding that the calcium content in the groundwater can inhibit the corrosion process.

Bill Santos is a graduate student at the University of Western Ontario under the supervision of Dr. D.W. Shoesmith in the Department of Chemistry.

All the award winners gathered after the ceremony for this photograph. Back (L to R): Ken Talbot, Parviz Gulshani, Clair Ripley, Duncan Hawthorne. Front (L to R): John Luxat, Bill Santos, Michel Pettigrew, Brien Stewart.

The Climax Jazz Band entertained during breaks in the awards ceremony.

25th Annual Conference of the Canadian Nuclear Society
Toronto, Ontario, Canada (2004 June 6-9)

Moving Along the Risk-Informed Path – Drivers and Challenges

S. Petrella, Fl. Dermarkar, D. Austman, Ontario Power Generation
R. Chun, Bruce Power

Abstract

The use of risk criteria and information has always been an important component of the licensing of nuclear reactors in Ontario. Early applications included the development of Safety Design Matrices in the early 80's for more comprehensive design reviews, the use of the Darlington Probabilistic Safety Evaluation in the late-80's to support the C-6 event categorization process for the initial Darlington licensing, and the use of risk-insights, along with cost benefit criteria, to evaluate design options for the Pickering A special safety system design retrofits and modifications, such as Shutdown System (SDS) enhancement and Emergency Coolant Injection System (ECIS) upgrades. Operational uses have included the management of outage risk, the review of containment test frequencies, and the review of abnormal operating configurations such as maintenance of electrical power supplies. It is envisaged that such applications will continue, aided by the continued development of Probabilistic Risk Assessments techniques. To provide enhanced assurance of safety, to evaluate current and new safety-related issues as they arise, and to realize the full safety and economic benefits of risk-insights, OPG and Bruce Power have, along with their Industry partners, embarked on a path to further increase the use of risk-information in the operation and licensing of their reactors. Drivers include the resolution of long standing safety analysis issues surrounding LBLOCA analyses and generic action items, the application of risk-insights to guide the response to design, inspection, and analysis findings, and the optimization of operating, maintenance, and testing programs. As well, a major near term driver is input to plant refurbishment decisions. In moving to a more risk-informed approach to safety assessment, challenges include developing and implementing the required suite of concepts, tools, processes and criteria, and reconciling the current largely deterministic approach to safety analysis with the risk insights gleaned from risk assessments, while maintaining an appropriate level of defense-in-depth. While a large body of knowledge already exists to help do this, and the current licensing framework is flexible enough to allow considerable continued development of risk-informed approaches, it is recognized that a proper regulatory framework will need to be put in place by the Canadian nuclear regulator to realize the full benefits.

From the earliest days of Canada's nuclear power program, risk-based criteria have been an integral part of the licensing basis for CANDU reactors. While the last expression of the so called Siting Guide[1], as published in 1972, provides fundamental risk-based criteria (i.e., frequency and associated dose limits for single process system and dual process and safety system categories of accidents), it was itself the culmination of various risk-based concepts that had, as its genesis, prompt fatality risk-goals using coal-based electricity generation as the basis for health risk comparison[2]. In fact, the Siting Guide criteria can be used to reverse specify, albeit in a limited fashion, risk-based safety goals for radiological risk to individuals and the public based on the maximum allowable frequencies and doses.

Notwithstanding this early risk-basis to reactor safety design, advances in reactor safety design philosophy and concepts overlaid, and rightly so, a number of increasingly detailed deterministic/defense-in-depth requirements for the licensing of CANDU reactors. These are exemplified by the content of such regulatory guidance documents as R-7, R-8, and R-9[3,4,5] for the safety requirements for special safety systems, and R-10[6], for the use of two shutdown systems, as well as the utilities' own internal safety design guidance documents such as Nuclear Safety Design Guides, and safety analysis approaches (e.g., analysis at the limit of the operating envelope).

In spite of various recommendations[7,8,9], beginning in the late 1970's, to improve on the risk-basis of the fundamental reactor safety design and assessment criteria, current approaches to safety analysis continue to emphasize deterministic approaches with limited risk considerations (e.g., as documented in C-6R1[10] for the safety analysis of CANDU nuclear power plants). Perhaps at the risk of oversimplification, lack of confidence in probabilistic risk analyses, and

a desire to minimize uncertainties through conservatisms and defense-in-depth, has largely contributed to the lack of development, beyond the single/dual failure approach, of high level risk-based criteria for licensing.

Nonetheless, developments in probabilistic risk analysis technology, beginning in the late 1970's and continuing to this day, resulted in a number of probabilistic analyses being incorporated in the licensing process, such as the Safety Design Matrices, and the Darlington Probabilistic Safety Evaluation[11]. Both these early analyses had a significant role in the verification of plant safety design - the safety design matrix approach ensuring acceptable consequences or sufficiently low frequencies of accident sequences not captured by the single/dual failure approach, and the Darlington Probabilistic Safety Evaluation for the acceptability of integrated risks.

The Darlington Probabilistic Safety Evaluation, completed in the late 1980's, represented a significant step forward in probabilistic risk analysis (PRA) for Ontario Hydro reactors, comprising the first Level 3 PRA for a CANDU reactor, albeit one which was limited in scope to "internal events". While it did play a major role in the licensing process for Darlington, in particular supporting the C-6[12] event categorization process and providing for a systematic review for the design, it also, by providing statements of the integrated risk posed by the plant, spurred the development of risk-based safety goals within Ontario Hydro[13].

In parallel and in complement to the development of Probabilistic Risk Assessments (PRAs), value-impact analysis methodology was developed by Ontario Hydro[14] to assess the integrated costs and benefits of various design and operating options. Early applications of these methodologies included the evaluation of options for the design upgrade of the Pickering NGSA shutdown system, and the acceptability of continued Bruce A Unit 2 operation with degraded boiler tubes.

A more recent application of the use of PRA insights to drive design improvement has been the separation of the Pickering A moderator circulation and ECIS recovery systems to reduce the severe core damage frequency to below the OPG safety goal of 10^{-4}/yr.

In the area of operational safety, more recent uses of risk insights and criteria have been the use of risk assessments to manage outage risk (first piloted at Bruce Power's Bruce B reactors) by modeling the impact of equipment removal on core damage frequency, and the evaluation of options for emergency power generator maintenance outages to minimize risks and define contingency responses.

It is envisaged that the use of risk-information in licensing and plant operation will continue to increase and, in fact, evolve in sophistication. Global drivers include the maturation and international acceptance of PRA approaches for verifying the safety of nuclear power plants, and the safety and economic benefits of risk informed approaches, as exemplified by some CANDU applications and the experiences of other jurisdiction in using risk-informed methods.

More specific drivers for the industry include:

- closure of longstanding issues (associated with low frequency events)
- transparency in regulatory and industry decision making
- shrinking operating margins arising from the treatment of uncertainty in current analytical methods, research findings, aging assessments and operating experience
- escalating standards for the quantification of uncertainties and available safety margin
- increasing costs of safety programs and retrofits
- pressure to upgrade operating plants to new regulations, codes and standards in the absence of a systematic decision-making process, particularly in the context of refurbishment
- optimization of operating, maintenance and inspection programs
- availability of a maturing technologies to facilitate risk informed decision making
- alignment with industry best practices

Specific to OPG and Bruce Power, major drivers include the need to resolve long-standing issues related to LBLOCA analyses (e.g., uncertainty treatment and adequacy of operating and safety margins) and CNSC generic action items (e.g., hydrogen source term for containment design basis accident analysis), as well as pending refurbishment decisions on reactors nearing the end of their design lives (e.g., retrofits to the Bruce A SDS2 design).

While the Canadian licensing framework already has a risk-based underpinning, and the traditional propose-dispose model allows for a fair amount of latitude on the part of the licensees to bring forth risk-information to licensing decisions-making, it is recognized that a coordinated approach to increasing the use of risk-information, including the parallel development of updated regulatory guidance documents, will need to be undertaken. It is recognized that this will not be an easy task and will take a number of years of sustained Industry and CNSC efforts to achieve. To this end, OPG and Bruce power have, along with their Industry partners, embarked on a coordinated Industry plan to pilot risk-informed applications, develop the suite of required concepts, tools, and techniques, and provide coordinated input to the CNSC on their regulatory guidance framework development[15].

The Industry envisions the implementation of a regulatory framework that enables objective risk-informed decision making; supports the effective and efficient use of industry and regulatory resources commensurate with the risk significance of issues; and maintains risk to the public at an acceptable level. While the task will not be easy, neither will it be impossible. This is due to the large amount of national and international guidance which already exists, or is under active development. This includes the proposals already made by licensees and design organizations, and the extensive guidance already developed by organizations such as the IAEA, the USNRC, NEI, and EPRI. Nonetheless,

major challenges remain on the review and rationalization of risk-information with such traditional safety concepts as defense-in-depth, safety margin, and the use of diversity and independence in equipment.

Risk insights will lead to the challenging of our understanding of these traditional safety concepts. Attempts to incorporate risk-information will also lead to a better understanding of what these concepts mean and the degree to which they must be applied in a specific situation. For example, defense-in-depth is a widely used term whose meaning and manifestation depends on the context it's used in. When defined as the provision of overlapping barriers to an undesired event to both limit the probability of an event, and to cater to "unknowns," it should be possible, in principle, to specify the number of barrier to be provided by factoring in the known frequency of the initiator, the known reliability of the barriers, and our state of knowledge of the phenomenology of accident progression. Similarly the provision of safety margins (either in the form of conservative "derived safety acceptance criteria," or in the spread between a result and a limit) could be quantified on the basis of risk information which could then help assess the impact of new issues. Diversity provided to cater to "unknowns" may, based on risk insights, be shown to be counter to good reliability, and hence, risk minimization. The process of applying risk-insights (i.e., "risk-informing") to traditional approach, can thus improve safety, improve safety assurance, and lead to more effective and efficient use of safety resources by focusing effort on risk-significant issues.

In the area of tools and techniques, other significant challenges include the availability, scope, and quality of probabilistic risk assessments, industry agreement on the risk-based safety goals, and risk-importance metrics, and the treatment of uncertainty in risk-information, both due to uncertainty in the state of knowledge (epistemic) and due to random variability (aleatory). Again, a fair amount of guidance, both national and international exists to continue the development of these tools.

With respect to these challenges, a number of initiatives are underway, both from the Industry and the CNSC. PRAs have been completed, or within the next few years, will be completed for most, if not all, CANDU nuclear power plants. These are generally consistent with international guidance, and agreement on methodological and scope issues appears to be close. It is expected that the CNSC will soon issue, for public comment, a proposed regulatory standard on PRA, thus providing a firm foundation for PRA acceptance and use. A regulatory standard on the Reliability Programs for Nuclear Power Plants, S-98[16], envisioning the use of risk-information from PRAs for setting safety system reliability targets, has already been issued by the CNSC and is being actively implemented by licensees.

The industry has already used and/or proposed a number of risk-based safety goals. OPG and Bruce power have had risk-based safety goals as part of their internal governance for a number of years. Risk-based safety goals have been used in licensing submissions for the Point Lepreau refurbishment licensing framework. Risk based safety goals are being considered as a component of the licensing basis of the Advanced CANDU Reactors. All of these proposed formulations are, in general terms, consistent with each other and with international guidance. Hence, agreement on risk-based safety goals for Canada appears to be a reasonably straight forward. Similarly, the use of metrics to judge the risk significance of systems, structures, and components modeled in PRA is well established internationally.

Other components of a truly integrated and risk-informed safety assessment framework, including cost-benefit methodologies, and severe accident management guidance are either in advanced development, or committed for development.

Over the next couple of years, the industry members will work together and with the CNSC to promote a common and consistent use of risk-informed approaches through a range of industry applications within the current regulatory framework. This will permit experience to be gained to guide subsequent further development and implementation.

In the regulatory front, the CNSC is in the process of developing an integrated set of regulatory guidance documents that collectively should provide the necessary framework for incorporating risk-information in licensing and regulatory decision making. In addition to aforementioned proposed PRA Standard and S-98, the CNSC has published a draft of its Regulatory Fundamentals Policy[17] which, along with the existing CNSC Regulatory Policy on Considering Cost-benefit Information[18], as well as other proposed CNSC documents on cost-benefit analyses, safety analysis, etc., should provide a firm foundation for risk-informed approaches.

Although the challenges are significant, so are the benefits. Once successfully implemented, a risk informed framework will result in improved safety focus for both regulator and licensees through better use of risk information in managing current and emerging safety issues. It will provide:

- a logical and quantifiable framework for resolution of outstanding licensing basis issues
- a sound safety basis for identifying risk, making decisions and allocating resources
- a vehicle for better communication of regulatory decisions resulting in improved public confidence

In all, it will result in safer and more reliable operation, improved cost efficiency and increased transparency.

There is no doubt there will be false starts, and perhaps some dead ends along the risk-informed path. However, the pieces for an integrated risk-informed safety assessment and decision making framework are beginning to fall into place.

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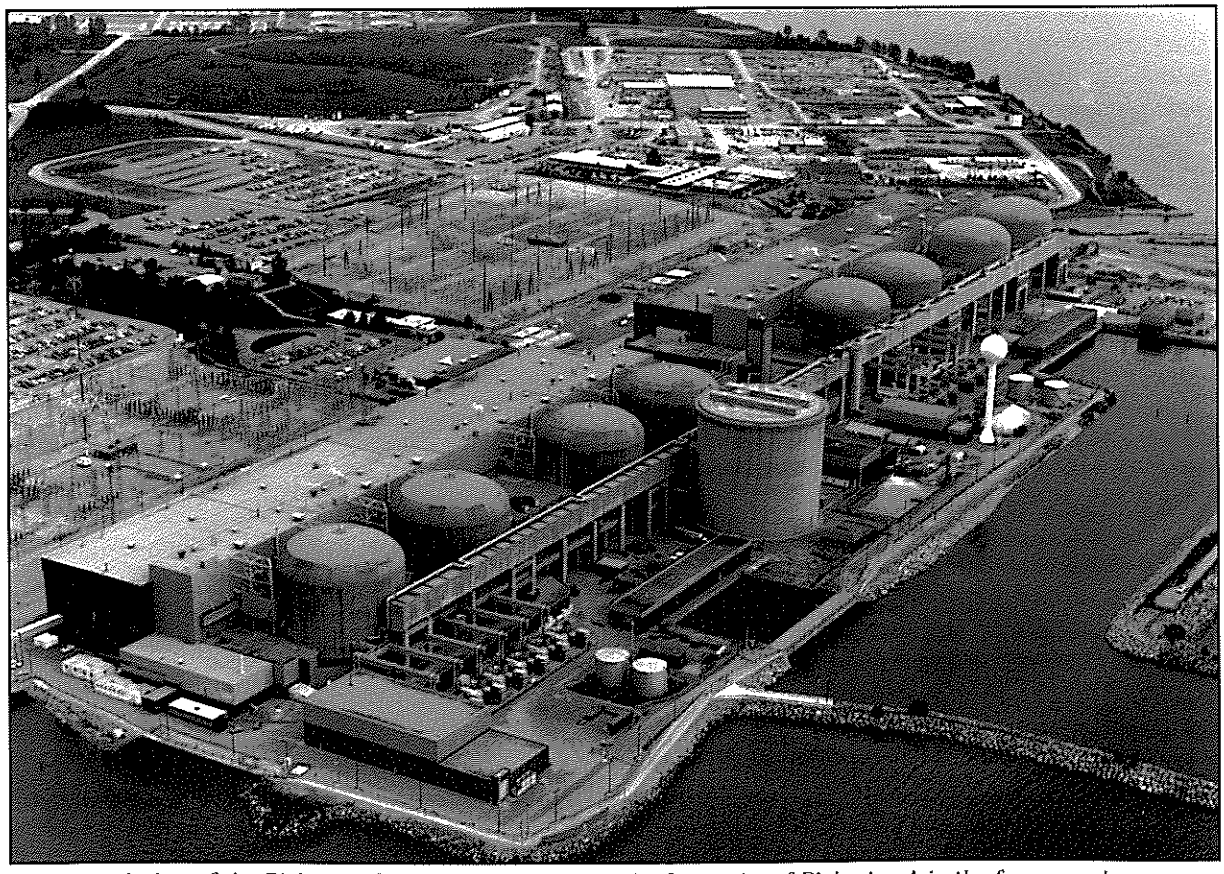

A view of the Pickering Generating Station with the four units of Pickering A in the foreground.

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Application of Plant Life Management Program and Experience at NRU

J. Nickerson, R. Dam, J. Arnold and D. See Hoye
Atomic Energy of Canada Limited

Abstract

The National Research Universal (NRU) reactor has seen extensive and excellent service since going into operation in 1957. During that time, significant investments in upgrading and improving the facility have been implemented. Recently, as part of the NRU Licenseability Extension (LE) program, AECL has developed a Plant Life Management (PLiM) program to support planned operation to at least 2012.

The objective of the PLiM program is to systematically assess the various aging related degradation mechanisms in order to evaluate both current condition and the potential for further extending service life. Another objective is to identify the associated maintenance, surveillance and inspection strategy for service life extension of important Structures, Systems, and Components (SSCs). The strategy uses approaches that build on AECL's PLiM/PLEx experience at CANDU plants, but also utilizes previous Age Management and refurbishment work performed at NRU. The program is multi-faceted, systematic and integrated, and involves the facility operations organization in the assessment process.

The PLiM program has used a number of pilot studies in the initial stages to test out PLiM procedures, gain experience with the various aging assessment techniques and enhance effectiveness of interfaces between the aging assessment team and the facility staff. The aging assessment process begins with the screening and prioritization of the facility SSCs. Selection of the appropriate assessment technique is based on priority and component type. Life and condition assessment techniques used at other plants have been adapted to NRU and performed on important components and structures. For important systems, a combination of condition assessment and systematic maintenance assessment techniques are being used.

Detailed PLiM procedures have been developed and are in trial use in pilot studies. These procedures are currently being updated with the experience gained during the pilot studies. In addition, a detailed PLiM work program has been developed jointly between the aging assessment team and the NRU facility operations staff.

The paper will describe the NRU PLiM pilot program, the next planned phase of work currently underway, and summarize some of the experience and results obtained to date.

1. Introduction

AECL has developed a Plant Life Management (PLiM) program strategy for the National Research Universal (NRU) reactor located at Chalk River, Ontario, to support planned operation of this facility to 2012. The program utilizes recent experience with PLiM/PLEx programs in CANDU reactors and also uses international experience. However it also builds upon the previous aging management work that had been performed at NRU. A particularly important element of the previous work was the aging assessments and subsequent implementation performed during the Upgrades project in the early 1990s.

Over its long and successful service life to date, AECL has invested in upgrading and improving the NRU facility. While there has been a variety of component and system aging assessments performed, the work has extended beyond paper studies. For instance, material samples of key components that have experienced significant service life, have been removed from the facility and taken for laboratory destructive examination and evaluation. As a mitigation measure for light water leakage from the reactor calandria, a specialized leak sealant process was developed and implemented [1]. Class 1 battery banks have been upgraded to improve the performance and reliability of the Class 1 power supply system. In-house developed 'solid-state function generators' replaced 'electron tube function generators', which were obsolete. The performance and stability of the new units is superior to the old ones, thereby reducing the calibration frequency.

In some situations, component parts that have been subject to long life (with potential aging degradation, such as heavy water coolant pump shaft fatigue) have been subjected to detailed non-destructive examination to confirm fitness-for-service. In addition, these pumps have also been modified with new CAN-9 dual mechanical seals.

Since 1990, 7 major upgrades have been installed to modernize NRU to current safety standards and over 1000 formal changes (through its change control process) have been initiated to replace aging components or to improve plant operation. An important element of the current NRU LE PLiM effort is to build upon the foundation of earlier work wherever possible and to recognize the many changes made to upgrade the facility.

The overall goal of the NRU LE PLiM program is to provide additional assurance that the facility can safely and reliably achieve further service life. This will involve updating the systematic assessments and ensuring significant aging effects in plant systems, structures and components are detected in a timely fashion to enable appropriate mitigation and management. The program is multi-faceted, systematic and integrated. Integration into the facility organization will support potential improvements of plant maintenance and monitoring programs for aging.

2. NRU Licensability Extension (Le) PLiM Strategy

In developing the PLiM strategy for NRU LE program, AECL first decided to carefully define the objectives for the program. Three major objectives were chosen as follows.

- To perform systematic assessments of all the systems, structures, and components to the level of detail related to safety and economic factors associated with individual SSCs (e.g., more comprehensive assessments of critical SSCs and less comprehensive assessment of non-critical SSCs).
- To thoroughly document the aging assessments and the processes used, in order to achieve an in-depth understanding of the material condition of the facility. This will then lead to identifying any additional measures (such as special inspections) that need to be performed to support additional life from the facility.
- To ensure continuing safe, reliable, and cost effective operation in accordance with the following goals:
  a) maintain public risk well within the regulatory requirements;
  b) maintain high facility availability;
  c) anticipate potential aging issues of significance and therefore to prepare a managed approach;
  d) support licensing for additional service life.

To meet these objectives, a number of possible approaches to Plant Life Management were considered but it was decided to adopt the basics of the CANDU PLiM program. This program is already in use by a number of utilities with CANDU reactors well into their design life and has been well recognized and presented internationally [2, 3]. While it is recognized that NRU is not a commercial power reactor, AECL has chosen a prudent approach, by using the recent PLiM experience gained from CANDUs (particularly the older ones who have either decided to embark upon life extension or who are actively considering such a program), but also tailoring the program to the uniqueness of the NRU facility.

It was recognized that this "tailoring" would take time and direct application experience. Hence, the overall PLiM program designed to meet the needs of NRU utilizes a structured work program that is being implemented in phases. Figure 1 illustrates the four major phases, as follows:

- Phase 1 - Pilot Program (per Section 3. following)
- Phase 2a - PLiM Assessments on the most critical systems, structures and components (SSCs) which could affect additional service life.
- Phase 2b - Additional PLiM Assessments, on less critical SSCs but yet deemed important enough to include in this Assessment program.
- Phase 3 - PLiM Implementation, in which changes identified in the Assessment phases are reviewed and if appropriate, implemented into inspection and maintenance programs necessary to assure service life goals

A variety of aging assessment techniques will be used. Life and Condition Assessment techniques used at other plants are being adapted specially for NRU and used on important components and structures. For important systems, systematic maintenance assessment techniques are being used. Procedures developed in the Pilot phase are being updated with the experience gained in application in the pilot studies.

3. Recent Plim Pilot Program Phase

In support of the proposed PLiM strategy for NRU, the AECL PLiM/PLEx group developed a Pilot Program that was performed in 2003 and early 2004. The following outlines the tasks that were undertaken in the NRU PLiM pilot. These tasks are all related to plant life management of the physical asset and will enable the NRU PLiM program to meet current PLiM program approaches based on international nuclear industry best practices.

The specific PLiM tasks in the Pilot Program are:

1. Develop preliminary NRU-specific program plan and procedures.
2. Perform a preliminary Life Assessment study of a major critical component (the Main Heavy Water Cooling Heat Exchangers were chosen).
3. Perform a preliminary screening and criticality ranking of the most important NRU systems, structures, and components. This was intended to help focus the aging assessment effort in later phases of the LE PLiM program.
4. Perform a preliminary systematic assessment of main-

tenance of a major critical system (the Main Heavy Water Cooling System was chosen).

5. Perform a preliminary Condition Assessment of a major system (the U2 Loop piping system was chosen).
6. Develop a preliminary, detailed work plan for later phases of the PLiM program.

These tasks gave a significant level of experience and learning that are enabling the NRU PLiM team to implement the full comprehensive PLiM assessment program.

The general objectives of PLiM Pilot Program are:

- To demonstrate the application and usefulness of the key elements of physical asset aging assessment program,
- To develop the preliminary procedures and plans for the later physical plant assessment phases,
- To review prior aging assessments and related work and to utilize this work wherever possible
- To introduce NRU engineering, operations and maintenance to the LE PLiM program and to refine the working interfaces.

This information then would serve to better define the most effective PLiM program structure and processes specific to NRU. It was recognized that PLiM is a shared endeavour between various plant groups - while led by engineering, operations and maintenance have a large and significant role and stake in the program. Hence, the pilot provided an opportunity to involve staff from various key NRU organizational groups that are involved in the PLiM program.

4. Pilot On Systematic Assessment Of Maintenance

Most PLiM programs tend to focus effort on passive major components, those that are very expensive to replace and are subject to long-term degradation. However, AECL also recognizes the importance of components with active functions as these components impact on the operating transients and general operating conditions of the system as well as overall system availability. These types of components are typically subject to short-term degradation and wear-out. These components could be critical to system function and if so, a comprehensive PLiM program provides assurance that the preventative maintenance program will minimize potential system failures that arise from aging effects.

Hence, for critical systems that involve active functions, a specialized PLiM methodology is currently being assessed for use on selected critical systems to assess the current preventative maintenance and inspection as well as health monitoring programs (and to provide the documented technical basis for these programs). The methodology is known as SAM (Systematic Assessment of Maintenance) and is based upon streamlined Reliability Centered Maintenance techniques but as customized by AECL for efficiency and value. SAM will provide a focus on establishing or validating, as appropriate, and documenting the technical basis of the existing maintenance program and potential improvements to that program.

A critical system has been selected for the Pilot on Systematic Assessment of Maintenance. This is the Main Heavy Water Cooling system at NRU. Using a solid knowledge of system operation and operating/maintenance history, the assessment team has been systematically analyzing system functions, functional failures and compensatory measures together with operation, maintenance and engineering staff. As details of the methodology are not familiar to most NRU Operations staff, the pilot task is both introducing this technology to NRU and creating the basis for later systematic maintenance assessments for other important systems.

The process utilizes a NRU-specific version of a software tool known as SYSTMSTM, which has been developed in support of the AECL PLiM program for the application of systematic assessment of maintenance program. The SAM process captures the systematic assessment, implementation, and information flow elements for establishing and maintaining the maintenance basis as described in INPO AP-913 Equipment Reliability guideline that is becoming so widely used in the nuclear industry. When the SAM assessments are complete, they will aid in assessing the current state of the NRU maintenance technical basis and provide insight into the value of assessing the maintenance program in a systematic manner. The deliverables from this pilot project will also provide the basis for documenting the health monitoring programs for systems and generic active components. NRU is currently at the decision making stage with regard to implementation of system-based maintenance assessment methodologies for later PLiM phases.

5. Integration With Facility Operations

It is widely recognized that the success of a PLiM program is very dependent upon the success in integrating the program into the plant organization and its current activities and programs. PLiM requires effective interaction with the plant staff (during assessments, they need to provide the current operational history and plant programs) and understanding by plant staff (typically plant staff perform a detailed review of the assessment reports). This helps the staff undertake "ownership" and eventually "Do" PLiM themselves.

One important aspect is that understanding of the aging assessments brings significant benefits to PLiM implementation. While various degrees of involvement of plant staff in assessments and implementation are possible, the objective is to increase the understanding of the "whys", in order to improve decisions of what changes to make in plant programs (these are the "hows").

Involvement of facility staff also helps identify the training needed for effective transfer of PLiM technology. For instance, training of plant staff in aging degradation mechanisms and in assessment techniques is important to the transfer of PLiM technology to the facility, in

ensuring effective implementation and "adaptation" to plant specific situations.

Effective PLiM implies and requires some additional effort by facility staff as the plant ages. Hence, plant staff involvement in the PLiM program does imply some additional responsibilities, but there are various ways to split the effort involved and the roles to minimize disruption to other day-to-day duties. The intent is to tailor the added effort to the specific NRU plant organization. With the experience of the PLiM Pilot Program, it has been decided to utilize a NRU-specific PLiM team for the LE PLiM program. This team will be responsible for both performing the various PLiM assessments in Phases 2 and 3 but also to work closely with those NRU groups who will implement the key outcomes of the work.

6. Supporting The NRU Le PLiM Program

Implementing a comprehensive and systematic PLiM program involves systematic assessment technologies, detailed understanding of degradation mechanisms and of system/component design and supporting tools, procedures, and methods. For CANDU plants, this program has been developed and advanced via extensive development and implementation experience at several utilities over the past six years. The technology infrastructure for a CANDU PLiM program is now fully mature. Many lessons have been learned on effective interfaces between the various disciplines and the organizations that will be involved in performing PLiM work.

Within the AECL organization various groups are working together to bring relevant CANDU PLiM experience to the NRU LE program, via detailed and close collaboration. There are many potential benefits of this collaboration. For instance, the AECL core PLiM/PLEx group will supplement the NRU aging assessments via direct experience in PLiM work at CANDU plants and via experience in design, procurement, construction, commissioning and operations feedback at these other plants. Support is provided by the active AECL Research & Development program that focuses on plant aging mechanisms, surveillance methodologies, mitigation methods, and improved inspection technologies, and also via ready access to a variety of world class degradation specialists. In addition, AECL is developing a suite of advanced system health monitoring tools and maintenance information systems to aid the effective aging management of CANDU plants. With the AECL objective to provide effective lifetime technical support to nuclear facilities, various groups at AECL will continue to work closely together to maximize the success of the NRU LE PLiM program.

7. Conclusion

The NRU LE Plant Life Management (PLiM) program is intended to meet the needs for additional service life consistent with the corporate and plant goals for safe and reliable operation. It incorporates the best international aging management practices.

AECL is taking a proactive approach to invest in a comprehensive and systematic PLiM program. The following actions are underway.

- A NRU PLiM team has been established to implement the PLiM plan based on the strategy described previously.
- The NRU PLiM group is refining the preliminary policies, procedures and performance/verification measures for the PLiM program, developed during the pilot phase. This PLiM Pilot has been used to gain experience with

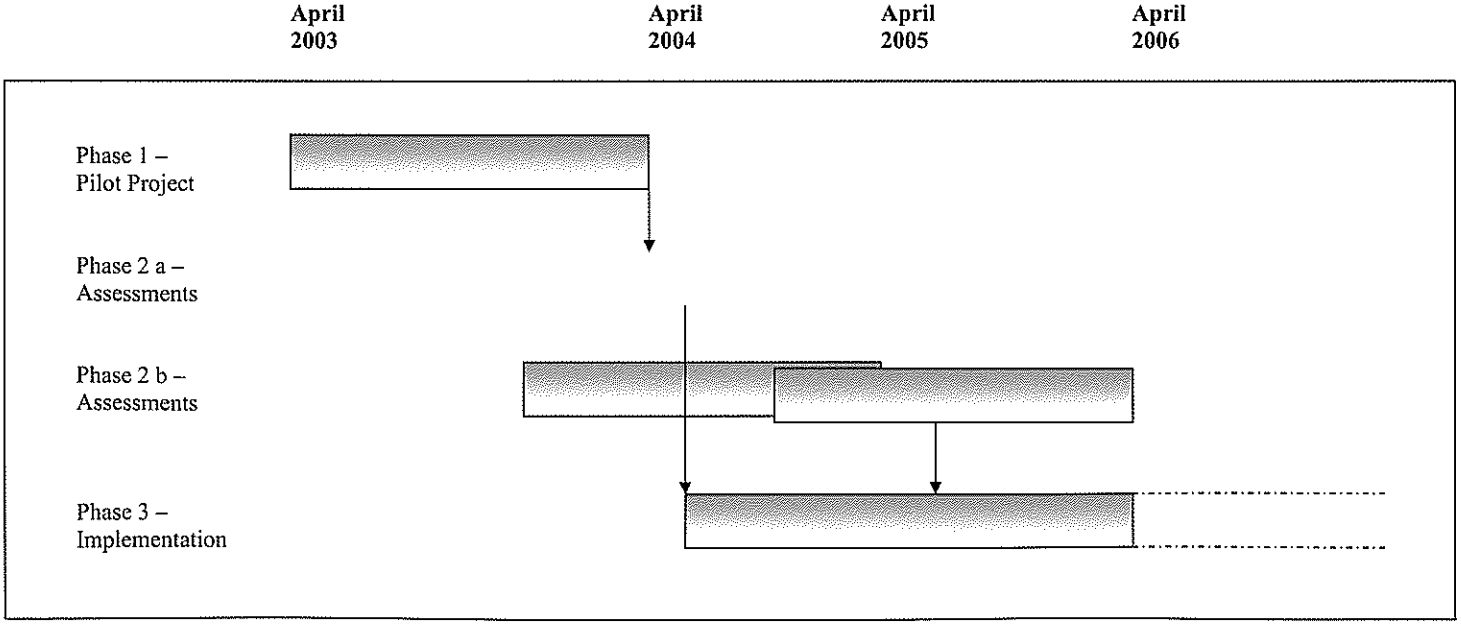

Figure 1: NRU LE PLiM Phases.

PLiM technologies and to develop a program that best matches the NRU organization and is most effective with the existing plant programs.

- Periodically, review the program in the light of progress achieved and experience gained as a result of PLiM activities. As and when necessary, refine/revise the plan.
- Analyze the benefits of the program based on feedback.

The intent of the above is that the NRU LE PLiM program will provide an effective systematic assessment of significant aging effects in Systems, Structures and Components (SSCs), at NRU for the planned additional service life. It will also provide assurance that aging effects are adequately addressed in the on-going plant surveillance, inspection, maintenance and operation programs.

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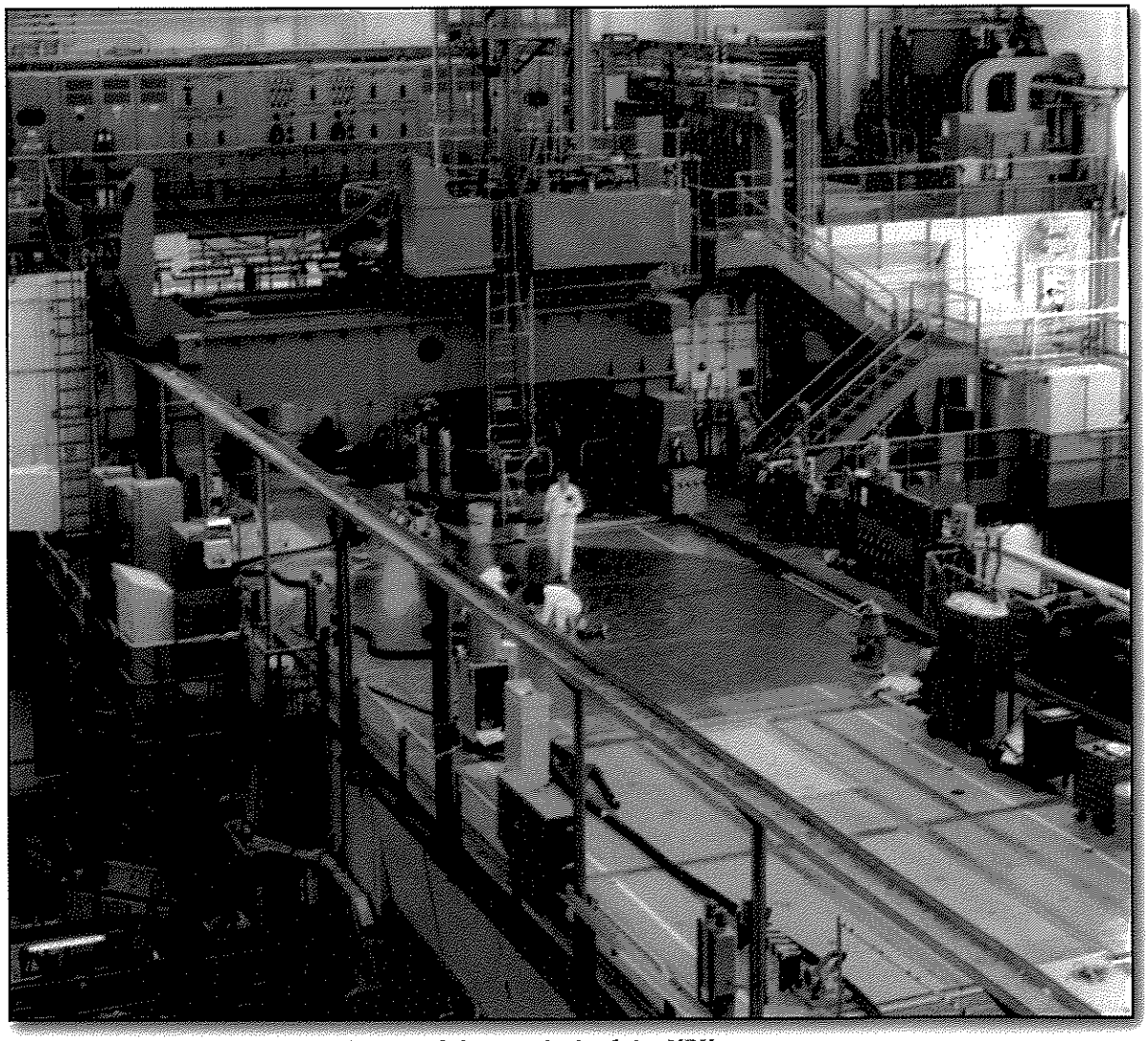

A view of the top deck of the NRU reactor.

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Development of the Advanced CANDU Reactor Control Centre

Scott Malcolm and Rob Leger
AECL
2251 Speakman Drive, Mississauga, Ontario, Canada L5K 1B2

Abstract

The next generation CANDU control centre is being designed for the Advanced CANDU Reactor (ACR) station. The design is based upon the recent Qinshan control room with further upgrades to meet customer needs with respect to high capacity factor with low Operation, Maintenance and Administration (OM&A) costs. This evolutionary design includes the long proven functionality at several existing CANDU control centres such as the 4-unit station at Darlington, with advanced features made possible by new control and display technology. Additionally, ACR control centres address characteristics resulting from Human Factors Engineering (HFE) analysis of control centre operations in order to further enhance personnel awareness of system and plant status. Statistics show that up to 70% of plant significant events, which have caused plant outages, have a root cause attributable to the human from such sources as complex interfaces, procedures, maintenance and management practices. Consequently, special attention is made for the application of HFE throughout the ACR design process.

The design process follows a systematic analytical approach to define operations staff information and information presentation requirements. The resultant human-system interfaces (HSI) such as those for monitoring, annunciation and control information are then verified and validated against the system design requirements to provide a high confidence level that adequate and correct information is being provided in a timely manner to support the necessary operational tasks.

The ACR control centre provides plant staff with an improved operability capability due to the combination of systematic design and enhanced operating features. Significant design processes (i.e. development) or design features which contribute to this improved operability, include:

Design Process

- Project HFE Program Plan - intent, scope, timeliness and interfacing
- HFE aspects of design process - procedures and instructions
- Design Guides - project needs, the implementation and impact
- HFE guidance for control centre HSI standardization.
- HFE analysis and on-going input/assessment of the full scale, dynamic ACR control centre mock-up.

Design Features

- HFE analysis and specifications leading to plant display system requirements including an enhanced annunciation system and the need for a central overview display.
- HFE considerations in support of automated safety system testing functionality, resulting in shorter test durations with reduced operator errors.

This paper will discuss these activities and present the design concept.

Introduction

The basic design of current CANDU control centres was established in the early 1970's. Plants constructed since then have, for the most part, retained the same basic design. To meet evolving client and regulatory needs, AECL has adopted an evolutionary approach to the design of future control centres. That is, the design will be enhanced to incorporate feedback from existing stations, reflect the growing diversity in the roles and responsibilities of the operating staff, and ensure that plant capital and operations, maintenance and administration (OM&A) costs are reduced through the appropriate introduction of new technologies. Underlying this approach is a refined engineering design process that cost-effectively integrates operational feedback and human factors engineering. This paper describes the design process as it is being used for

the development of the Advanced CANDU Reactor (ACR) control center.

Key elements of the design process are described in the following sections and cover the steps listed below.

- Specify design goals and principles.
- Establish the design basis.
  - Define operational, functional, and maintenance bases.
- Design the control centres.
  - Establish requirements and designs.
  - Assess the operational impact of requirements and designs.
  - Evaluate the design.
- Provide support for the customer utility.
- Transfer information for training and procedure development.

Three design goals have been identified to ensure designers meet product needs in the areas of licensability, and capital and OM&A costs.

- Safety - The control centre should be designed to support the operation of the plant safely in all operational states to maintain safety of the public and the facility staff.
- Capital Cost - The control centre should be designed to minimize the cost of design, procurement, construction, and commissioning (including the costs of equipment and schedule).
- Operability/Maintainability - The design of the control centre and the design process should:
  - provide an assignment of functions that effectively utilizes operator and system capabilities to achieve operational objectives,
  - ensure the availability of plant functions when they are needed,
  - provide for the planning and scheduling of maintenance and testing based on plant performance, and permit necessary system/equipment maintenance safely, quickly, and cost-effectively, and minimize the cost of operating and maintaining the plant.

The first two design goals are effectively addressed by the existing AECL design process. The third goal has resulted in a number of enhancements to the process, cast in the context of Human Factors Engineering processes, and is the main subject of the remainder of this paper.

At the start of the ACR project, the executive committed to implementing an HFE methodology for the design process in order to standardize the design activities and deliverables, minimize the opportunity for human error, improve the visibility and auditability of HFE endeavours, while improving the operability and maintainability capabilities. This initiative was consistent with past projects undertaken by AECL in the area of advanced reactor design and plant modernizations. This continuing evolution of our design processes is driven by an ever-increasing awareness of HFE in the technical community, and increased nuclear regulatory HFE scrutiny.

Design Process

Human Factors Engineering Program Plan (HFEPP)

ACR HFE staff prepared the project HFEPP to provide the framework for the HF analysis, design and Verification and Validation (V&V) work. The technical basis for this plan was IEEE 1023 [1], with further guidance from NUREG 0711 [2]. AECL has been using this technical basis for HFEPPs on many projects ranging from limited equipment enhancements to advanced reactors such as ACR. The basic approach is now well established, although specific aspects of the analyses continue to be improved through project experience.

The ACR program director approved the HFEPP to apply the necessary administrative authorization so that the HFE intent would be applied equally across all project disciplines. Once the ACR HFEPP was approved, project documents called up by this plan were prepared. These documents included basis documents, design guides, design requirements and design descriptions. Also, an operating instruction describing HFE considerations for ACR Design Descriptions was issued for project use. This operating instruction improved the incorporation of HFE design criteria for function analysis, HSI development and maintainability throughout all ACR design descriptions.

Selected Aspects of the Process

The HFE program is organized in elements using the guidance provided in NUREG 0711, and includes the use of operating experience, function analysis and allocation, task analysis, interface design, training, procedures and V&V. HFE design process implementation is practical so that each designer can and will use HFE design criteria in their daily design work activities. The ACR design process follows a systematic analytical approach (involving designers from safety, process systems , controls, electrical, civil, control center, HFE, etc.) for system design with requirements definition, function analysis, function allocation and task analysis, combined within a V&V cycle, to define required operator and maintainer information and information presentation requirements in the ACR station.

To assist in implementing the desired systematic ACR design process, the HFE staff also developed project specific HFE Design Guides (DGs) as required by the HFEPP to provide further guidance to all project designers and to facilitate following the engineering procedural instructions. These HFE DGs provide the specific detailed information necessary to implement particular aspects of the design. ACR HFE DGs address design topics such as:

ACR HFE DGs address design topics such as:

- Function Analysis
- Maintenance, Testing and Inspection
- Computer Display and Navigation
- Video Display Unit Workstation
- Annunciation
- Panel Device Selection

The system designers refer to these design guides for increasing levels of design detail or methodology as the design for the application system proceeds. The designer has

the reference plant Functional and Operational Basis documents, the operational feedback input, the project procedures, and the HFE DGs as guiding mechanisms for the content and methodology for that portion of the design. Traditional discipline oriented design techniques are followed, but these are directed and standardized by the mechanisms mentioned above, to achieve a more even and complete consideration of operational and maintenance needs.

Function analysis and allocation is conducted in conjunction with system designers in the process of completing Design Requirements and Design Description documents. HFE staff work with system designers in applying the functional analysis methodology in order to ensure a systematic application. This process supports the identification of levels of automation and the information requirements for personnel, whether they are for operation or maintenance, or whether they are instrumented or gathered manually. The project design procedures, DGs and reference plant bases assessment documents aid the designers in this process.

Task analyses will be completed for selected operational tasks which are identified as having high risk and/or a high degree of difficulty for completion, or those tasks which are judged by HFE design staff to significantly benefit from such analysis. Only a few operational sequences will be subjected to the task analysis process.

Standardization of Human System Interface Design

Standardization of the operator and maintainer interfaces to the plant systems is crucial for an efficient station design. During plant manoeuvring conditions, it must be possible for an operator to move from system to system interface with a minimum of conflicting data presentation methods, alarm formats or control implementation methods. Standard panels/ displays for the entire ACR plant (NSP, BOP, F/H, SSMT) will be implemented with a standard display/presentation philosophy which provides operators with a consistent appearance across systems The design goal for this Human Systems Interface (HSI) aspect is that the general appearance, meaning and operability of the key indicators and controls will be immediately apparent to the operator. In addition, HSI features such as device location on each panel, colours, light status, handswitch positions, and VDU display features, are standardized so that operator data assimilation and problem solving is completed with a minimum cognitive overhead and error.

The resultant operator or maintainer display, annunciation and control information is verified against the system design requirements to provide a high confidence level that adequate and correct information is provided, necessary for the operational or maintenance task at hand. This verification process includes the traditional supervisory and peer document reviews, CADDS reviews, procedural walkthroughs moving to validation by utilizing the full scale control centre mock-up facility.

Full Scale Mockup Assessment

A mockup of the ACR Control Centre panels and consoles in the AECL design facilities will be used for HF V&V of Control Centre design. The functionality of the Control Centre mockup provides a mechanism for V&V design activities such as the panel or console attributes, displays, annunciations and operator/ maintainer interfaces. The ACR system designers will utilize the mockup throughout the entire project design life-cycle. The Control Centre mockup will serve as a designer tool to verify that the individual system designs conform to HFE principles, ensuring acceptable performance of specified operational tasks.

The ACR Control Centres HFE V&V will be formalized in its own planning document, based on standards for V&V such as NUREG 0711[2] and IEC 1771 [3]. This plan will identify the activities required to both verify that alarms, displays and controls that have been specified in design documents are present and have the appropriate appearance, and validate their use in operational situations (e.g. plant startup and event mitigation). Design verification has always been well entrenched in CANDU systems engineering, however, HFE control centre validation is an area of ongoing design process evolution. In ACR, validation activities will include Subject Matter Experts (e.g. operators and shift supervisors) walking through panel and display designs for operability assessments as well as participating in real time scenarios where a significant portion of the HSI and control centre staff are involved.

The Plant Display System (PDS) mock-up (part of the Control Centre mockup) will be used to evaluate display/ navigation concepts as the design proceeds. Plant data will be provided to the mock-up of the PDS from the ACR mockup simulator. This simulator will provide a realistic appearance of plant operating conditions. The Control Centre mockup will serve as a designer tool to validate the HFE design aspects of the Plant Display System thus ensuring acceptable performance of specified operational tasks.

Support for The Customer Utility

Inherent in this design process is the ability to transfer information to the client utility to support the development of operating and maintenance procedures, and training programs and manuals. Key to this information transfer are the three basis documents plus the task analyses for the specific design.

- The operational and maintenance bases answer questions such as:
  - when and what tasks to do?
  - who performs tasks?
- The functional basis answer questions such as:
  - what is available to use? - functions available for different plant operating regions (e.g. full power thru shutdown) and their attributes.
- The task analyses answers such questions as:
  - how to perform tasks? - sequence and timing of applying functions to meet operational goals.

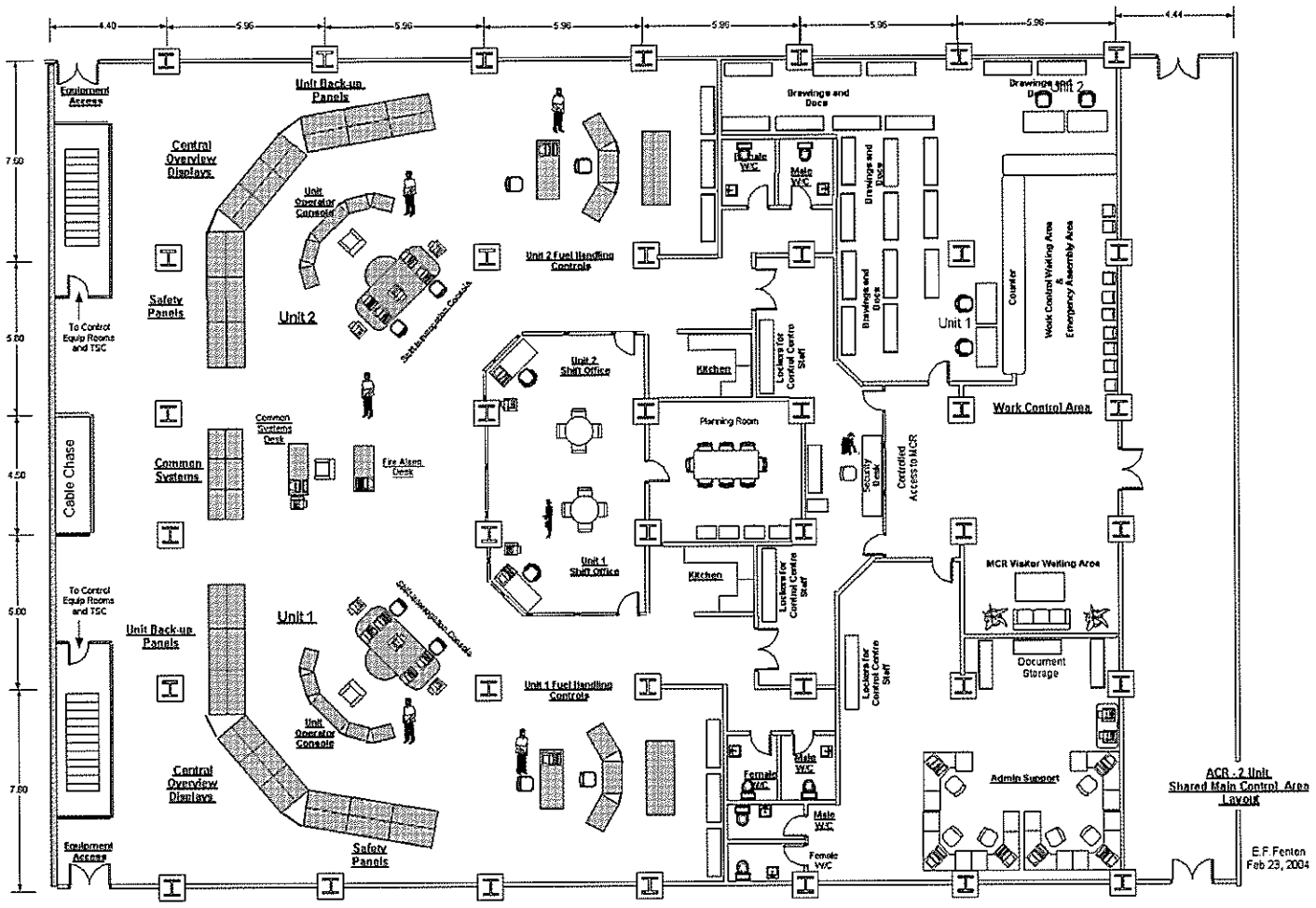

Figure 1: Main Control Centre Layout.

Summary of Design Process

In parallel to these operationally-centred concepts, AECL has looked closely at both the capital and ongoing operating cost of CANDU stations to improve CANDUs competitiveness with the world-wide competitors. Emphasis on reduction of operating, maintenance, engineering, and construction costs has contributed to changes in the information infrastructure for our CANDU products. Effective strategies combined with efficient information systems can lead to significantly reduced costs and higher capacity factors.

This approach has been used to support the evolution of control centre design through the identification of design improvements and enhancements that improve the operational support and cost-effectiveness of the product. These improvements and enhancements are developed through co-operation with existing CANDU stations with many of them implemented/proved in full or part in Canadian CANDU stations or their simulators, or in AECL's CANDU Control Centre evaluation facility to confirm effectiveness. The improvement opportunities were then scrutinised for practicality of implementation resulting in a planned evolution of the CANDU products including the recent CANDU 6 in China, the CANDU 9, and now, the ACR.

Design Features

The following is a brief description of the ACR control centre concept covering the main control room (MCR), its related facilities, and the secondary control area (SCA).

Main Control Centre

This is a facility serving two generating units, and any common equipment (see Figure 1). It comprises:

- The MCR containing the human-system interfaces (HSI) for both units, common systems, and the on-power fuel-handling systems. It also houses a shift supervision office, a planning area, and a kitchen and washroom facilities for the MCR occupants.
- A work control area (WCA) for the issuance of permits for plant maintenance activities and the associated records and drawings.
- Office space for the MCR support administration personnel.
- A technical support center (TSC) used in the management of incidents affecting the safety of the plant. (not shown in Figure 1)
- A security desk to control access into the MCR.

The Human-System Interface

The general appearance of the ACR HSIs is shown in Figure 2. This photograph was taken in the AECL mockup design facility and some of the panels do not represent the style and size of those proposed for ACR - ACR panels will be smaller. Regardless Figure 2 represents the consoles, PDS, safety system testing and large screen displays proposed for ACR. Each of the unit HSIs will include the following features:

- The HSI for each generating unit comprises a console for normal plant operating functions, minimum height panels, and central large screen displays.
- Main Operator's console, including dedicated portion for safety system monitoring and testing (left-hand side of forward console is for safety system functions and right-hand side is for plant monitoring and control).
- Shift interrogation console for shift supervision team in upset or emergency conditions (console located behind operator's console i.e., in immediate foreground of photo).
- A panel (or console) will be used for any required Common Services HSI (not shown in Figure 2).
- A panel/ console facility will be provided for the fuel-handling systems for each unit (not shown in Figure 2).
- The design intent is to provide a compatible HSI for both the Nuclear Steam Supply System and the Balance of Plant. The primary HSI for both information display and control input will be a PDS using video display units (VDU) and context (task) sensitive keyboards respectively. The PDS will be the normal interface for all activities relating to the operation of the plant process control systems. Large screen displays will be used to provide the operators with plant overview information in support of maintaining operators' situation awareness.
- The primary interface for the plant safety systems will be located on low height panels and will be a combination of both VDU and hardware based information displays and controls. Testing of safety systems will normally be conducted via the console VDUs.
- A secondary interface for plant process information and controls that would be required for heat sink maintenance and asset protection in the event of a failure of the PDS will be located on low height panels again using a combination of both VDU and hardware based information displays and controls. These would be interfaced to the Distributed Control System (DCS), and via direct wired connections respectively.
- Alarm annunciation will be presented by VDU and hardware based methods.
- The interface for the fuel-handling systems will use a similar approach for information display and controls.

Plant Display System, Annunciation And Central Overview Display

The basis for the design of the ACR Plant Display System (PDS) was the well known information and operations requirements for the successful CANDU 6 single unit power plants, and in particular, the recent Qinshan plants in China. In addition, complementary operations features adapted from the Darlington CANDU multiunit station were assimilated into the design. The design strategy is to preserve the functionality of the existing control/monitoring systems while providing enhancements which will result in an improved operating staff awareness of the plant operational state, provide for better detection and diagnosis of faults and improved operational reliability. The ACR Plant Display System application will be based on HFE principles and criteria that are distilled for use in project specific design guides for such aspects as Video Display content, navigation , control interaction, and interface device selection.

Unit operability is further enhanced by a functional display system navigation philosophy which facilitates the operator's task of accessing and assimilating necessary plant data. Due design consideration has been given to the functional relationship between parameters of operationally related systems so that operators can easily move laterally or vertically through the display hierarchy to call-up the desired display. The operator can navigate from plant overview to system to component levels directly , as well as move between selected systems or components. Display action points are presented as device icons, menus, or action buttons in a standardized display format. The utilization of a flexible navigation system for the VDU-based plant display system allows custom information displays to be accessed in a simple, direct, convenient and logical manner by operations staff.

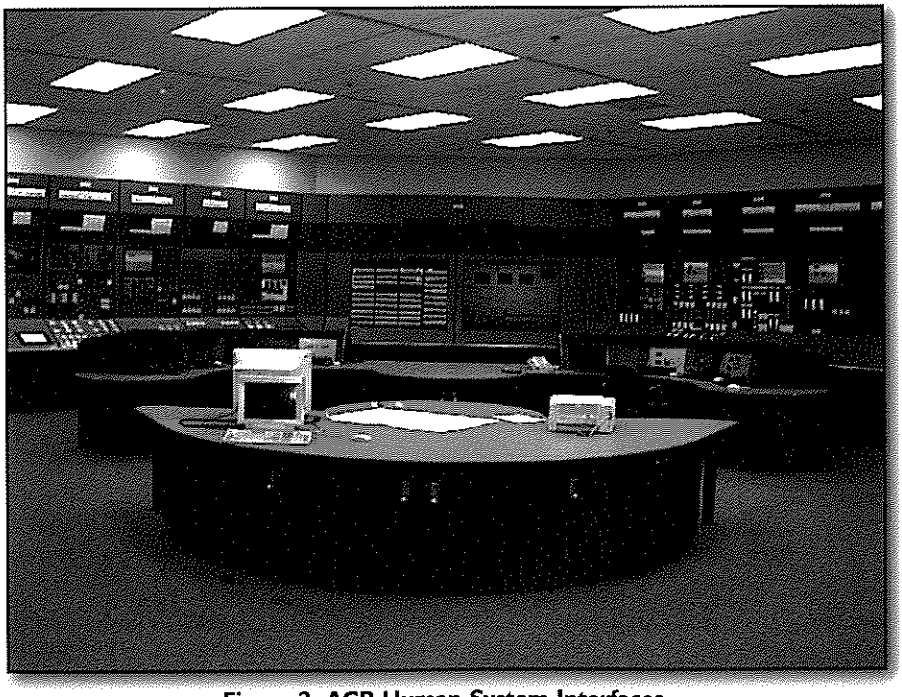

Figure 2: ACR Human-System Interfaces.

The ACR annunciation system has been designed to alert the operators of potential off-normal conditions, to clearly indicate the plant state and system event occurrences and to provide a fast, user friendly procedural action verification aid. Two centrally located, large screen VDUs are provided for display of computerised annunciation messages . One VDU provides unit state change or status alarms, while the second VDU provides fault message annunciations. Selected alarms are prioritised for operator review using multiple setpoints (e.g. first warning, significant deviation, setback imminent, etc.) and with preset filtering features such as cause-consequence.

The two central overview displays are used to present current and uncomplicated plant status information to facilitate operator awareness of unit status in a highly readable and recognizable format. The overview display is an operational aid which will facilitate operating staff awareness. These centrally located overview displays indicate the status of the major station systems so that the general state of the plant is immediately recognized by operating staff with a quick visual scan (e.g. following first entry to the MCR or glancing up from the main console).
The overview display presents the unit status in a simple format so that comprehensive unit awareness is immediate and uncomplicated for operating staff.

Automated Safety System Testing

Automatic Safety System Testing encompasses computer assisted testing, full automation of test signal generation, application and switching, comparison of the results with test specifications and the approval or rejection of test results. The operator has the freedom to step through the test in any order, provided that the necessary prerequisites are satisfied - which are also checked by the computer program. All calculations and scaling are provided by the testing software as well as the generation of textual/graphical displays and test records.

The testing HSI is further improved in the ACR design, where test information is provided in an easy-to-read format. The test prompts are equipped with conditioning delays, which eliminate possible operator errors due to the incorrect timing of the commands, such as a typical valve test which requires the evacuation of a valve interspace to be completed before a second valve is tested .

The screen displayed menus list all legal commands and possible choices. The system responds only to acceptable commands while ignoring predefined illegal selections . All test signals are provided with selected trajectories that are automatically ramped, so that operators and technicians can easily confirm the trip level or equipment calibration status. The test data values are automatically stored in the database, which enables the convenient issuing of periodic reports, statistical evaluations etc. The results of the reports may also be used for preventive maintenance analysis or the scheduling of a planned shutdown.

Secondary Control Area

A Secondary Control Area (SCA) will be provided to serve the functions of Control, Cooldown, and Contain in the event of incapacity of the MCR functionality. The SCA will be located with sufficient distance from the MCR to prevent any common-mode failure of both facilities. The SCA will be used to:

- Remotely shutdown the reactor
- Monitor and maintain the reactor in a sub-critical state
- Maintain adequate cooling for the reactor (including cooling of the fuel)
- Initiate reactor building box up
- Monitor the plant conditions and perform actions necessary to maintain the above safety functions
- Send or receive emergency messages to and from within the plant and external locations

Conclusions

The ACR project strategy for implementing HFE in a pragmatic fashion within the design process has been very successful. The project HFEPP ensures HFE design criteria is considered in all design activities. The systematic approach for design described in the HFEPP (requirements definition, function analysis, function allocation, task analysis and V&V) combined with the use of HFE Design Guides and operational feedback results in a control centre design that provides adequate, correct and timely information to support the necessary operational tasks.

The ACR control centres design is based on the past successes of CANDU plant design and operation. This foundation is enhanced through selected exploitation of advanced digital technologies, such as that used for control and display in the Plant Display System. Through the use of the advanced digital technologies, and their associated functional enhancements, the ACR control centres are cost effective with reduced OM&A costs and meet the needs of personnel in the areas of operation and maintenance.

References

1. IEEE 1023, Institute of Electrical and Electronic Engineers, 1988.
2. NUREG 0711, "HFE Program Review Model", United States Nuclear Regulatory Commission, 2004.
3. IEC 1771, "Nuclear Power Plants - Main Control Room Verification and Validation of Design", International Electrotechnical Commission, 1995.

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Development and Implementation of the Waste Diversion Program at MDS Nordion's Cobalt Operations Facility

Tomasz Wasiak
Support & Contributions: Jackie Kavanagh and Jennifer Bellemore

Abstract

Historically, the MDS Nordion (MDSN) Cobalt Operations Facility sent solid waste for disposal to Atomic Energy of Canada Ltd.'s Chalk River Laboratories (AECL-CRL). A large portion of this waste was not contaminated. Because this non-contaminated waste originated in the "active area" of the MDSN facility, it was routinely disposed of as low-level active waste.

In 2002, MDSN undertook an initiative to develop and implement a more sophisticated and more economical waste management program. The Waste Diversion Program (WDP) ensures continued environmental and public protection, and reduces the demand on Canada's limited capacity for storage of radioactive material and the associated operating costs. The goal of the WDP is to reduce the volume of waste currently being shipped to AECL-CRL's Waste Management Operation as low-level active waste.

The presentation discusses key elements of both the development and the implementation of WDP.

It focuses on the following areas:

- The regulatory environment surrounding the waste disposal issues in Canada and abroad.
- Methods used by MDSN for determination of radionuclides, which could be present in the facility.
- Choice of equipment and calculation of individual alarm levels for each identified radionuclide.
- Key elements of the practical implementation of the program.
- CNSC Regulatory approval process.
- The bottom line - dollars and cents.

The primary objective of the WDP is to ensure that only waste, which meets regulatory requirements, is diverted from the solid active waste stream. This has been successfully accomplished in MDSN's Cobalt Operations Facility.

The objective of the presentation is to share the knowledge and experience obtained in the development process, and thus provide a guideline for other nuclear facilities interested in establishing similar proactive and cost effective programs.

1. MDS Nordion - Background

MDS Nordion (MDSN) is a world leader in radioisotope technology. Established in 1946, MDSN has over 1,000 employees in North America, Europe and Asia. MDSN generates $350 million in revenues with over 95 percent coming from exports to more than 80 countries. MDSN is part of MDS Inc., an international health and life sciences company focused on advancing health through science. It does this by providing: laboratory testing, imaging agents for nuclear medicine testing, sterilization systems for medical and consumer products, research services to speed drug discovery. MDS develops new drugs, therapy systems for planning and delivery of cancer treatment, analytical instruments to assist in the development of new drugs, and medical/surgical supplies. MDS employs nearly 11,000 highly skilled people on five continents.

MDSN has two business units:

- The Nuclear Medicine business unit is the world's leading supplier of short-lived isotopes for medical diagnostic nuclear imaging and therapeutic applications.
- The Ion Technologies business unit is the world's leading supplier of commercial irradiators, cobalt-60 sources, radiotherapy equipment and blood and research irradiators.

1.1 Nuclear Medicine

Radioisotopes

MDSN supplies medical isotopes for most of the estimated 15 to 20 million nuclear medicine imaging and therapeutic procedures performed every year around the world. MDSN supplies over two thirds of the world's reactor and cyclotron-produced radioisotopes producing a wide variety of diagnostic and therapeutic radioisotopes and distributing them, some in as little as 24 hours, to radiopharmaceutical producers and researchers around the world.

Radioimmunotherapy

MDSN's isotope technology provides a platform to develop new radiotherapeutic treatments for cancer. MDSN helps to move these products from concept to market reality for partner companies, such as biotechnology, pharmaceutical and medical device firms. MDSN's partners in radioimmunotherapy include some of the world's foremost biotechnology innovators such as IDEC Pharmaceuticals Corp., Corixa Corp. and Human Genome Sciences Inc..

Non-destructive testing

Agiris, a division of MDSN, is a pioneer and global leader in the manufacturing of non-destructive gamma radiography testing equipment and radioactive sources.

1.2 Ion Technologies

Commercial Irradiation & Sources

MDSN irradiation technology prevents disease by reducing micro-organisms in a variety of products. Safe, predictable and effective, cobalt-60 emits high-energy gamma rays to sterilize single-use medical devices, pharmaceuticals, lab ware, and consumer products. Over 40 percent of the world's disposable medical supplies and a vast array of consumer products are sterilized using gamma technology. MDSN supplies approximately 75 percent of world demand for cobalt-60. The company's C-188 double-encapsulated cobalt-60 source is the industry standard for power, performance and reliability in gamma processing.

MDSN designs and installs a range of commercial irradiators to meet specific customer requirements. Its Canadian Irradiation Centre (CIC), in Laval, Quebec, provides training for technical, professional and scientific personnel; conducts applied research; educates industry and government; develops procedures and standards; and carries out product- and market-acceptance trials.

Food Irradiation

Irradiation technology is increasingly used to make food safer by eliminating pathogens and protecting food from insect infestations. MDSN's expertise helps food processors gain the greatest competitive advantage from fully integrated and cost-effective food irradiation systems.

Teletherapy

MDSN is a pioneer in the development of external beam radiation therapy technology. Each year, over 12 million cancer treatments are delivered with MDSN's cobalt teletherapy units to patients in over 50 countries. MDSN produces the Theratron family of radiotherapy equipment known around the world for their reliability, ease of use and effectiveness offering cancer treatment centres flexibility, productivity and dependability.

Self-contained Blood and Research Irradiators

MDSN manufactures and distributes several lines of self-contained radioisotope and x-ray based irradiators for blood irradiation and research applications. Irradiated blood is used for patients with severely weakened immune systems and to prevent Transfer Associated Graft versus Host (TA-GVH) disease in blood transfusions.

2. The Origins Of The Waste Diversion Program

Learning of the challenges facing Low Level Waste (LLW) facilities to keep up with growing storage demands, MDSN undertook a study to develop an efficient and cost effective solution to reduce the quantity of material it disposes of as low level waste. This solution became MDSN's Waste Diversion Program (WDP).

Specific areas of the MDSN facility, which are utilised for the processing of radioactive materials, are commonly referred to as the "active area". One section of the active area, dedicated primarily to the production of radioactive sources containing Cobalt-60, is called Cobalt Operations. This facility houses production facilities as well as offices for production and support staff. Some areas in Cobalt Operations are utilised directly in the processing of radioactive materials. These areas produce primarily contaminated waste. Others are generally maintained as "contamination free" areas and therefore produce primarily non-contaminated waste. Some offices are separated from the rest of the facility and are designated contamination free zones.

Historically, all solid waste from Cobalt Operations was treated as contaminated or potentially contaminated waste and sent for disposal to the Atomic Energy of Canada Ltd.'s Chalk River Laboratories (AECL-CRL). A large portion of this waste was not contaminated, but was routinely disposed of as low-level active waste, since it originated in the "active area".

Over the years, several initiatives to separate the non-contaminated waste in active areas were undertaken. Regulatory hurdles, lack of definitive and reliable technol-

ogy, potential public perception issues and relatively low economical incentives always led to their abandonment.

Late in 2001, AECL announced that their storage facilities for Low Level Waste (LLW) were filling up and new facilities would need to be built. This led to a drastic price increase for the disposal of LLW. The price rose nearly by a factor of nine, which provided a compelling financial incentive for the waste segregation initiatives.

In 2002, MDSN began to investigate potential methods to develop a more sophisticated and more economical waste management program for active area waste. The new program needed to ensure environmental and public protection, while reducing the demand on Canada's limited capacity for storage of radioactive material and the associated operating costs. The goal of this program was to reduce the volume of waste shipped to AECL-CRL's Waste Management Operation as low-level active waste by separating and diverting the non-contaminated waste stream. These initiatives led eventually to the WDP.

3. Key Elements of The Waste Diversion Program

Under the Waste Diversion Program (WDP), solid waste from Cobalt Operations with activity concentrations below the clearance level established for solid waste is diverted from the low-level active waste stream. This has been achieved through **segregation** at source of solid waste based on its origin and potential for being contaminated, followed by **verification** of all segregated non-contaminated waste at the monitoring station prior to release. When confirmed as clean, the waste is considered non-hazardous and disposed of according to disposal practices for conventional waste.

Hazardous materials are diverted to a separate waste stream prior to segregation.

The proposed clearance levels have been reviewed and accepted by the CNSC. The clearance levels are based on guidelines provided by various Canadian and international regulations.

3.1 Segregation

All waste generated in MDSN's Cobalt Operations is segregated at source based on the point of origin and on its potential for becoming contaminated. Contaminated and suspected contaminated waste is disposed of in waste bins that have bright red lids and are lined with yellow bags marked with radioactive caution labels. Non-contaminated waste is separated and disposed of in waste bins that have green lids and are lined with clear translucent bags.

In order to determine the appropriate location for each type of waste bin, an examination of the Cobalt Operations Facility (COF) waste disposal was performed. We focused on the type of waste generated in each area and classified the areas accordingly as generating contaminated, non-contaminated or mixed waste.

The next step was to identify all existing waste bin locations in the COF. With this information and the area classification plan prepared earlier, we were able to propose the distribution of the new bins facilitating the segregation of waste. Areas generating one type of waste received the appropriate type of waste container and the areas generating mixed waste received both types of containers.

The successful segregation of waste is contingent upon the active area staff disposing of waste into the appropriate containers and remaining committed to this procedure. General principles have been developed and incorporated into a formal training process to provide guidance for employees. The most important principles are listed below.

- Highly contaminated process waste from hot cells is disposed of as radioactive waste. The Waste Diversion Program does not affect its current handling and disposal practices.
- Waste, known to be or even suspected to be contaminated at low levels, should only be disposed of into the red containers labelled "Contaminated /Active".
- Waste that is not contaminated should be disposed of into the green containers labelled "Not-Contaminated / Non-Active".
- When unsure if the waste is contaminated or not, the red containers labelled "Contaminated / Active" should be used for disposal.
- All waste generated in rooms and areas where only the "Contaminated / Active" (red) containers have been provided should be disposed of in these containers.
- No hazardous waste of any type (radioactive, chemical, biological, etc.) should be disposed of into the (green) containers labelled "Not-Contaminated / Non-Active".

Contaminated / Active Not Contaminated / Not Active

Figure 1: Two types of waste bins used to facilitate waste segregation.

- No labels or any other cautionary markings indicating radioactive content should be disposed of into the (green) containers labelled "Not-Contaminated / Non-Active".

3.2 Verification – adventures in regulatory affairs and nuclear physics

Segregation alone would not be sufficient in ensuring that only non-contaminated waste is diverted and leaves the facility as conventional waste. An additional verification step is required that makes use of sensitive monitoring equipment. In order for the verification to be meaningful, it needs to be demonstrated that all radionuclides potentially present in the facility can be reliably detected in quantities below the regulatory clearance level. This is where the adventure began.

3.2.1 Cutting through the "regulatory jungle"

During the initial phase, MDSN researched relevant laws, regulations and guidelines to determine release limits for the disposal of non-contaminated waste from nuclear facilities. This search revealed that there were no current Canadian regulations or guidelines in existence. Past Canadian regulations however provided limits called "Scheduled Quantities"[1], below which no licence is required to handle or process radionuclides. These "scheduled quantities" limits, however, far exceeded MDSN's acceptable limits for release.

Additional research regarding regulatory release criteria (world-wide) revealed proposed limits for release from the UK[2], which appeared technologically challenging. Further to this, MDSN found a draft copy of proposed limits established by the former AECB[3]. These levels proved to be impossible to detect with current technology, and the document itself has never been finalized and formally released (possibly for that reason).

Finally, an International Atomic Energy Agency document was reviewed, which dealt specifically with solid waste materials and was in line with MDSN's vision for this project. The IAEA-TECDOC-855 "Clearance Levels for Radionuclides in Solid Materials..."[4] was found to have limits for "unconditional clearance", which appeared to be technologically challenging but achievable.

After consultations with CNSC, this last document (IAEA-TECDOC-855) was chosen as a basis for MDSN's release criteria.

Following the submission of MDSN's screening report for the proposed waste diversion program, another document was suggested for review - a proposed IAEA Safety Standards Series, Draft Safety Guide document (DS161) called "Application of the Concepts of Exclusion, Exemption and Clearance"[5]. The limits proposed in this document vary slightly from those proposed by the IAEA-TECDOC-855, but appear to be achievable. They would however, in some cases, challenge the capabilities of currently available detection technology and leave only minimal room for detection errors and administrative safety margins.

Table 1 demonstrates the variance in regulatory release criteria as found in five sources reviewed during the course of this project.

3.2.2 Determination of the radionuclides present in the Cobalt Operations facility

In order to ensure that all possible isotopes are covered by the analysis, we decided to approach the problem from the practical angle first and supplement it with the nuclear physics analysis.

The practical aspect was based on a spectral analysis of contamination samples with use of a multi-channel analyser. Contamination samples were collected from processing cells, various other locations in the facility, as well as from a multitude of shipping containers arriving on site from various nuclear facilities. Based on the results obtained from the quantitative spectral analysis, the initial list containing radionuclides of concern was created.

The theoretical analysis focused on the internal manufacturing processes. It was geared towards the identification of all radionuclides, which could be present in raw cobalt and its zirconium alloy encapsulation following their activation in a nuclear reactor. All base elements and impurities of various cobalt forms and zirconium alloys used in the facility were included in this analysis. The result was an extensive table containing activation and decay products and their quantities (activities). Because some elements were shown to be present in extremely small quantities, only these radionuclides, whose presence exceeded 0.2% of the total activity, were taken for further consideration.

Compilation of both theoretical and practical results produced the final list of radionuclides of concern for Cobalt Operations.

The primary isotopes, which may be present in this facility, are Co^{60}, Zr^{95}, Nb^{95} and Cs^{137}.

1 "Atomic Energy Control Regulations" Office Consolidation, Atomic Energy Control Board of Canada, Ottawa, 1986

2 UK Proposed Limits as found in "Department of the Environment, Transport and the Regions, The Radioactive Substances Act 1993: Implementing The Revised Basic Safety Standards Directive Euratom 96/29, A Consultation Paper issued jointly by the Department of the Environment, Transport and the Regions, Department of the Environment (Northern Ireland), The Scottish Office, and the Welsh Office"

3 AECB proposed Limits were derived from a "Proposed Policy Statement, C-123 Radioisotope Release Concentrations", Consultative Document, Atomic Energy Control Board, Issued for comments on May 19, 1995

4 Clearance Levels for Radionuclides in Solid Materials: Application of Exemption Principles Interim Report for Comment, IAEA TECDOC Series No. 855 1996, IAEA, Vienna, Date of Issue: 5 February 1996.

5 IAEA Safety Standards Series, Application of the Concepts of Exclusion, Exemption and Clearance, Draft Safety Guide DS161, International Atomic Energy Agency, Vienna, January 2004

Table 1: Overview of Regulatory Release Criteria.

Isotope	Scheduled Quantities	UK Proposed Limits (Bq/kg)	AECB Proposed Limits (1995) (Bq/kg)	IAEA Unconditional Clearance Limits (Bq/kg)	IAEA Proposed Limits (Bq/kg)
C-14	3,700,000	10,000	200	300,000	1,000
I-123	3,700,000	N/A	1,000	30,000	10,000
I-125	37,000	1,000	2	30,000	1,000,000
I-131	37,000	100	1	N/A	10,000
Ir-192	370,000	100	20	3,000	1,000
Co-60	370,000	100	1	300	100
Cr-51	3,700,000	10,000	1,000	30,000	100,000
Cs-137	370,000	100	9	300	100
Fe-59	370,000	100	20	3,000	1,000
Nb-95	N/A	100	N/A	3,000	10,000
Zr-95	N/A	100	30	3,000	1,000

Radionuclide	Unconditional Clearance Level [Bq/kg]
Co-60	300
Cr-51	30,000
Cs-137	300
Fe-59	3,000
Nb-95	3,000
Zr-95	3,000

Table 2: Sample of Radionuclides of Concern for the COF and their Clearance Levesl based on the IAEA-TECDOC-855.

		Energy	Incidence	Efficiency	cps from	Total for Isotope	Alarm Level	
Half Life	Isotope	E [keV]	I [%]	(empirical)	100 Bq	cps/100Bq	[Bq]	Isotope
5.27 y	Co-60	1332.50	99.99	15.6%	15.60	31.20	100	Co-60
		1173.24	99.99	15.6%	15.60			
27.70 d	Cr-51	320.08	10.00	8.4%	0.84	0.84	3714	Cr-51
30.07 y	Cs-137	661.66	85.10	16.8%	14.30	14.30	218	Cs-137
44.5 d	Fe-59	1099.25	56.50	15.6%	8.81	15.55	201	Fe-59
		1291.60	43.20	15.6%	6.74			
34.97 d	Nb-95	765.79	100.00	16.8%	16.80	16.80	186	Nb-95
64.02 d	Zr-95	756.73	54.00	16.8%	9.07	16.49	189	Zr-95
		724.20	44.17	16.8%	7.42			

Table 3: Sample calculations of individual alarm levels.

		Individual	Clearance	Alarm /					Actual
	cps from	Alarm Qty	Level	Clearance		Example of	Cps from		to Limit
Isotope	100 Bq	[Bq/kg]	[Bq/kg]	Ratio		% Contribution	100 Bq Mix	Bq in Mix	Ratio
Co-60	31.20	100	300	33%	PASS	18.59%	5.798	32.6	0.1088
Cr-51	0.84	3714	30,000	12%	PASS	5.25%	0.044	9.2	0.0003
Cs-137	14.30	218	300	73%	PASS	0.80%	0.115	1.4	0.0047
Fe-59	15.55	201	3,000	7%	PASS	0.03%	0.005	0.1	0.0000
Nb-95	16.80	186	3,000	6%	PASS	38.71%	6.504	68.0	0.0227
Zr-95	16.49	189	3,000	6%	PASS	19.95%	3.290	35.0	0.0117
				indicates clearance levels which were not listed in the IAEA-TECDOC-855					
				and were therefore calculated with use of the formula provided there.					

Table 4: Individual alarm levels compared with clearance levels for a sample of radionuclides.

3.2.3 Establishing individual alarm levels for all radionuclides of concern

With the list of isotopes established and clearance levels agreed upon, the next step was to determine if all of the radionuclides of concern could be detected by the monitoring equipment in quantities lower than their respective clearance levels.

A typical waste bag monitor is equipped with large plastic scintillator detectors and cannot differentiate or quantify isotopes in a mixture of unknown composition. It detects emissions coming from all radionuclides and simply reports the total "count per second". It is also typically calibrated for one particular radionuclide or a specific mixture of radionuclides and it reports accurate results only for objects containing the same or similar mixture of isotopes.

Based on the IAEA-TECDOC-855, the clearance level for $Cobalt^{60}$ is 300 Bq/kg. Our intention was to establish the administrative limit for $Cobalt^{60}$ at 100 Bq/kg and calibrate the equipment to match this value. Due to differences in their emission characteristics, all other radionuclides would alarm (and be rejected) at their own unique specific activity level.

In order to determine the alarm level for each radionuclide, the following calculations were performed:

1. Energies and incidence rates for all significant gamma emissions were identified for each radionuclide of concern.
2. Based on the detector efficiency data provided by the manufacturer of the detection equipment, the detection efficiency was established for each emission. The detection efficiency data was later corrected with empirical results.
3. The efficiency data was then converted to counts per second produced by 100 Bq of a radionuclide and totalled for all emissions produced by this radionuclide.
4. Knowing that the alarm setting of the monitoring equipment will match the "cps" produced by 100 Bq of $Cobalt^{60}$, quantities of each isotope producing the same "cps" could be calculated from a simple proportion (based on previously determined "cps" produced by 100 Bq of each radionuclide). These are the individual alarm levels for each isotope.

The results and intermediate steps of this calculation for a few selected isotopes are shown in Table 3.

3.2.4 Comparison of individual alarm levels with clearance levels for each radionuclide.

With individual alarm levels established, the next step in our analysis was to compare them all with their respective clearance levels provided in the regulation (IAEA-TECDOC-855).

The results of this comparison are illustrated below:

The information that follows offers a summary of the results:

- The majority of radionuclides of concern for Cobalt Operations could be detected at specific activity levels below their respective clearance levels, with ratios varying from 2% to 77% of their clearance level.
- Some radionuclides added to the list as a result of the theoretical analysis could not be detected by the equipment due to their minimal or non-existent gamma emissions. Conservative numbers for their (%) contribution in the contamination mix were then established based on the maximum presence determined by the theoretical analysis. The scaling factors were used next, as suggested in the IAEA-TECDOC-855, to determine the expected levels of these radionuclides in the contaminated waste stream of a typical composition.
- Based on the results obtained from the analysis of contamination composition in Cobalt Operations, an average composition case was established. Ratios of actual presence to clearance level were calculated for each isotope and added up to produce the total result for the mix. The obtained number (k=0.21) was compared with the clearance criteria (k<1) for a mix of radionuclides (provided in the IAEA-TECDOC-855).
- As can be seen from the numbers provided in the point above, the safety factor of a typical contamination composition case would be a conservative ~4.76 (1 / 0.21). For such a case waste bags would be rejected at ~176 Bq/kg (total activity of all radionuclides present).

3.3 Choice of the monitoring equipment

In the early stages of the project several potential monitoring candidates were identified:

- "Condor" – by Aptec NRC (USA)
- "WCM-10PC" – by Eberline (ThermoElectron) (USA)
- "Lo-Rad BM" – by Helgeson (USA)
- "BM-285" – by TSA Systems (USA)
- "AWM" – by NE Technology (UK)
- "RTM 600" – by Rados (Finland)
- "RTM 661" – by Rados (Finland)
- "GTM" – by Eberline (ThermoElectron) (USA)
- "BM-185" – by TSA Systems (USA)

The following criteria were used to make the final choice:

- Sensitivity - the lower the minimum detectable quantity of $Cobalt^{60}$ the better. *The targeted number was 100 Bq of $Cobalt^{60}$.*
- Measurement time – shorter times were preferred, providing the sensitivity did not suffer. *Measurement time around 30 seconds per bag was considered acceptable.*
- Chamber volume – large enough to accommodate a full waste bag used by COF. *Excessive chamber volumes (for drums) were considered disadvantageous. Small instruments, which could not accommodate a full bag could possibly provide better sensitivity, but were also rejected as impractical in this application.*

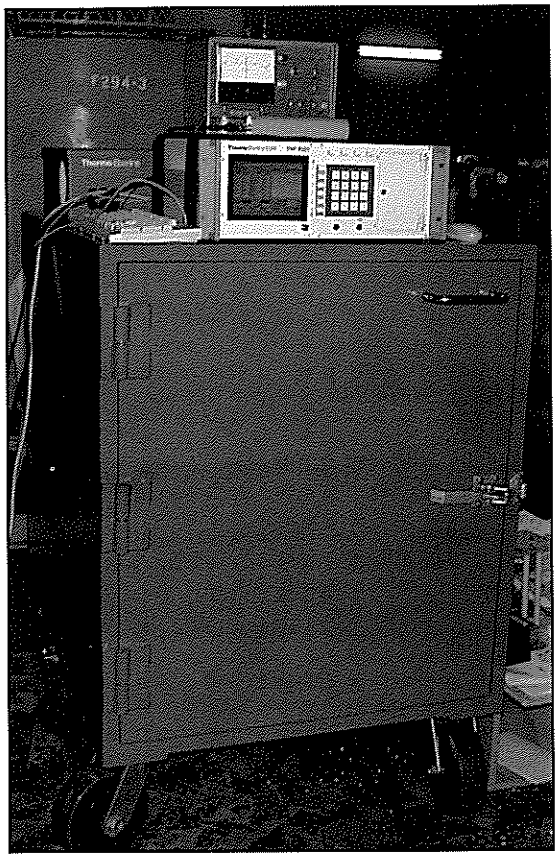


Figure 3: Waste Curie Monitor (WCM-10PC) by Thermo Eberline.

- Detector type and total volume of all detectors. *Most candidates used plastic scintillator detectors. To ensure best possible detection efficiency, higher total volume of detectors was considered beneficial.*
- Manufacturer's location – *North American companies were preferred due to the predictable better availability of service and support.*
- Manufacturer's size and market position - *larger, well known and established companies were preferred over new, smaller and less known ones.*
- PC technology – *current or recent (newer) PC technology was preferred for better availability of parts and technical support.*

Based on these criteria, the WCM-10PC from Thermo-Eberline was chosen for implementation. It is shown in Figure 3.

We experienced the following challenges after the unit was installed and tested:

- Although the shielded test chamber with the detectors was manufactured in the USA, the controls hardware and software originated from Germany.
- Although we performed the "reference check" with another Canadian owner (Hydro Quebec), they owned an older version of the unit. We received the first unit of a new generation. This was contrary to the specific assurances of the sales person that it is a stable and mature product.
- As frequently happens with the first units of new generation, this monitor was not sufficiently tested and challenged during development. Multiple, mostly minor, glitches occurred over an extended period of time.
- Thermo-Eberline was understanding and co-operative, but not very efficient in dealing with prolonged debugging and frequent communication with its German branch. Currently we have had one printed circuit board (PCB) replacement and seven software revisions with one or two still pending to address the last few minor findings.
- For several months Thermo-Eberline did not have another complete unit like ours to perform their own testing. Significant effort was required by MDSN to test and troubleshoot the unit, as well as write extensive deficiency reports.

3.4 Conclusion

Based on the analysis described, we determined that the use of the monitoring equipment calibrated and set up to alarm for Cobalt^{60} at a level of 100 Bq/kg, ensures compliance with IAEA-TECDOC-855 limits with a high degree of confidence.

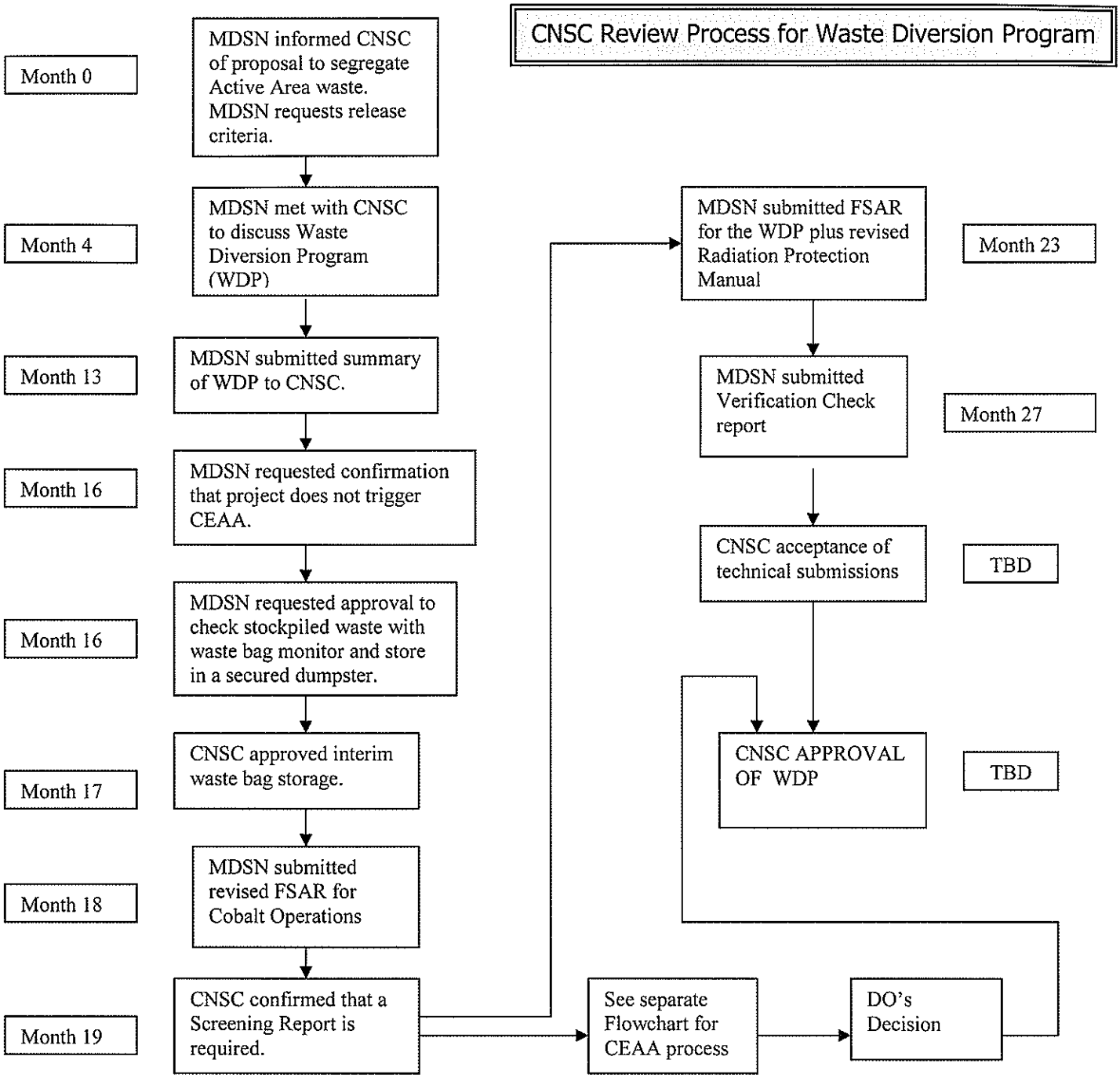
NOTE - It is important to realise, that with a highly effective waste segregation process (expected 80-95%), the verification step provides a degree of redundancy in the system.

3.5 Findings and observations from the initial implementation:

- It takes some time for employees to adapt to the new segregation practices and routinely dispose the waste as required.
- With use of sensitive monitoring equipment and a traceability system for waste bags, the segregation practices can be fine-tuned through the identification of troublesome locations or even individual contaminated items.
- Although, in general, the predictions regarding which items are, and which are not contaminated were confirmed, we faced some occasional surprises. This was due to the implementation of new, highly sensitive detection technology.
- On a few occasions, the monitor rejected some items, which were not expected to be contaminated. Further investigation revealed that this was caused by naturally occurring radionuclides present in the rejected items in quantities far below those required for regulatory licensing.

4. Regulatory Approval Process

In the case of MDSN, implementation of the Waste Diversion Program required regulatory approval by the Canadian Nuclear Safety Commission (CNSC). During the



initial assessment of the regulatory approval process, we discovered that there were no current Canadian regulations or guidelines regarding the disposal of non-contaminated waste from nuclear facilities.

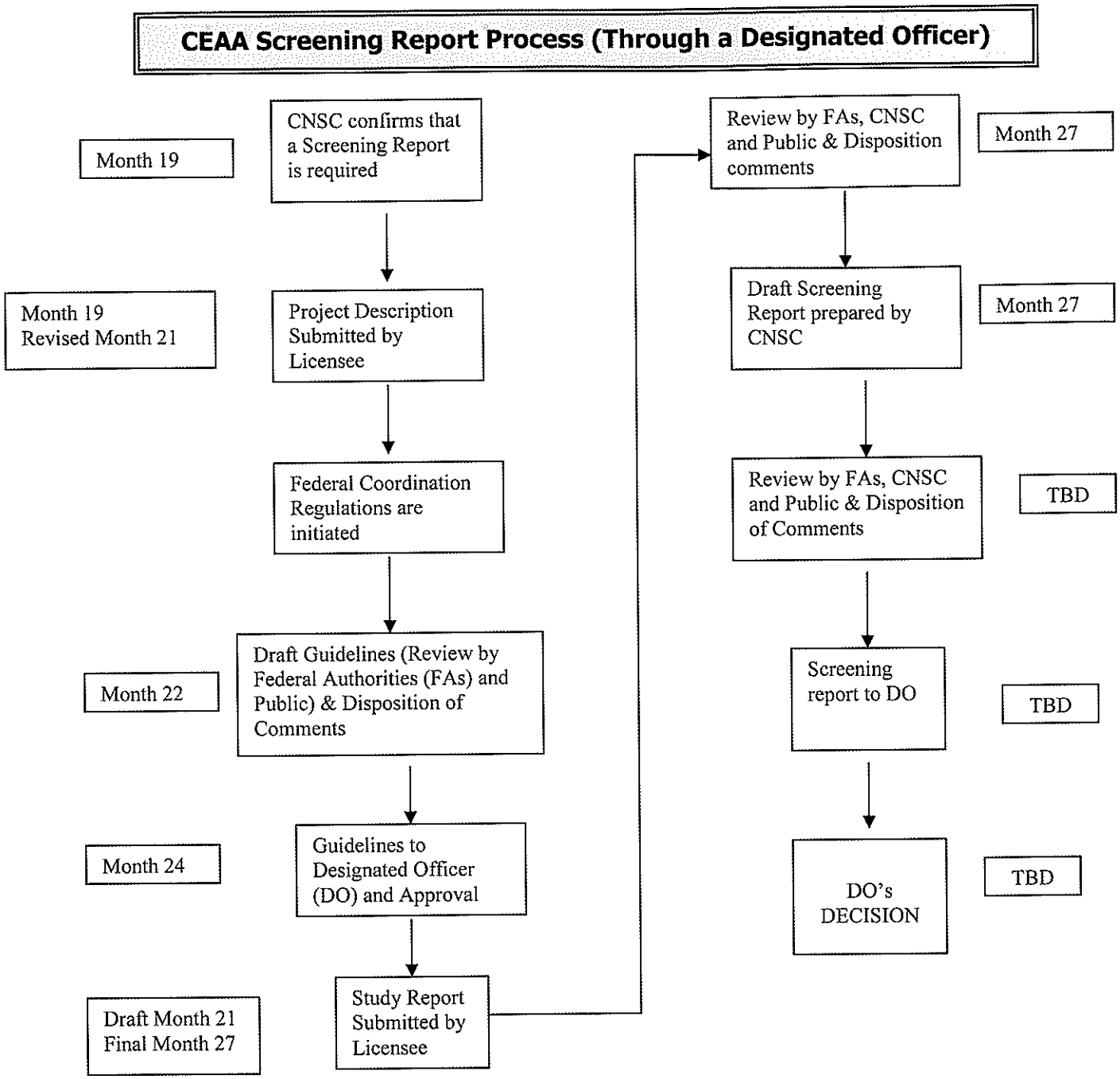
As a result, MDSN reviewed guidelines and regulations used by a few other countries and proposed the use of the IAEA document TECDOC-855 - "Clearance levels for radionuclides in solid materials". Although the use of this document has been accepted by CNSC early in the process, the entire exercise proved to be lengthy and has just recently been completed.

The flowcharts below illustrate key events of the approval process and their timing.

5. The Bottom Line – Dollars And Cents

With the drastically increased disposal costs announced by AECL in 2001, savings from the diversion of non-contaminated waste are quickly realized and offset the investment required to implement the program.

In the case of MDSN, the estimated savings in disposal costs are approximately $100k per annum. With the investment required to develop and implement the Waste Diversion Program being ~$150k, the return on investment (ROI) is just 1.5 years.



The increased waste disposal efficiency and solid financial savings with full regulatory compliance definitely assisted us in providing justification and gaining approval for the WDP initiative.

Glossary of Acronyms

AECL – Atomic Energy of Canada Ltd.
CIC – Canadian Irradiation Center
CNSC – Canadian Nuclear Safety Commission
COF – Cobalt Operations Facility
CRL – Chalk River Laboratories
IAEA – International Atomic Energy Agency
LLW – Low Level Waste
MDSN – MDS Nordion
WCM – Waste Curie Monitor
WDP – Waste Diversion Program

History

Design of On-Power Fuelling Machines

by Wm. H. Jackson[1]

Ed. Note: This piece of history was sent to us by Joe Howieson, an early president of the CNS. It has been reviewed by Bill Brown and others involved with the NPD design. Bill Jackson is now in his 90s and lives in Cobourg, Ontario.

Bill Jackson at his computer.

It was in May 1957 that I was called into the CGE Tool Design office and in there with my superiors was Dick Johnson of the Atomic Dept. They asked me to consider going to the Atomic section to design the fuelling machine for the NPD2 reactor. I would only be on loan, my desk and job would be waiting for me when finished and the decision was up to me. I accepted and in early June I was interviewed by Mr, Ian F. McRae, who was in charge of the Atomic Dept. He intimated that if we did not succeed it would likely be the end of CGE participation in the atomic field. The general attitude in the Department seemed to be that they didn't have much of a chance as we were competing with Canadair in Montreal and they were supposed to be well on the way with a design that would likely be accepted.

At that time, the original pressure vessel design of the NPD reactor had just been scrapped and replaced with the new "CANDU" concept using a horizontal reactor core and continuous refuelling. CGE had the design contract and were very aware that the success of the whole program depended greatly on the fuelling machine. I was assigned to Dick Johnson's group where I worked mainly with Cy Skinner and Don Medd. They quickly introduced me to the whole new idea of nuclear power and the details I needed to know about the NPD2 design.

Two fuelling machines were required, one at each end of the reactor, that could either push the fuel bundles through the reactor or accept the bundles being pushed out. The machines had to connect on to the end fittings of the same tube, seal, fill with heavy water, and pressure up to 1000 psi without external leaks. Each machine had to remove the tube seal plug from its end fitting and store it in an indexing magazine, which also had to hold up to six fuel bundles, or retrieve that many, if the magazine was empty. There was also provision to store a spare plug. When finished moving fuel bundles, the tube plugs were to be replaced and tested for leaks, before the fuelling machines would be detached from the end fittings. This was all to be done by remote control. Also, if a machine contained used fuel bundles after being released from the end fittings, it would be coupled to another fitting connected to the spent fuel bundle storage tank to discharge the bundles into the tank at atmospheric pressure.

There were no known types of electric motors, or hydraulic fluids that could provide the power needed to drive the various components, and survive the high radiation fields to which they would be exposed. After considering this problem for some time, it occurred to me that the power used for operating the systems of the Peterborough Lift Lock was water hydraulics. I was familiar with this operation because I had taught hydraulics at night school the previous year and had used the lift lock as an example for the students. Water flow from the upper reach of the canal provided energy to drive a multiple piston pump to supply the high pressure water which opened the lock gates as well as adjusting the position of the main pistons raising the lock so the lock was in the correct position for the gates to open. In addition, by drawing air from the top in a stream of falling water, the air was compressed to 30 psi and used to inflate the inflatable seals, which prevented leaks from around the lock gates.

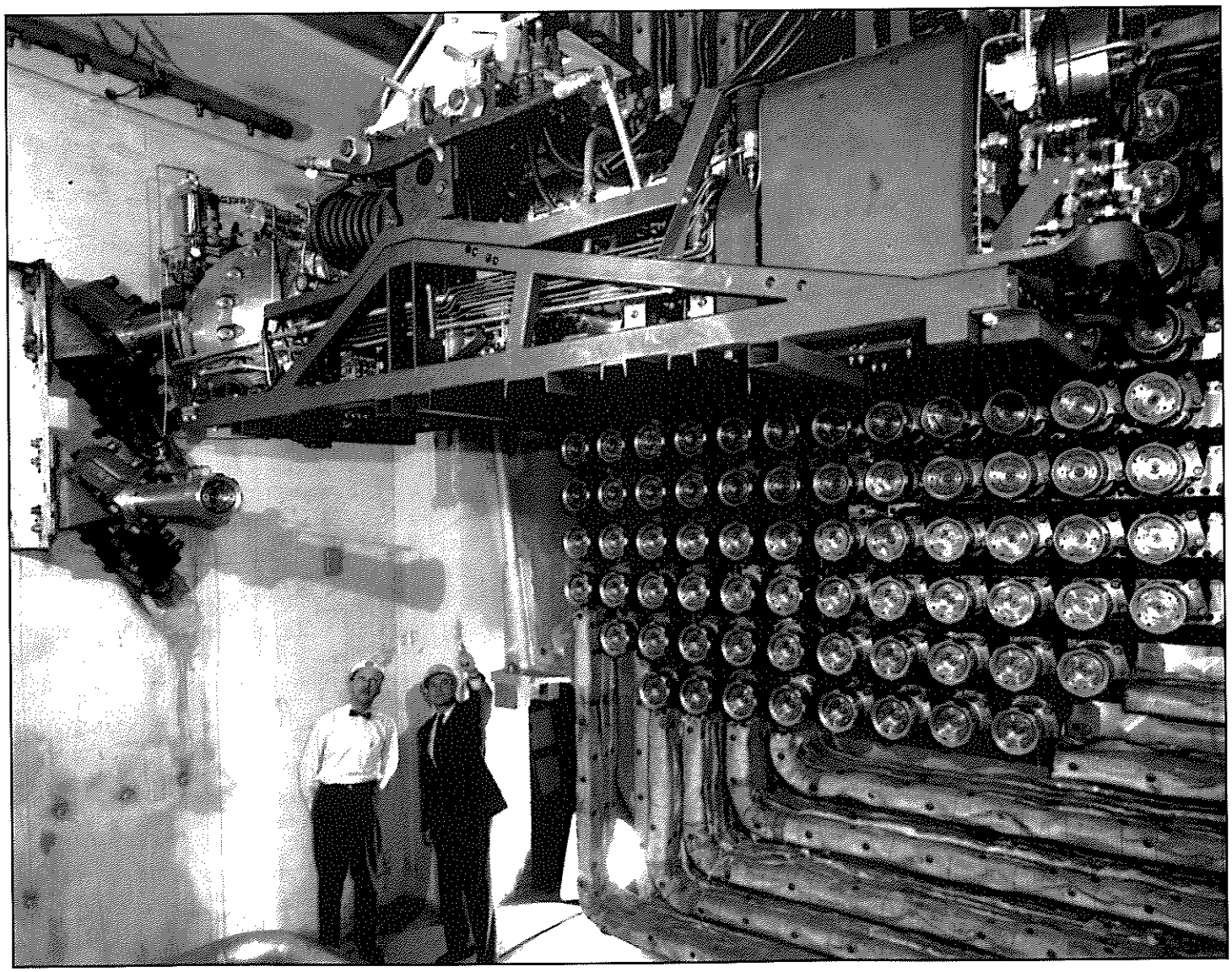
There was heavy water at pressure in the machine body, so why not use it to power hydraulic cylinders to give the desired movements. The required pressures could be produced by a double-ended air-water intensifier pump. This would allow operation at both atmospheric and 1000 psi water pressures using electrically operated valves to direct the heavy water flow to the correct hydraulic cylinder for each operation. This thought, developed over several agonizing weeks, proved to be the breakthrough needed to start on the design proper.

1 Design Specialist, CGE, Management and Professional Dept., Retired.

Don did the design of the supporting structure, which was required to lower the machine into the reactor vault, rotate it ninety degrees, and home in on any of the 132 tube fittings and be flexible enough to follow any movements of the end fitting. This requirement was necessary in case the moderator was dumped while the machine was attached and the calandria lifted due to weight loss.

My next consideration was to select one of three possible types of end fitting seal that would be dependable, a positive seal, not subject to damage, and one the machine could install and remove. The preferred design consisted of a thin round disc, held by a backup plug ring against a narrow face ring on the end fitting. The plug ring was a little smaller in diameter than the end fitting seal face ring so the disc could be forcibly distorted inward and the plug threaded against it. When this distorting force was removed, the disc became a highly self-energised metal to metal seal fitting between two true polished ring faces and the faces of the disc. This allowed repair by repolishing, if any damage occurred. To remove the plug and break the seal, the disc was distorted inward again and the plug removed.

Another place that required prolonged study was the mechanism to guide the machine accurately on to the end fitting, then lock and seal it to the end fitting. The mating surface on the end fitting had a 45 degree internal angle face, and the machine had a 45 degree external angle face. Four sensing fingers, operating microswitches, were spaced 90 degrees apart and extended slightly through the angle face of the machine mating face and could signal the final lineup of the two faces. The axial load on the joint would be about thirty thousand pounds. It was originally intended to use a metal to metal seal here but from my experience with the metal to metal joints on steam turbine case joints, I objected. When I asked if there was anything that would seal, even once, in the high radiation area, I was told that an ordinary "O" ring would do it at least



A 1962 photo of the NPD fuelling machine before start-up.

once. We therefore put a groove for an "O" ring into the machines' angled face.

The most suitable locking mechanism seemed to be the breech block system, which would require eight external lugs and spaces on the end of the reactor end fitting. There needed to be a fixed inner sleeve also which provided the smooth surface for the movement of fuel, seals, etc. We eventually came up with a design which performed as follows. When the machine approached the end fitting, two sleeves were retracted back against the body until it was in its correct position. The inner sleeve would then be rotated, and advance on acme threads between it and the thread on the inside of the outer sleeve that carried the sealing 45 degree machine sealing face. When the inner sleeve reached the end of its travel, the outer sleeve, not being allowed to rotate, with its internal acme threads and breech block lugs, and spaces, had been carried forward by the inner sleeve, to its correct position. At this point, the outer sleeve would be rotated 22 1/2 degrees and the breech block lock made. By rotating the inner sleeve in the opposite direction, everything was tightened up and the necessary seal made prior to the fuelling operation. With these ideas now firmly in place, we were able to proceed with the design drawings.

The indexing magazine was rotated by a modified Geneva Link mechanism, which provided indexing to accommodate the fuel bundles and the plugs, which were of different diameters, as indexing spaces were not all the same. This was accomplished by using cam rollers on the magazine, and spaced to suit the amount of movement required as the drive disc rotated. It derived its power to rotate from a cylinder, which also provided the central support for the magazine, transferring its axial movement to a rotating motion by a rack on the piston rod and bevel gears.

The main body of the machine was to be two stainless steel hollow forgings about thirty inches in diameter and eighteen inches deep. They had a wall thickness of near two inches, and were held together by studs and nuts at the centre joint. It was necessary to alternate the studs axially to get sufficient space to tighten the nuts. My proposal was for a differential threaded ring joint, which would have been cheaper, but this was something they had never seen before and the studs were able to carry the load.

To provide the necessary movements to push fuel out, carry the ram to deflect the sealing disc, and the tool to insert and turn the plug, required a very long cylinder extending out the back of the main body. It also had to be made of non-magnetic stainless steel and on the same centreline as the homing device. To sense movement and position of the various moving parts, strong permanent magnets were attached to them and magnet operated switches were placed on the outside of the cylinder in the required positions and were operated when the appropriate magnet got to the proper position. Another requirement was that of the internals of this cylinder must be removable by remote tooling. This was in case a fuel bundle jammed in the reactor tube and other remote controlled tools were necessary to remove it. The lock unit device consisted of an inner ball bearing race, providing a fixed stop for the parts moving through it, and a split outer race, one half of which was fixed while the other half was moveable on an acme thread, rotated by gear teeth cut in the acme thread and mating with a remotely operated small gear, to allow the balls to move outward, and release the inner race. A special retainer kept the balls from getting out of position and the internal parts could be installed remotely.

By late September 1957, we had sufficient design features on paper that CGE management made a presentation to AECL at Chalk River. When they returned to Peterborough, we were told that AECL were satisfied and to continue with the design work. In mid November, with the final assembly drawing about 80% complete, we were shocked by the AECL decision to increase the length of the fuel bundles to 21 inches from 18 inches. "What are you going to do?" I was asked. I said I would go to the supply cabinet and pull off at least 15 feet of drawing paper and start again. Luckily, we were able to trace quite a lot from the old one.

It was the end of the year when both Don's supporting structure and my machine drawings were ready for display. Early in January 1958, I was part of CGE's team which presented the design to AECL at Chalk River. After the presentation, we were told to proceed with the work and they would let us know their opinion as soon as possible. We asked about the alternative design, which we understood was being done by Canadair, but were only told it was on the shelf. The job was formally given to CGE later in the month.

It was about March 1st that I returned to my previous position. After my return a very appreciative letter was sent by the Atomic Dept. to my superiors for my contribution. I know they would have liked me to stay on, but I was happy to get back to my old position, where our motto was "The difficult we do immediately, the impossible takes longer".

Some further assistance was provided in getting the manufacturing of the machine done in Peterborough, and being go-between the tool room and the Atomic Dept. for manufacturing problems. I never did see the machine in operation but, knowing that it had worked as expected, the experience gained allowed for the design and manufacture of bigger and better machines, and a continuing business for the company.

Before leaving this subject, I would like to express my appreciation of the associates and management of the Atomic Dept. with whom I dealt. Often, when I started work in the morning, John Foster, our chief engineer, would come and sit down with me and by the questions he asked it was clear he had spent much time studying the drawings the evening before. John Foster, Ian MacKay, Bill Lowes, Dick Johnston, Bill Brown, Cy Skinner, Don Medd and many others were always available to provide good council and guidance.

GENERAL news

Cancer studies of miners discontinued

The Saskatchewan Uranium Miners' Cohort Study Group has concluded that it is not scientifically feasible to conduct a study of lung cancer in present and future miners who work in modern Saskatchewan uranium mines (1975 onward).

The Study Group comprises representatives from the Canadian Nuclear Safety Commission, the Government of Saskatchewan, and two mining companies involved in uranium mining in Saskatchewan (Cogema Resources Inc. and Cameco Corporation)

The report, issued during the summer of 2004, noted that today's Saskatchewan uranium miners have radon exposures that are between 100 and 1000 times lower than those of past uranium miners, such as miners from Beaverlodge, because of dose limits, improved mining techniques, and other radiation protection practices. They conclude that any higher-than-normal rates of lung cancer from such workplace exposures would be virtually impossible to measure.

The feasibility study was completed in October 2003 and was subsequently reviewed by three internationally respected radiation researchers.

Based on the conclusions and recommendations of the study and reviewers, the Canadian Nuclear Safety Commission, the Government of Saskatchewan, and the workers and management from the mining companies agreed to continue to carefully monitor the occupational exposures of uranium miners to ensure that they remain at the current low levels. Records of these exposures will be maintained for the indefinite future. However, an ongoing health study of modern Saskatchewan uranium miners will not be conducted.

The report of the Study Group is available from the Canadian Nuclear Safety Commission

CNSC invites comments on draft Guide

The Canadian Nuclear Safety Commission has issued Draft Regulatory Guide G-224 rev. 1 Environmental Monitoring Program at Class I Nuclear Facilities and Uranium Mines and Mills.

The purpose of the proposed guide is to help applicants develop environmental monitoring programs in accordance with the Nuclear Safety Control Act and regulations. Comments are requested by October 15, 2004.

The draft guide can be viewed at the CNSC website <www.nuclearsafety.gc.ca> or a printed copy can be requested.

New engineering services company

Canadian Power Utility Services Limited (CPUS Limited), a design, project management, procurement and engineering services company formed exclusively to support the power industry in Canada, began operation July 2, 2004.

CPUS Limited is jointly owned and operated by Mike Jansen, Derek Mori, and Jordon Chou, together with Kinectrics.

This new organization will have a preferred supplier relationship with CPUS Engineering Staffing Solutions Inc. and a strategic partnering relationship with Kinectrics Inc.

CPUS Engineering Staffing Solutions Inc. is a privately owned Canadian employment staffing agency or manpower services company formed exclusively to provide staffing solutions to the power industry. Kinectrics Inc., formerly the research arm of Ontario Hydro, is a member of the AEA Technology Group.

Although distinct entities, CPUS Limited and Kinectrics Inc. will work together to offer customers integrated solutions encompassing the facilities, specialized scientific and engineering services.

The company is located at 800 Kipling Avenue in Toronto, Ontario and will be operational from July 2, 2004.

Romney Duffey named Fellow of ASME

Dr. Romney Duffey, Principal Scientist with Atomic Energy of Canada Limited, has been named a Fellow of the American Society of Mechanical Engineers (ASME).

As Fellow, Dr. Duffey joins an esteemed group of less than 500 other individuals from the 120,000 members of the ASME around the globe who have achieved the same status. Fellows of ASME are recognized for their significant engineering achievements and contributions to the engineering profession.

In addition to his role at AECL, Dr. Duffey is also an internationally recognized scientist, manager, speaker, and

author, having written more than 200 papers and articles. Dr. Duffey co-authored the book Know the Risk (Butterworth-Heinemann 2002) concerning the safety of modern technological systems, accidents, learning, and the role of human error. An active member of the American and Canadian Nuclear Societies, and past Chair of the American Nuclear Society Thermal-Hydraulics Division, Dr. Duffey is also the current Canadian representative on the Expert Group and leading the Super Critical Water Reactor (SCWR) Steering Committee for Generation IV International Nuclear Forum.

Cameco receives licence for surface work at Cigar Lake

The Canadian Nuclear Safety Commission (CNSC) has announced its decision to issue a Uranium Mine Construction Licence to Cameco Corporation (Cameco) for the construction of specific surface facilities at the Cigar Lake Uranium Mine Project located in northern Saskatchewan. The licence is valid until January 31, 2005.

Cameco applied to the CNSC for approval to construct and modify both the surface and underground facilities at its Cigar Lake Uranium Mine Project in order to bring the mine into commercial operation. In an update to that application, Cameco sought approval to construct certain of the surface facilities at the project site prior to the Commission deciding on Cameco's application for the full construction project. On July 7, 2004, the Commission held the first day of a two-day public hearing on Cameco's application for the full construction licence. The second day of the hearing on the full construction project will be held on November 17, 2004.

Bruce Power achieves high industrial safety rating

Bruce Power has achieved Level 8 on the 10-point International Safety Rating System (ISRS) following an independent audit of its safety management system. James Ebidia of the Industrial Accident Prevention Association who was the lead auditor during Bruce Power's ISRS review praised the company's ongoing commitment to nurturing a strong safety culture.

ISRS is an internationally recognized standard that measures a company's safety systems from one to 10, with Level 10 considered excellent. Bruce Power had sought a Level 5 during its initial audit in 2002, but exceeded its goal by achieving a Level 7.Lightning shuts down Point Lepreau

In July the Point Lepreau Generating Station was shut down for three days after lightning strikes on two 345 kV transmission lines resulted in automatic protection circuits tripping the turbine. The operator then initiated a safe shut down of the reactor.

CAE appoints new CEO

Robert E. Brown was appointed president and chief executive officer of CAE, August 12, 2004.

He was chairman of Air Canada and previously president and CEO of Bombardier. He succeeds Derek Burney who will continue as vice-chairman until his formal retirement on October 31.

Montreal based CAE is the leading manufacturer of simulators for nuclear and other power plants and for aircraft.

50 years with AECL!!

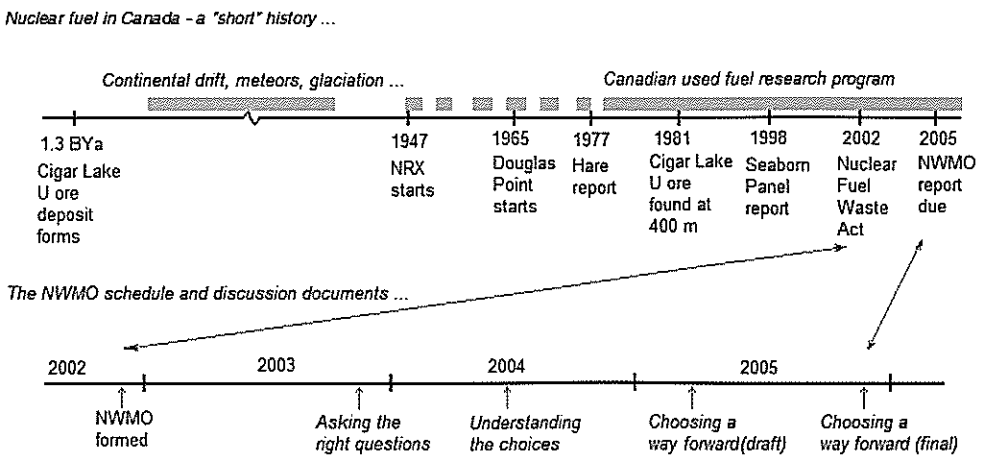
Dr. Don Charlesworth celebrated 50 years of service with Atomic Energy of Canada Limited in June 2004. He is a Senior Chemist in the Decommissioning and Waste Management Division at the Chalk River Laboratories

In 1994, Don received the CNA "Outstanding Contribution Award" in recognition of his outstanding contribution to Canada's nuclear industry in reactor chemistry and waste management. He has been involved in many of CRL's strategic programs, most notably in the area of low-level radioactive waste management.

NWMO seeks input

The Nuclear Waste Management Organisation (NWMO), which was formed in 2002, is presently reviewing the options, which include deep geologic disposal in the Canadian Shield and indefinite storage at either a central site or the reactor sites. The NWMO will recommend a preferred approach in late 2005. The Federal government will then decide.

The NWMO is consulting as widely as practical with all Canadians. Since nuclear professionals have the knowl-



edge the NWMO particularly seeks their views on used fuel management. Have you done so?

The NWMO website (www.nwmo.ca) holds a large number of background documents, and is a forum for people to comment on topics and give their input. They periodically adds surveys to this website related to their discussion documents. These surveys typically take only a few minutes.

Previous NWMO surveys:

www.nwmo.ca/Default.aspx?DN=363,204,21,1,Documents

"Have we described the problem correctly?"

"Have we identified appropriate ways to deal with the problem?"

"Are we asking the right questions?"

Latest NWMO survey: "Is our proposed decision-making process understandable and appropriate?"

www.nwmo.ca/Default.aspx?DN=363,204,21,1,Documents

Some interesting links:

Swedish and Finnish used fuel disposal programs in the FennoScandian Shield: www.skb.se/default_8563.aspx

www.posiva.fi/englanti/index.html

Report on Dialogue issued

On August 26, 2004 the NWMO released the report Responsible Action - Citizens' Dialogue on the Long-term Management of Used Nuclear Fuel, prepared by the Canadian Policy Research Networks (CPRN) based on "dialogues" CPRN held earlier this year on behalf of NWMO.

A representative sample of 462 Canadians took part in dialogues in 12 cities across the country, in both official languages. Citizens from all walks of life gave up a Saturday or Sunday to discuss what principles should guide decisions about used nuclear fuel over the long-term.

"The citizens' dialogues tell us what values Canadians believe should govern our decisions regarding used nuclear fuel." said Judith Maxwell, President of CPRN. Those values are:

- Responsibility - live up to our responsibilities and deal with the problems we create.
- Adaptability - develop and apply new knowledge as it emerges.
- Stewardship - our duty to husband resources and leave a sound legacy to future generations.
- Accountability and Transparency - to rebuild trust.
- Knowledge - a public good for better decisions now and in the future.
- Inclusion - we all have a role to play.

The report is available on the NWMO website.

OPG taking different approach to Pickering I

OPG is taking a different approach to the Pickering A Unit 1 return to service project, incorporating the lessons provided by the earlier Unit 4 return to service project.

When the major construction phase of the Unit 4 return to service project was begun, only 3 per cent of the engineering design change notices were complete. As a result, the assessing and materials procurement were far from complete. This led to the construction schedule being re-established eight times after it was initially issued. These factors, in turn, caused the budget for the project to escalate.

OPG states that these planning failures have not been repeated in the Unit 1 project. All the required preparatory and planning work for the initial months of the major construction phase is completed.

The project scope has been finalized for some time. All design engineering for Unit 1 is complete. As of June 1, all of the work that is on the schedule for the first four months had been assessed. The remaining assessment work for the project is targeted to be complete by October 1. More than 90 per cent of all materials necessary for the first three months of major construction are at the station, including all the long-lead-time materials. These materials have been assembled in work execution kits.

The budget is the cumulative result of all of the above stages of the project. A budget of $900 million, including a contingency reserve, has been established for the Unit 1 project.

The following is a list of the scheduled target dates for the major milestones of the project:

Major Milestone	Date
All the planning and assessment for the entire project complete	October 15, 2004
All materials through to the end of the project have been placed into field execution kits, and all long-lead items are either on site or scheduled	December 1, 2004
Major construction on Unit 1 project is 50% complete - examples of completed projects include: low pressure service water header available; high pressure service water headers also in service	January 15, 2005
Major construction on Unit 1 project is 75% complete - examples of completed projects include: the two digital control computers for Unit 1 will have been installed; and the two new moderator heat exchangers will have been installed	March 15, 2005
The Guaranteed Shutdown State is removed and commissioning of Unit 1 begins	June 1, 2005
Unit 1 is returned to commercial service	September 1, 2005

Obituaries

William Frederick (Bill) Baldwin

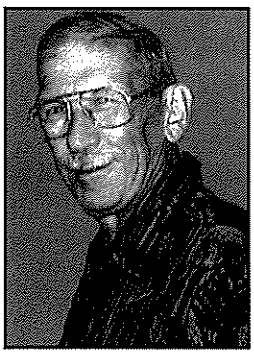
Dr. W. F. Baldwin, a research scientist in the Biology Branch at the Chalk River Laboratories of Atomic Energy of Canada Limited from 1954 to 1975 died in Ottawa on July 26 in his 91st year.

After obtaining an undergraduate degree from the Ontario Agricultural College and a Master's degree from the University of Western Ontario he served as an officer in the Canadian Army during World War II. Following the war, he was employed as a research scientist at the Entomological Laboratory in Belleville and pursued graduate studies at the University of Toronto receiving his Ph.D. in 1954.

He then joined the Biology Branch at the Chalk River Laboratories where he conducted basic and applied research on the effects of radiation on insects. He was particularly interested in radiation-induced mutations and the influence of dose rate on radiation injury. A practical application of this basic was in the use of the "sterile male technique", where male insects, sterilized by radiation, are released into the wild population in an attempt to reduce reproductive success and thereby reduce the numbers of undesirable insects. At various times Dr. Baldwin was seconded to United Nations agencies to use his expertise in the control of insect populations. He was president of the Canadian Entomological Society in 1970-1971.

Peter Barry, a colleague at the Biology Branch, remembers Bill's sense of fun and his great laugh that could be heard down the corridors.

A private family service was held at St. Thomas' Anglican Church in Belleville on Wednesday, July 28, 2004



John Ingolfsrud

(The following tribute to John Ingolfsrud was prepared by George Pon, a colleague and a former vice-president of Atomic Energy of Canada Limited.)

John passed away on June 11, 2004 in his 77th year.

He received engineering degrees from Queens and MIT. After graduation he joined the Foundation Company of Canada. This company had a vision of nuclear electric generation in Canada and sent John to the UK Atomic Energy Authority's Reactor School at Harwell. This was the beginning of a four-decade career in nuclear engineering.

On returning to Canada from Harwell John was assigned to Chalk River to help design the NRU Research Reactor which was Lo become the world's most powerful research reactor of its time. From Chalk River John joined the newly formed Nuclear Power Plant Division of AECL in 1958- He was to participate in the engineering of the Douglas Point Reactor and the two CANDU reactors in India. He played a leading role in engineering the eight reactors at Pickering, the eight reactors at Bruce, the four reactors at Darlington, the reactors in Argentina, Korea, and Romania.

He knew how to listen, when to consult and when to take effective action. He was able to separate reality from ideals. As a leader he knew he could not take everything over and he also knew he could not turn everything over. He knew how to effectively delegate. In business good managers are rare and highly prized. John was one of the best. His career spanned the nuclear power industry from its infancy to its maturity. His last position with AECL was Vice President of Engineering.

John had many interests centred on Canadiana, Canadian art, antiques, culture, and history. He supervised the restoration and enlargement of his country home in Elgin County with the same addiction to perfection as he demonstrated with his nuclear engineering. He was proud of his renovated home as he should be - it was his castle, his kingdom.

In his last years John was beset with health problems. He was a walking infirmary but faced life with tremendous grace and quiet strength. Even though he was ill John's generous personality and loyalty to friends inspired him to periodically visit with Gord Brooks who was withering away with Lou Gehrig's disease.

John went gracefully and peacefully. He had a noble heart. He left us with noble memories. His legacy is the indomitability of the human spirit - never losing sight of what tomorrow had to offer.

Colin Graeme Lennox

Colin Lennox, an early pioneer of computer control for CANDU reactors, died in early June 2004, in Victoria, B.C.

Colin studied at the Imperial College, London and joined Atomic Energy of Canada Limited at the Chalk River Laboratories in 1954 where he worked with Al Pearson on the control system for NRU. Subsequently they began to explore the use of computers for reactor control using POP computers from Digital Equipment Corporation. This pioneering work led to the computer control of CANDU power plants, a first in the world.

Colin moved to AECL's Whiteshell Laboratory in 1964, where he was in charge of control and instrumentation. In 1970 he left AECL to join McDonald Detweiler Associates in Vancouver. In 1978 he came back to AECL, joining Bob Hart at the AECL Research Company Head Office as General Manager of Business Development. Under his direction several small companies were successfully spun off from the Research Company.

In 1991 he moved to Victoria as a representative of the B.C. Advanced Systems Institute. He became active with the Vancouver Island Advanced Technology Centre.

A private funeral service was held in Victoria in June and a memorial celebration in August.

CNS news

Meet the President

The 25th president of the Canadian Nuclear Society comes from a different background than that of most of his predecessors who have been primarily from the realms of reactor design or analysis or academia. **William (Bill) Schneider** has spent most of his career working on that most important "balance of plant" component, steam generators.

A native of southwestern Ontario, Bill was one of just 80 students in the first engineering class at the University of Waterloo in 1957 who attended class in two prefab buildings on the campus of the them Waterloo College. Following graduation he worked for three years at the aircraft engine maker, Orenda, a subsidiary of Hawker Siddley, located at Malton, Ontario. At the same time he pursued graduate studies at McMaster University, earning an M. Eng. in 1965. Then he joined Babcock & Wilcox Canada, in Cambridge, where he has spent the last 37 years in nuclear equipment engineering and development.

His first job was associated with the design of the steam generators for the Bruce A plant. Since then he has been involved with 263 steam generators including those for most CANDU plants and 40 replacement steam generators for PWR plants in the USA. His current position is Manager of Nuclear Technology and Steam Generator Services.

In 2001 Bill was honoured as a recipient of Babcock & Wilcox (international) Engineering Honours Award, given to outstanding engineers who have made significant contributions to the development of the company's products and services.

Bill has been active with the CNS for many years, initially as chairman of the Design and Materials Division, subsequently as chairman of the Program Committee and then, in 2002, elected as 2nd vice-president. In those roles he has been involved with many courses and conferences and initiated the CANDU Chemistry course that has been given at B & W Canada over the past three years.

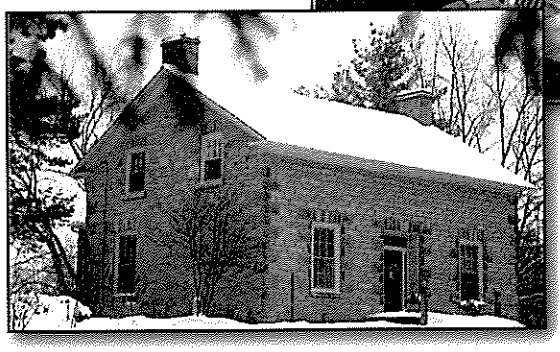
Bill is particularly proud of his family and their 150-year-old heritage house. Wife Lynda has her own graphics arts business. Son Michael, also a CNS member, is president of a new small company, Invaritar Data Centre Inc., which analyses test results of eddy current examinations performed on equipment for CANDU and other nuclear plants. His elder daughter Jayne is in magazine and event advertising in Toronto and younger daughter Lesli is now also in Toronto with an insurance company.

Their stone farmhouse was built in 1855 by an early settler of the area, Angus MacIntosh, and is now registered as a Heritage House. The surrounding land became the town of Galt and then was merged into the City of Cambridge.

See Bill's vision for the CNS in his address to the AGM in this issue.

Above: Bill Schneider addresses the 25th CNS Annual Conference.

The Schneider family - L to R. Jayne, William, Michael, Michael's daughter Hope, Lynda and Leslie.



The Schneider 1855 heritage stone farm house.

Annual General Meeting

The Seventh Annual General Meeting of the CNS Inc. was held June 7, 2004 at the Toronto Marriott Eaton Centre following the first day of the 25th CNS Annual Conference. Eighty members were recorded as attending.

President Jeremy Whitlock called the meeting to order at 5:15 p.m. The minutes of the 6th AGM were approved. He introduced the Council Executive and presented his report summarizing the activities of the past year, including the very successful CANDU Maintenance Conference, the CANDU Fuel Conference, and the participation of the CNS in the International Youth Nuclear Congress held in Toronto in May. His report is included separately in this issue.

Treasurer Ed Hinchley presented the Financial Report and the Auditor's report for the fiscal year ending December 31, 2003. He noted that a surplus of $54k was reported compared to a planned deficit of $15k due to the contributions from the successful Conferences and Courses. These reports were approved.

Due to the recent death of the long-serving auditor David Rogers, a motion was passed authorizing the Council Executive Committee to select a new auditor and negotiate the audit fee.

The reports from the Committees of Council followed. Murray Elston, the new President and CEO of the Canadian Nuclear Association was introduced. In his address to the meeting, he reported that his plans include a more coordinated effort to deliver broadly a positive message from the Canadian Nuclear Industry.

Ben Rouben, chair of the Membership Committee reported that membership exceeded 900 as of that date. (His most recent report is that there are now 949 members in good standing, with an annual rate of lapsing members of about 10%.)

Eric Williams, chair of the Branch Committee introduced the Branch Executive members attending:

Branch	Representative
Bruce	E. Williams
Golden Horseshoe	Dave Jackson
New Brunswick	Bryan Patterson
Québec	Michel Rhéaume
Toronto	Robert Hemmings
Saskatchewan	Bob MacLeod
Sheridan Park	Adriaan Buijs

Eric presented a summary of the Branch activities and noted that the Officers' Seminar is planned for August 26-27 in Cambridge.

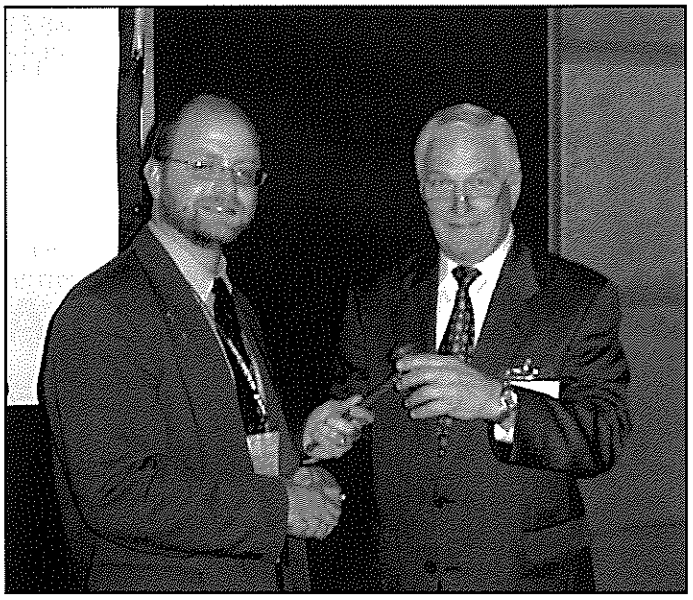
Bill Schneider, chair of the Program Committee began the presentation of the Division reports. The members were apprised of the upcoming 6th International Simulation Conference (Montreal, October 2004), the National Conference on Radioactive Waste Management, Decommissioning and Environmental Restoration (Ottawa, May 2005), and the next CANDU Maintenance Conference that is planned for the fall of 2005.

Election and Installation of the New Council

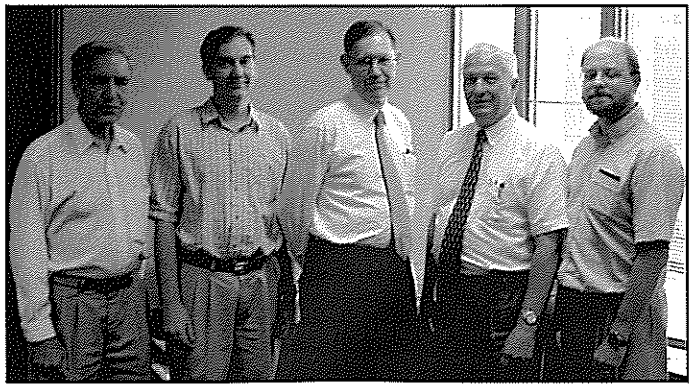
Past President Ian Wilson presented the slate of nominees for CNS Council and called for nominations from the floor. The slate was elected by acclamation

The outgoing President, Jeremy Whitlock presented the gavel to the incoming President, Bill Schneider. Bill Schneider presented a plaque to Jeremy Whitlock in recognition of his leadership and energy in his successful term as 23rd President.

Incoming Bill Schneider addressed the meeting. His report is included separately in this issue.



Outgoing president Jeremy Whitlock hands the symbolic gavel to 2004-2005 president Bill Schneider.



2004-2005 CNS executive: L to R: Ed Hinchley, Adriaan Buijs, John Luxat, Bill Schneider, Jeremy Whitlock. Missing: Walter Thompson.

CNS Council for 2004-2005

Executive Committee:

W.G. (Bill) Schneider	Babcock & Wilcox	President
J.W. (Walter) Thompson	Nuclear Safety Solutions	First Vice-President
J.C. (John) Luxat	McMaster University	Second Vice-President
A. (Adriaan) Buijs	AECL	Secretary
E.M. (Ed) Hinchley	Formerly AECL	Treasurer
J.J. (Jeremy) Whitlock	AECL	Past President

Council Members-at-Large:

1.	J.M. (Jerry) Cuttler	Cuttler & Associates, Inc.	11.	D.A. (Dan) Meneley	Formerly AECL, etc.
2.	M. (Mike) Gabbani	GEC Nuclear	12.	K.K. (Kris) Mohan	Formerly AECL
3.	J. (Jim) Harvie	Formerly CNSC	13.	E.M. (Dorin) Nichita	UOIT (formerly AECL)
4.	R.L. (Bob) Hemmings	Canatom NPM Inc.	14.	J. (Jad) Popovic	AECL
5.	D.P. (Dave) Jackson	McMaster University	15.	M.R. (Michel) Rhéaume	Hydro-Québec
6.	V.S. (Krish Krishnan)	AECL	16.	R. (Roman) Sejnoha	Formerly AECL
7.	P.S. (Prabhu) Kundurpi	Formerly OPG	17.	K.L. (Ken) Smith	UNECAN
8.	S.Y. (Andrew) Lee	Formerly OPG	18.	B.F. (Bryan) White	Formerly AECL
9.	M. (Marc) Léger	AECL	19.	E.L. (Eric) Williams	Bruce Power
10.	D.G. (David) Malcolm	Mid Canada Research Institute			

Ex-officio Members of Council:

M.J. (Murray) Elston — President and CEO, Canadian Nuclear Association

All Division, Committee, and Branch Chairs who are not elected as Members-at-Large

President's Report to Annual General Meeting

It has been both a pleasure and a learning experience to serve as your 23rd President during these past 12 months, the final year of the Canadian Nuclear Society's first quarter-century. It was the vision of the CNS' founders – including my next-door neighbour and your first President, the late George Howey – to create a distinctly Canadian learned society in the fields of nuclear science and engineering. The CNS was thus born on June 11, 1979, in the wake of Three Mile Island (two and a half months earlier). That time marks in many ways the "end of innocence" for the world's nuclear industries: Aging issues were starting to demand more and more resources of the R&D community, anti-nuclear sentiment moved to the forefront of social activism, and orders for new reactors tailed off. At the same time, the maturing of the industry, through the catalyst of Three Mile Island, brought forth a renewed commitment to communication within the professions of reactor safety and operation. The CNS was thus formed at precisely the moment when its mandate had become more relevant than ever.

The twenty-five years since then have seen major changes in the face, style, size, perception, operation, regulation, and governance of the nuclear industry – and also of the CNS. We are on the brink of a new era of growth in the industry, and never have the issues of professional and public communication been more critical, and the contributions of the CNS more necessary.

The past year was a very successful one for the CNS, attributable without question to the efforts and dedication of a core group of CNS volunteers. We were assisted also by many other individuals in the nuclear community, and we received, as always, generous support and sponsorship from the nuclear industry.

On this note, I cannot end my year as CNS President without acknowledging the unflagging support of my employer, AECL, and that of my line managers, over the last three years and in my upcoming final year on the CNS Executive. Their backing has been a model of the kind of industry partnership that enables young and otherwise fresh-faced employees to take on leadership roles in support organizations like the CNS.

Let's look at some of the highlights of the past year:

- We came off an excellent annual conference in June of 2003 and shortly thereafter produced two excellent topical conferences on CANDU Fuel (September 2003) and CANDU Maintenance (November 2003), for which we are grateful for the dedicated effort of CNS and industry volunteers, and our many sponsors.

- We continued to provide a useful service in the running of topical courses; namely, two Reactor Safety Courses run in September 2003 and June 2004.
- As the financial report will demonstrate we ended the 2003 fiscal year in a significantly positive financial position, largely due to the success of the CANDU Maintenance Conference. This enables the continuing support of CNS programs in years like the current one with significant projected deficits.
- We were a major supporter of the very successful 3rd International Youth Nuclear Congress in Toronto in May, bringing together over 260 young professionals, students, and "established" members of the worldwide industry to discuss common issues. Almost 80 students were registered, including 30 from Canada.
- Our support and participation enabled a successful Teachers' Workshop on the Science of Radiation at McMaster in April 2004.
- We held positive discussions on collaboration with the science teams at both the Ontario Science Centre in Toronto and the Canadian Museum of Science and Technology in Ottawa; initiatives with both institutions are under development.
- Our public profile was enhanced by having several items published in the print media and on CBC radio, including an interview on CBC radio's "The House" in October 2003, featuring a debate with the Sierra Club by your President. An ad in a recent issue of Ottawa Life Magazine, with regional circulation in the Globe and Mail and 500 newsstands in the Ottawa area is possibly the cause of simultaneous increased interest in our website. Ottawa Life Magazine is also distributed to MPs, Senators, provincial and territory assembly members, 3300 national organizations and lobbyists, 1800 Board-of-Trade member companies in the Ottawa area, and 120 embassies.
- As President I was pleased to be able to visit 10 of our 12 branches, hearing local views and seeing the facilities, institutions and companies that form our nuclear community. Included was an address to over 100 first-year nuclear engineering students at the UOIT in Oshawa, many of whom are now student members of the CNS.
- CNS membership has increased steadily, with 10% growth over this time last year.
- We signed several new cooperation agreements with nuclear societies around the world, renewed a great number of other agreements, and now have 19 active agreements in place.
- We continued to lend our support to organizations representing the professional development of important demographic sectors of the nuclear community, such as the Young Generation Network and Women in Nuclear – both having some involvement in this conference.

There is much more that we can do as a Society, but we run on People Power and our fuel is you. Ask not what your Society can do for you, but jump on board and take it in a direction it hasn't gone yet. Take part in activities at the branch level that reach out to the public, or encourage communication within the local technical community.

I hope that I leave the Society's helm pointed towards greater relevance, public profile, and member participation. I hope that we can carve a niche for ourselves in the area of nuclear education and communication, as the voice of the individuals behind the science and technology. We can play an important role in encouraging studies in this area, from scholarships and essay contests at the branch level, to Teachers' Courses, Science Journalism workshops, science curriculum assistance, and partnerships with the country's leading science and technology museums.

Twenty-five years from now I hope to be invited back as a past President of one of the country's most important organizations for the advancement of science and technology. Failing the discovery of a radically new and much more efficient, non-nuclear source of energy, that brass ring is ours to grasp.

Jeremy Whitlock
CNS President, 2003-2004

Incoming President's Address

W.G. (Bill) Schneider
June 7, 2004

Being elected as President CNS 2004 to 2005 is an honour – it may also be a lot of work. The CNS is an organization with a large number of programs and a large and earnest membership of people with vast experience and keen interest in intensely managing all of these programs down to the last detail. In the next year, I want to initiate some changes in the way the CNS is administered to take advantage of that and let the energies of the Council and the Executive focus on some new initiatives that I believe are very important to enhancing the value and relevance of CNS particularly to plant operations which, after all, is the main area of activity in our industry at this point.

In the area of administration - I want to have a structure where a very small number of administrators are provided with terms of reference by council and where they proceed to do whatever is necessary to manage their respective areas. Two new positions reporting to the Executive have been proposed: Executive Administrator, and Financial Administrator. The terms of reference for these two positions will call upon them to manage all the issues, documentation and actions as appropriate to the orderly execution of their responsibilities, to resolve all issues, and to execute all actions that relate

to that. For issues beyond their terms of reference, the administrators shall research the issue and put the question before the Executive for direction; and likewise, if it is beyond the scope of the Executive then it will be forwarded by the Executive to Council or even to the AGM as appropriate. Also, their responsibilities as administrators are to include all the planning, tracking and reporting that goes with executing their duties.

The objective here is to have all things that can be handled by the administrators under their terms of reference handled by them – there is no need to spend time in Council arguing over the details of insurance policies or other specific matters for which council members may have opinions, but little knowledge or expertise. Council needs to focus on its direction and new initiatives; to do that it needs to be kept clear of delegable administrative issues.

I am happy to report that, subject to approval of the new Council, two exceedingly well qualified and energetic individuals, have been selected for these positions.

These positions are in addition to the other existing positions reporting to the Executive/Council. The list of such positions will be; Executive Administrator, Financial Administrator, Bulletin Editor, Assistant Bulletin Editor, CNS Webmaster and CNS Office Manager

In addition to this administrative team, we also already have a similar small team serving as the Communication Advisory Committee. This team of three people is expected to be current on communication, public interface, and media issues; and to track such issues and take action as appropriate based on pre-existing terms of reference from Council. The terms of reference would delineate under what conditions the CAC would reply in an immediate situation and under what more sensitive conditions they would seek special approval and support from Council. In pursuing their activities in the volatile area of communications they would be expected to maintain a close relationship of Council so as to maintain its confidence.

The major initiative - for the next year or years is finding some means of enhancing the relevance, value and usefulness of CNS to operating plants. As evidence of this condition I have heard the rhetorical question asked in Council many times as to why there doesn't seem to be more interest in CNS from that quarter.

The CNS is a fine organization of people intensely interested in and supportive of CANDU technology. However, as I have said at times, it sometimes appears that the horizon of CNS interest extends only to the end of the pressure tubes – and – only to the end of design. This comment does not apply to the plenary sessions of this conference. It certainly does not apply to any aspect of the CNS CANDU Maintenance Conference or to the recently introduced course on the Chemistry of Preservation and Degradation; but it seems to apply to a lot of other areas.

If you were involved in plant operations, you would hope that all aspects of reactor core design had been dealt with long ago; you would hope that all credible safety scenarios had been identified and dealt with. If you heard of any new developments in that area, you would imagine that there was an oversight in the previous design work and that you may get to realize your worst fear - someone showing up with yet another complicated patch to add to your already complex plant to deal with some scenario previously un-addressed.

As an operator what you are primarily concerned with is keeping the plant in good condition, fully compliant with all of the reliability needs and regulatory requirements and generating reliable electricity. To achieve that, you want to be supported by maintenance and inspection programs that are reasonable in scope, short in duration and of no greater complexity than necessary.

So what may CNS do that would be of interest to people in operations? In my mind they need a variety of things. To start with, people at the more junior levels need familiarity with the equipment they're dealing with. True, a plant engineer can go out at any time and look at the actual equipment - but all they will see is a lot of insulation; there will be no hint as to what the people who set up the plant architecture, designed the equipment or built it had in mind in the way of its function.

Having gotten some insight into these arcane functional and performance aspects, the next big area of interest is the care and feeding of the equipment and particularly any degradation it may be subject to. Degradation may involve a variety of conditions including; corrosion, fatigue, wear, etc. and it will clearly be a major preoccupation of the responsible systems and equipment engineers at a plant.

So what to do? The CNS can organize a number of courses, workshops and conferences which expand our involvement in these areas – and has done so in past. These need to be designed to provide a multi-disciplinary bridging so as to get at the real subject of interest rather than being a focused repeat of some particular science. We can not - and should not - model our activities on classical course work as performed by universities; nor, should we get into any areas already covered by the existing training programs at the plants. These very large programs meet large and ongoing needs – we need to concentrate on cross-over technologies.

Let me use the CNS Chemistry Course as an example of what I think we need to be doing here. Mention the "C" word and people's faces cloud over immediately – they would say, "I thought I finished with all that when I left school and slammed the book for the last time". In fact the chemistry course provides an enlightening perspective on the whole area of degradation and preservation of process equipment; as well as an overview of plant process systems, a brief chemistry refresher and a look at the major primary, secondary and cooling water systems. The course has a segment to review what happens to real systems when operated by real people.

After the course, people will certainly not be expert chemists. They will have some insight into the systems they are dealing with and the nature of the degradation which they have to try to track and correct. They will certainly know who to contact within their own organization or within the

community of international experts – of which their lecturers were all eminent examples.

As part of the program of doing this, I want to try to establish a communication mechanism between executive level operations people and the CNS in order - to discuss what they see as their needs - and any areas of opportunity for CNS. This will also be a mechanism for us to get out our message as to our initiatives and programs to our ultimate clients at the working levels. This program has been variously referred to as an advisory; or executive champion; or mentor program – regardless, - I believe it will do a lot for us all.

I visualize the program as follows; i) a very small group of senior people with technical / operations responsibility who are asked to be part of the executive champion (EC) group; ii) a similar CNS group – mostly CNS Executive – is formed as a counter-part.

The objectives are;

- To receive input and recommendations from the EC side as to their needs and interests re future CNS program i.e. courses, workshops, conferences.
- To establish a path of communication with training departments to optimize coverage without conflict or duplication.
- To have a mechanism for encouraging people at working levels to take advantage of such program.
- To have an executive level single point contact for any issues that need to be resolved with the respective organizations.

These two groups would meet infrequently – perhaps once per year and possibly at the CNS Annual Conference. Otherwise, communication would be by mail and primarily e-mail. The intent is a program that will achieve some important objectives, but with the minimum demand of time from busy executives – who are already major CNS supporters in terms of input, inspiration and funding – including their presentations at conferences like this one, and sponsorship support.

I close at last. I'm sure you all want to be intensely involved in making these interesting new challenges happen – I encourage you to do so and I thank you in advance for all of your efforts in that regard.

Nominations for the Engineering Institute of Canada Awards

The Canadian Nuclear Society is a member of the Engineering Institute of Canada, (EIC). The EIC each year accepts nominations from its constituent societies for the seven categories of awards that it administers. To be eligible for an award, a nominee must be a current member of one of the constituent societies.

The Honours and Awards Committee of the CNS has been given responsibility by the CNS Council for coordinating and approving any nominations from CNS members to the EIC Honours and Awards and Fellowship Committee. The chair or designate of the CNS H&A participates in the selection process.

The seven EIC awards and a brief comment on the criterion for each are as follows.

1 **Sir John Kennedy Medal.**
This is the premier award of the EIC and is presented for outstanding service to the engineering profession or noteworthy contributions to the science of engineering. The award is made every two years.

2 **Julian C. Smith Medal.**
This award is made for "achievements in the development of Canada".

3 **K.Y. Lo Medal**
This medal recognizes achievements in engineering internationally.

4 **John B. Stirling Medal**
Awarded for service at the national level of the EIC.

5 **CPR Engineering Medal**
This medal recognizes service at the regional, branch or local level.

6 **Honorary Members of the EIC.**
This category recognizes the achievements of non-members of the EIC in the engineering or related fields.

7 **Fellowships of the EIC**
This award recognizes excellence in the practice of engineering and services to the profession and to society.

Further details are available on the EIC website.
The CNS H&A Committee will be pleased to advise CNS members of the procedure for making a nomination. Such nominations need to be completed for submission by the end of October.

E. G. Price, Chair, CNS/CNA H&A Committee.

University of Ontario Institute of Technology

Following a recent visit by then CNS President Jeremy Whitlock to the UOIT, the CNS received a number of new applications for Student Membership. Dr. George Bereznai, Professor and Dean of the School of Energy Engineering & Nuclear Science has indicated interest in developing a "Durham Branch" of the CNS. Jacques Plourde has been working to develop the Darlington Branch with limited success. Hopefully this new initiative will bring improved services to the CNS members in this area.

With the continued development of the undergraduate program at UOIT, two CNS members have joined the faculty: Dr. Parviz Gulshani and Dr. E. (Dorin) Nichita both formerly at AECL Sheridan Park. Parviz will be instructing fluid dynamics, thermodynamics and heat transfer course. Dorin will be teaching reactor physics as two separate semester-long courses: Reactor Statics (which includes some basic nuclear physics), and Reactor Dynamics.

Nuclear Science and Engineering Division

The CNS is organizing its Sixth International Conference on Simulation Methods in Nuclear Engineering, to be held in Montréal, Québec, October 12-15. Information on the Course and a registration form are available on the CNS website.The scope of the Conference covers all aspects of nuclear modelling and simulation, including, but not limited to:

- Reactor Physics
- Thermalhydraulics
- Safety Analysis
- Fuel and Fuel Channels
- Computer Codes and Modelling.

For further information, contact the Technical Program Chair, Professeur Jean Koclas, Directeur, Institut de Génie Nucléaire, Ecole Polytechnique de Montréal.

The Nuclear Science & Engineering Division of the CNS is organizing a CANDUReactor Safety Course, to be held at the Best Western Governor's Inn,Kincardine, Ontario, 2004 October 25-27. The course Registration Form and-Preliminary Program are available on the "Conferences and Courses" page on the CNSWebsite: www.cns-snc.ca.

Fuel Technologies Division

The Fuel Technologies Division of the CNS is organizing a CANDU Fuel Technology Course, to be held at the Holiday Inn Mississauga, Ontario, October 18-20. Information on the Course and a registration form are available on the CNS website.

The aim of this course is to provide an understanding of CANDU fuel design, performance and operation, and how the fuel interacts with the interfacing systems. The course will be of interest to fuel designers, manufacturers, station operations staff, fuel channel and fuel handling system designers, safety analysts, and inspection staff.

For further information, contact:

- Joseph Lau, Manager, Fuel Products, Atomic Energy of Canada Ltd.,Tel: (905) 823-9040 x 4531, email: lauj@aecl.ca; or
- Erl Køhn, Senior Technical Expert, Fuel Design, Nuclear Safety Solutions Ltd. Tel: (416) 592-4603, email: erl.ko . hn@nuclearsafetysolutions.com

Environment and Waste Management Division

The Environment and Waste Management Division of the CNS is organizing a National Conference on Waste Management, Decommissioning and Environmental Restoration for Canadian nuclear facilities to be held at the Crown Plaza Hotel in Ottawa, Ontario on 2005 May 8-11. Information on the conference and a call for papers are available on the CNS website.For further information, contact the Conference Chair Michael Stephens, Quality Assurance Manager for the Decommissioning & Waste Management Unit of AECL,

Tel: (613) 584-8811, email: stephensm@aecl.ca.

CNS 25th Anniversary

In celebration of the 25th anniversary of the Society, a CNS mousepad will be provided to every member in good standing. Please find yours enclosed with this copy of the Bulletin.

« 25ième anniversaire de la SNC »

En célébration du 25ième anniversaire de notre Société, un tapis de souris SNC sera offert à chaque membre en bonne et due forme. Veuillez trouver le vôtre joint à cette copie du Bulletin.

Preferred Corporate Rate for CNS Members at Quality Hotel Downtown Toronto

The CNS has arranged for a special rate for its members at the Quality Hotel in downtown Toronto. This hotel is located at 111 Lombard St., just West of Jarvis St. The

Canberra Co.

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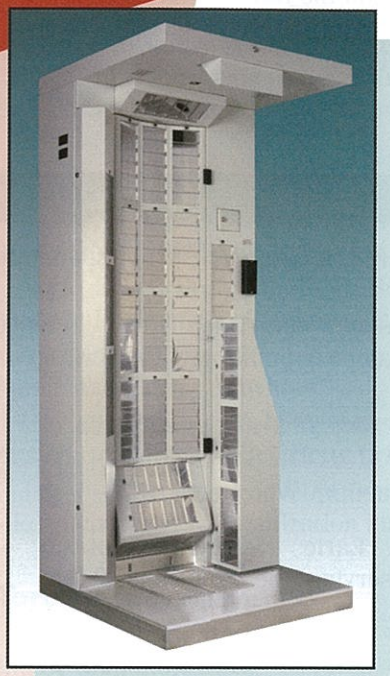
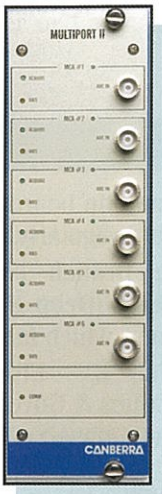
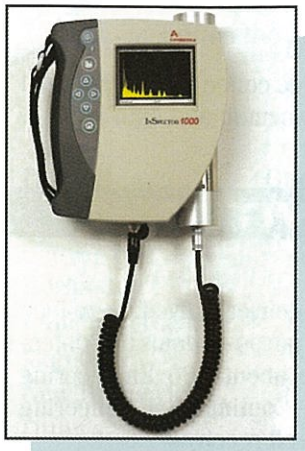


Argos Series
Whole Body Monitors

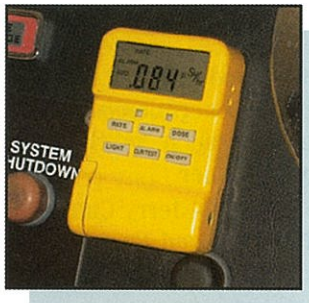


MULTIPORT II
Multi-Input MCA

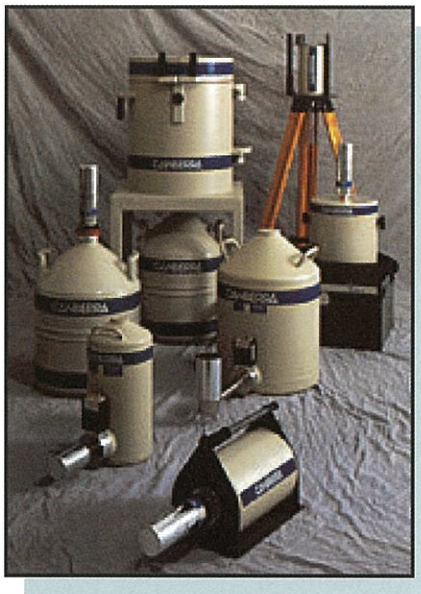


InSpector 1000
Hand-held integrated spectrometer
- Survey Meter
- Dosimeter
- MCA

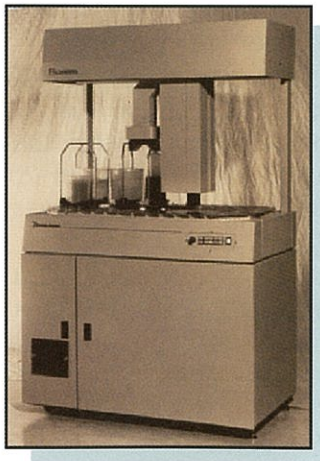
Solo
Mobile Alpha/Beta Counting System



Mini-Radiac
for first responders



Germanium Detectors and Accessories



Gamma Analyst
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Canberra is an AREVA company, the world leader in nuclear power and components.

Hotel offers 196 recently renovated rooms.

CNS members in good standing are eligible for the following room rates per night (single or double) at the Quality Hotel downtown, on a space-available basis:

- Standard room, single or double $100
- Business room, single or double $110

Note also:

- Continental breakfast is included
- Free amenities in the room include coffee maker, iron and ironing board, color cable TV, voicemail and data jacks
- The Hotel also features a Fitness Room
- Business rooms features free unlimited internet access and upgraded amenities
- Parking is an additional $15 for 24 hours, with in/out privileges
- Frequent-Traveller guests can join the Choice Club Plus Card Program loyalty program.

To place a reservation, call the Hotel directly at 416-367-5555, or send an e-mail to whg4104sc@whg.com, and mention Account Number 104837.

BRANCH ACTIVITIES

Bruce *Eric Williams*

The Branch Chairperson recently delivered five face to face information sessions on the CNS, its purpose, goals and objectives, and membership benefits to about 180 Engineering Staff at Bruce Power during the Continuing Engineering Training days. The sessions were well received.

June 29 – Brent Williams presented a summary of his experiences at the International Youth Nuclear Congress 2004, and explored the interest of starting a North American Young Generation Nuclear (NAYGN) branch at the Bruce. A Bruce Branch NAYGN kick off meeting is planned for later this summer.

July 21 – Jerry Cuttler, Cuttler and Associates, spoke on "CANDU Used Fuel. Is it really waste?" Jerry's last visit was 11 September 2001.

August 31 – George Bereznai, Dean and Professor, University of Ontario Institute of Technology, will share the details on the "UOIT Innovations With Energy Engineering and Nuclear Science Programs.

Chalk River *Morgan Brown*

2004 May 20 – Mark Porringa spoke on "Low Energy Induced Nuclear Fusion via Coherence of the Quantum Vacuum, Zero-Point Energy through Ultra Close Range Casimir Effects", on May 20 2004. His presentation is available on the branch web page under "Past Events".

Blair Bromley headed up a successful essay-writing contest "The Beneficial Applications of Nuclear Science & Technology" for Renfrew County high schools. The essays were ranked by Blair, Morgan Brown and Michael Stephens. The winners and parents were invited to dinner, and received their prizes at the beginning of the meeting on May 20, 2004 (above).

The Branch again sponsored the Mathematics Awards at the June, 2004 graduation ceremonies at Mackenzie High School (Deep River).

The Chalk River Branch maintains CNS bulletin boards -- one in a high-visibility area in AECL's cafeteria at the Chalk River Laboratory and a second one, newly installed in the lobby of the J.L. Gray Engineering Centre in Deep River. The bulletin boards feature CNS and nuclear news, and are updated regularly.

The Branch co-sponsored the Deep River Science Academy (Deep River Campus) public lecture series this summer, which included:

July 8 – Elizabeth 'Betsy' McGregor: "Science, Ethics & Governance.
Who Risks? Who Benefits? Who Decides?"

July 15 – Davis Earle (Sudbury Neutrino Observatory): "Observing the Sun from 2 km Underground".

July 22 – Richard Cassidy: "Missing Links in Scientific Knowledge: Historical, Philosophical, and Sociological Aspects of Science."

Golden Horseshoe *David Jackson*

At AGM07, David Jackson reported that principal activity of the Golden Horseshoe Branch is the Annual Nuclear Careers Night – the 4th of which was held November 19, at McMaster University. It was sponsored by the CNS, the Engineering Physics Society, and the Department of Engineering Physics. Representatives of OPG, AECL, Bruce Power, Candesco, CNSC and Nuclear Safety Solutions gave brief presentations and afterward were able to talk informally with the more than 100 students who attended. Some of the students who first became interested in nuclear careers at previous Nuclear Careers nights returned, representing potential employers. These sessions has proven to be very successful in interesting students in positions in the nuclear industry.

New Brunswick *Mark McIntyre*

CNS President Jeremy Whitlock presented 2 lectures in New Brunswick on April 6. The topic was related to the Maple reactors at Chalk River.

The NB Branch co-hosted a retirement gathering for long time NB Branch volunteer Rick Sancton. Rick retired from PLGS.

The Branch participated in the Nuclear Waste Management Organization's 2 NB meetings held in Winter 2004. Neil Craik provided a technical orientation to these meetings.

Of special interest to NB Branch members, the NB Branch will be hosting an evening dinner party celebrating the 25th Anniversary of the CNS. The event takes place on **October 16, 2004** at the Union Club in uptown Saint John. Mr. Gerald Grandey, President of Cameco will be the guest speaker. All are welcome to attend. Tickets can be purchased from Ray Quan, Branch Treasurer or Larisa Duffy, Branch Secretaryat 506-659-2220.

Sheridan Park *Adriaan Buijs*

March 17 – Jerry Cuttler, DSc, PEng: "What to do with used CANDU fuel? Is it really waste?"

April 21 – Professor G.T. Bereznai: "Undergraduate Nuclear Programs at Canada's Newest University."

April 29 – Michael E. Stephens: "Update on AECL's Spent Fuel Management Activities."

May 19 – Ronald W. Batholomew: "Is Nuclear Power the Answer to Ontario's Electricity Crisis?"

July 7 – Eric Davey: "At the Controls of a CANDU Reactor - Responsibilities, Organization and Challenges."

Toronto *Bob Hemmings*

The May program featured Paul Gierszewski who spoke at the OPG auditorium on "Deep Geological Repositories" and was well received by about 40 attendees.

The Branch AGM was held June 4. Following the meeting, incoming CNS President Bill Schneider (B&W Canada) addressed the group on the Organization of the CNS, and introduced some of the initiatives he has planned for the coming year.

Branch Spending *Eric Williams*

In his Branch Affairs Committee report to the AGM, Eric Williams identified the 2003 expenditures for each Branch.

		Expenditures Education	
Branch	**Operations**	**Activities**	**Total**
Bruce	317	0	317
Chalk River	2,235	200	2,435
Darlington	27	0	27
Golden Horseshoe	1,301	0	1,301
Manitoba	0	0	0
New Brunswick	2,618	0	2,618
Ottawa	1,000	250	1,250
Pickering	327	0	327
Québec	388	1,000	1,388
Saskatchewan	0	0	0
Sheridan Park	2,215	600	2,815
Toronto	1,123	730	1,853
Totals	11,551	2,780	14,331

Honouring CNS Pioneers

As part of the celebration of the 25th anniversary of the creation of the Canadian Nuclear Society several of the pioneers involved with the beginning of the Society were honoured at a special dinner held June 7, 2004, at the end of the first day of the 25th CNS Annual Conference. Attending the dinner were members of the CNS Council and members of the Board of Directors of the Canadian Nuclear Association.

After much deliberation it was decided to specifically recognize those who were involved in the pre-organization, the "pro-tem" Council, or the first elected Council AND were still members.

The nature of the honour was finally decided as naming each individual as an Honorary Life Member of the CNS.

Three exceptions to the criteria outlined were made. Phil Ross-Ross and Wladimir Paskievici, who, although very involved in the creation of the Society, are not members today. Neither could attend the dinner. The third was Beatrice Howey.

Phil Ross-Ross participated in many of the early discussions and became a member of the "pro tem" Council of 1979 - 1980. He continued on the first elected council and then was president for both the second and third Councils, the only person to do so. With a background of helping other organizations he did much of the work in drawing up a constitution and By Laws and later was the principal author of a paper "The Formative Years of the Canadian Nuclear Society 1976 - 1984".

Wladimir Paskievici, now retired from Ecole Polytechnique, organized several of the "third day" technical sessions at early CNA conferences, was a member of the "pro tem" Council, the first elected Council and the second elected Council.

Those honoured at the dinner were: Joe Howieson, Bob James, Dan Meneley, Jim Weller and Beatrice Howey, widow of George Howey, a prime mover and the first CNS president.

Joe Howieson was a member of the CNA "task force" and was on the first elected Council. Beyond the criteria given earlier he was on the next four Councils and became president in 1984-85.

Bob James was elected to the demanding role of secretary-treasurer of the first elected CNS Council in 1980. He is a charter member of the Society having joined in 1979 and was active "behind the scene" during that interim year. He has continued to support the Society in various ways over the years.

Dan Meneley was one of the organizers of several of the "third day" technical sessions at the CNA Annual conferences during the 1970s. He was on the CNS "steering committee" of 1977 and the CNA "task force" of 1978, and was secretary-treasurer of the "pro tem" Council of 1979-1980. He has continued to support the CNS while in his various careers at AECL, UNB and elsewhere.

Jim Weller played a significant role in both the CNA and the CNS over two decades as general manager of both organizations. As GM of CNA he was very involved with the various committees and task forces created during the 1970s set up to work towards the creation of what is now the CNS. He was an official member of the CNS "pro tem" Council of 1979 - 1980 and an "ex-offico" member of the subsequent elected Councils until his retirement in the early 1980s. Although working for the CNA and the CNS Jim became and has continued to be a CNS member.

Probably the key person in motivating the CNA to look into the creation of a technical society in the mid 1970s was George Howey, then head of nuclear training at Ontario Hydro and chairman of the CNA Education and Manpower Committee. He persuaded the CNA to look into the question, to create the "steering committee" and the "task force" which led to the establishment of the "pro tem" Council of 1979 - 1980 on which he served as president. The following year he was elected president of the first elected CNS Council of 1980 - 1981.

Sadly, George is no longer with us. However, his wife Beatrice is. Not only did she support George through all those years when he was immersed in CNS business she has continued a personal interest in the Society and is a member. The CNS is pleased to name Beatrice Howey as an Honorary Life Member of the Canadian Nuclear Society

As part of the ceremony Fred Boyd and Ben Rouben provided short reviews of the creation of the CNS and of its incorporation in 1998.

The CNS "pioneers" honoured at a special dinner June 7, 2004, pose following their presentation with Honourary Life Memberships. L to R: Dan Meneley, Jim Weller, Beatrice Howey, Joe Howieson, Bob James

Inukshuk Winners in CNS 25th Anniversary Draw

As earlier announced, in celebration of the 25th anniversary of the CNS, a lottery draw was held at the Honours & Awards Banquet at the 25th Annual CNS Conference, on 2004 June 8, for 25 beautiful jade-coloured-glass Inukshuit, 7 cm high on a green-glass base. All CNS members in good standing on June 8 were eligible to win. The names drawn are given in the Table below. Congratulations to the winners! Their name will be engraved on their individual Inukshuk.

Gagnants d'Inukshuk au tirage en célébration du 25ième anniversaire de la SNC

Tel qu'annoncé il y a quelque temps, en célébration du 25ième anniversaire de la SNC, un tirage a eu lieu au banquet des prix à la 25ième conférence annuelle de la SNC, le 8 juin 2004, pour 25 superbes sculptures "Inukshuk" en verre couleur jade, 7 cm de haut sur une base en verre. Tous les membres en règle au 8 juin 2004 étaient éligibles. Les noms des gagnants apparaissent au tableau ci-bas. Félicitations à tous les gagnants! Leur nom sera gravé sur leur Inukshuk individuel.

Name/Nom	Affiliation
G. Ray Berzins	Ontario Power Generation
Lou W. Champagne	Lou Champagne Systems Inc.
Douglas D. Coleman	OPG, Pickering NGS
Brenda Dean	Wardrop Engineering Inc.
Hazen Hezhi Fan	AECL
David L. Freeman	Freeman Engineering Inc.
Gordon E. Fry	Ontario Power Generation
Sam Horton	
Neale Hunt	Nuclear Safety Solutions Limited
J. David Irish	AECL
Mark Langridge	Bruce Power
William J. Lewis	Royal Military College
Peter J. MacGillivray	GasTOPS Ltd.
Robert F. Moore	AECL
Andrew Oliver	Cameco Corp.
Wladimir Paskievici	
Wilhelm M. Postma	Mariner's Inn
Uditha P.M. Senaratne	AECL
Harold John Smith	HIZ and Associates Inc.
Michael E. Stephens	AECL
Simcha Stroes-Gascoyne	AECL
Steven Walter Thoss	Ontario Power Generation
Geraldine A. Underdown	Department of National Defence
Hartmut Ted Westermann	
Chang Cong Zhao	Nuclear Safety Solutions Inc.

CNS 25th Anniversary Mousepads

Dear CNS member:
In celebration of the 25th anniversary of the Society, a CNS mousepad will be provided to every member in good standing. Please find yours enclosed with this copy of the Bulletin.

Tapis de souris < 25ieme anniversaire de la SNC >

Cher/Chère membre de la SNC :
En célébration du 25ieme anniversaire de notre Société, un tapis de souris SNC sera offert à chaque membre en bonne et due forme. Veuillez trouver le vôtre joint a cette copie du Bulletin.

Ben Rouben for CNS Council

Canadian Nuclear Society
2nd Conference Announcement

Waste Management, Decommissioning and Environmental Restoration
For Canada's Nuclear Activities:
"Current Practices and Future Needs"
Crowne Plaza Hotel, Ottawa, Ontario, 2005 May 8-11

The Canadian Nuclear Society is pleased to announce a conference on Waste Management, Decommissioning and Environmental Restoration Activities in Canada, to be held May 8-11, 2005 at the Crowne Plaza Hotel in downtown Ottawa. An equipment and services exhibition is planned in conjunction with the Conference.

The main objective of the conference is to provide a forum for discussion and exchange of views on the technical, regulatory and social challenges and opportunities for radioactive waste management, nuclear facility decommissioning and environmental restoration activities in Canada. The conference is organized into one or more plenary sessions and eight technical tracks: Low-and intermediate-level wastes; uranium mining and milling wastes; spent nuclear fuel; decommissioning; environmental restoration; policy, economics and social issues; licensing and regulatory issues; and radioactive materials transportation. Papers are being solicited in all of these tracks, and could be presented in either oral or poster sessions. (Potential topic areas are listed at the end of thisin the Call for Papers on the conference web site).

Conference Web Page

http://www.cns-snc.ca/waste_05.html

Deadlines

- **Receipt of summaries: 2004 September 30**
- Notification of acceptance: 2004 October 30
- Receipt of draft full papers: 2005 January 15
- Receipt of final full papers: 2005 February 28

The full paper may also be submitted by the September 30 deadline, in which case no summary is required. This one-step process canmay shorten the time required for the internal review of papers by the authors' companies.

Guidelines for Submission

Summaries and full papers should present facts that are new and significant or represent a state-of-the-art review. Proper reference should be made to all closely related published information.

Summaries should be approximately **750-1200** words in length (tables and figures counted as 150 words each). They should include:

- an introductory statement indicating the purpose of the work
- a description of the work performed
- the results achieved

Full papers should include enough information for a clear presentation of the topic. Usually this can be achieved in 8-12 pages, including figures and tables. The use of 12- point Times New Roman font is suggested. The name(s), affiliation(s), and contact information of the author(s) should appear below the title of the paper. **An abstract of 50-100 words should be placed at the beginning of the full paper, after the title and author names.** Abstracts will be collected in an Abstract Book as a guide to the contents of the presentations. **For a paper to appear in the Conference Proceedings, at least one of the authors must register for the Conference by the "early" registration date (April 1, 2005).**

Submission Procedure

The required format of submission is electronic (MSWord or PDF). Submissions should be made through the Conference web page.

Post Conference Technical Tours

Technical tours are being planned to several Canadian nuclear facilities: AECL's Chalk River Nuclear Laboratories, the Low-Level Radioactive Waste Management Office activities at Port Hope, Elliot Lake uranium mines, and Hydro -Quéebec's Gentilly 2 nnuclear generating station and AECL's shutdown Gentilly 1 prototype reactor.

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

e-mail: cns-wm2005@___cns-snc.ca

General questions regarding the Conference should be addressed to:

Denise Rouben, CNS Office Manager

e-mail: cns-snc@on.aibn.com

Tel: 416-977-7620

Energy at the crossroads
Global Perspectives and Uncertainties

By Vaclav Smil.
373 pages. The MIT Press. ISBN 0-262-19492-9

Review for CNS Bulletin by A. Raymond Burge.
(Ray Burge is a former head of public relations for AECL now living in B.C.)

Vaclav Smil is a Distinguished Professor at the University of Manitoba. Author of eighteen books on energy, the biosphere and civilization, in his latest publication he presents an informed and unbiased assessment of world energy prospects today and in the future. It is a book that should be read by any who seek to understand the energy constraints and opportunities we face, energy planners and politicians alike.

Professor Smil can claim some forty years of studying energy questions reaching from his early work at the Carolinum University in Prague to his present position in Canada. He brings to the subject a thorough and impartial judgement of the prospects put forward by the proponents of the various energy sources and of the overall outlook for providing the energy needed to sustain the world economy in this century and beyond.

The book traces the phenomenal rise in production of primary energy that took place in the 20th century and the predominance of fossil fuels over biomass that ensued. By the end of that century the world had at its disposal about 25 times more useful commercial energy than in 1900 and coal-burning plants were supplying 40% of the world's electricity. Again the rapid rise of crude oil, with its dominance in the transportation market, has seen it overtake coal and produce 50% more of the world's energy than coal. Along with this gain by oil has come the emergence of gas as a powerful contender for electricity generation especially because of its higher efficiency and lower releases of greenhouse gases.

At this point in the history Professor Smil introduces nuclear energy stressing not, as one might expect, the enthusiasm which inspired the surge in building nuclear power plants as offering pollution free electricity, but emphasizing the Three Mile Island accident and the Chernobyl disaster. It is a theme to which he returns as he details the broken promises of fusion advocates and the ever-receding promise of commercial fusion energy.

Vaclav Smil then poses the question "Is there a future for nuclear energy?" It is a question which most of our readers would answer with a resounding, "yes". Today over 400 nuclear plants operate safely around the world and as oil and gas supplies reach their peak nuclear must surely be the choice from both the economic and biological viewpoint.

The obvious answer concludes the author may be "yes" but the obvious is not always correct With the exception of France, he points out, no western country has placed an order for a nuclear plant within the last two decades of the 20th century. Countries with heavy dependence on nuclear such as Germany, the UK, Sweden and the US are, in fact, decommissioning their ageing nuclear facilities and turning to the alternatives of wind and solar energies.

Despite the best efforts of the industry to gain public acceptance, despite the outstanding safety record of the operating plants, referenda, as in Sweden and public or political pressure condemn the use of nuclear power as a "contract with the devil". The myth of the "Faustian Bargain" still exercises a strong compunction in the public mind. Little comfort can be found in the present world situation. Terrorism is the wild card in the pack and the threat to nuclear plants from hijacked aircraft cannot but be a cause for concern.

Professor Smil ends as he began "none of us knows what lies ahead". The world is indeed at the crossroads of energy; the equations of energy production and its consequences are indeed complex. A study of his book is a good first step in grappling with so intractable a problem.

The Regulatory Control of Radioactive Waste Management: Overview of 15 NEA Member Countries (Print Paperback)

OECD 2004
212 p. $63.00 (US)

Regulators are major stakeholders in the decision-making process for radioactive waste management. The NEA Radioactive Waste Management Committee (RWMC) has recognised the value of exchanging and comparing information about national regulatory practices and having an informal, international network for discussing issues of common concern. The RWMC Regulators' Forum provides considerable opportunity for such activities.

This report presents the initial results of the Forum's work. Information is given for 15 NEA member countries in a format that allows easy accessibility to specific aspects and comparison between different countries. It includes an array of facts about national policies for radioactive waste management, institutional frameworks, legislative and regulatory frameworks, available guidance, classification and sources of waste and the status of waste management. It also provides an overview of current issues being addressed and related R&D programmes.

Thoughts On A Street Corner

by Jeremy Whitlock

On Toronto's Yonge Street everybody is talking to themselves. The Destitute and Disturbed carry on conversations, often angrily, with invisible persons all around. Scuttling past is the cell-phone crowd, likewise carrying on conversations, often angrily, with invisible persons. Nobody takes notice, nobody cares. There is talking everywhere, but no conversation.

The celebrated street is said to be the longest in the world (presumably ignoring Main St. Cobden and other towns sitting astride the TransCanada Highway), but draws most attention within a few blocks of its start. Around Yonge and Dundas the diversity of the surrounding urban watershed is concentrated and amplified.

Towering homages to mass media block out the sun and bleat messages that few appear to notice. The crowds surge into the Eaton Centre, clutching currency as plastic as the geese that fly within. Everywhere there is noise: subwoofers and car horns, jackhammers and talking billboards, a whining rock radio station and people talking everywhere, to themselves.

It is said that Leo Szilard stepped off a curb at another intersection, a world away, on the morning of September 12, 1933, and conceived the neutron chain reaction. It was a simpler world back then: simple enough to be lead down the garden path towards a world war for the second time in as many decades, but also clearly a world conducive to great discovery.

At that moment in London the British Association for the Advancement of Science was meeting amidst hurricane-force winds of change in the world of nuclear physics: In 1931 Lawrence's cyclotron caused a revolution (sorry), followed the next year by Chadwick and Anderson's discoveries of the neutron and positron, respectively. In the wings was the Seventh Solvay Conference in Brussels (October 1933), for the first time dedicated to nuclear physics.

The following year would see the Curies pioneer artificial radioactivity, and Fermi split the atom (although generally unrecognized as such, including by Fermi, until five years later: a fortunate oversight given events in Germany). Also that year Fermi would formalize his theory of beta decay, and Urey would discover deuterium. In 1935 Bohr's liquid-drop model would describe the nucleus in practical terms, and von Hevesy would invent nuclear medicine.

The Nobel Committee could barely keep pace.

On Szilard's street corner the changing traffic lights were inspiration enough. The 35-year-old brilliant Hungarian, preoccupied since his recent arrival in London with saving other Jews from Hitler, was not attending the British Association meeting and would not be going to the Solvay in October. He had strolled to the intersection of Southampton Row and Russell Street that morning, having read the Times' account of Lord Rutherford's now-famous declaration to the Association that the idea of atomic energy on a practical scale was simply "moonshine".

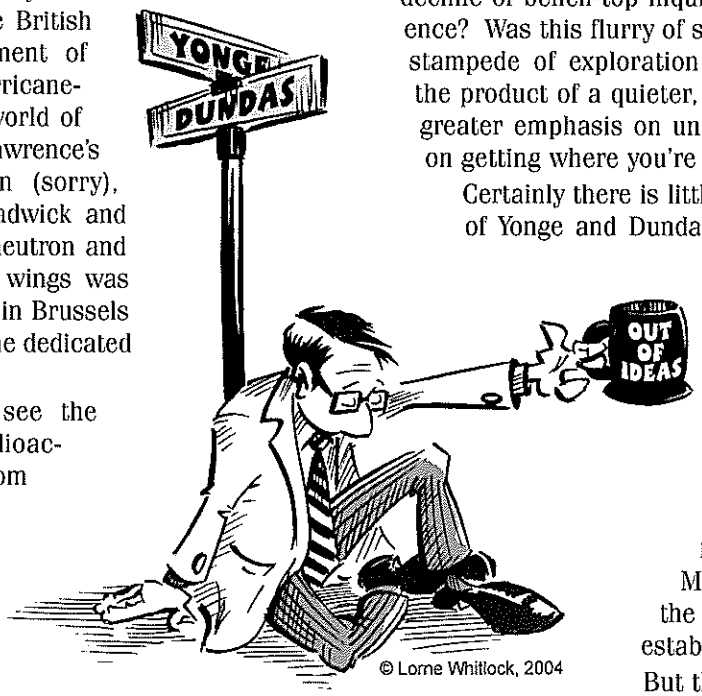
Rutherford, who didn't live to see nuclear fission, was of course only echoing the wise thoughts of other luminaries of the day (including Einstein), in reference to the relatively low-energy nuclear transitions studied to date.

Neutrons, Szilard mused, are a different beast. Might not their neutral nature, and some convenient (n, 2n) reaction, lead to a chain reaction with large net energy gain? The next year Szilard patented the idea, then waited four more years to see it start to make sense.

Did this simple, golden age of discovery end with the decline of bench-top inquiry and the rise of corporate science? Was this flurry of seminal breakthroughs merely the stampede of exploration in an undiscovered country, or the product of a quieter, more contemplative time, with a greater emphasis on understanding where you are, than on getting where you're going as fast as possible?

Certainly there is little physics to be had at the corner of Yonge and Dundas. Perhaps some second law of thermodynamics and a little disordered system theory, with a smattering of non-equilibrium dynamics, stress behaviour, turbulent flow, eccentric body stability, studies of large rectilinear diameters, the occasional gas throttling, a dash of chaos theory, a few rolled joints, and a handful of Monte Carlo aficionados taking in the Godiva experiments at the seedier establishments up the strip.

But that's it.



CALENDAR

2004

Sept. 22 - 26
4th International Topical Meeting on Nuclear Plant Instrumentation, Control and Human Machine Interface Technology (NPIC & HMIT 2004)
Columbus, Ohio
website: www.ans.org

Oct. 2 - 6
11th International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH)
Avignon, France
email: nureth11@cea.fr

Oct. 3 - 6
Americas Nuclear Energy Symposium
Miami Beach, Florida
email: anes@hcet.fiu.edu
website: www.anes.fiu.edu

Oct. 3 - 6
CSChE 2004
54th Canadian Chemical Engineering Conference
Energy for the Future
Calgary, Alberta
wesite: www.csche2004.ca

Oct. 4 - 8
NUTHOS-6
Nara, Japan
Contact: Hisashi Ninokata
email: hninokat@nt.titech.ac.jp

Oct. 11 - 14
EPRI Int'l. Conf. on Water Chemistry of Nuclear Reactor Systems
San Francisco, California
email: cwood@epri.com

Oct. 11 - 14
EPRI International Conference on Chemistry of Nuclear Reactor Systems
San Francisco, California
Contact: Christopher Wood, EPRI
email: cwood@epri.com

Oct. 12 - 15
6th International Conference on Simulation Methods in Nuclear Engineering
Montreal
Contact: Denise Rouben
CNS Office
email: cns-snc@on.aibn.com
web: www.cns-snc.ca

Oct. 13 - 15
6th International Conference on Simulation Methods in Nuclear Engineering
Montreal, Québec
website: www.cns-snc.ca/simulation2004

Oct. 18 - 20
CNS CANDU Fuel Technology Course
Mississauga, Ontario
Contact: Denise Rouben
CNS Office
email: cns-snc@on.aibn.com
web: www.cns-snc.ca

Oct. 25 - 27
CNS CANDU Safety Course
Kincardine, Ontario
Contact: Denise Rouben
CNS Office
email: cns-snc@on.aibn.com
web: www.cns-snc.ca

Nov. 14 - 18
ANS Winter Meeting
Washington, D.C.
website: www.ans.org

2005

Mar. 9 - 10
CNA Annual Seminar
Ottawa, Ontario
website: www.cna.ca

Apr. 17 - 21
Monte Carlo 2005
Chattanooga, Tennessee
Contact: Bernadette Kirk, ORNL
email: kirkbl@ornl.gov

Apr. 25 - 29
5th Int'l. Conference on Isotopes
Brussels, Belgium
website: www.jrc.nl/5ici

May 8 - 11
National Conf. on Radioactive Waste Management, Decommissioning and Environmental Restoration
Ottawa, Ontario
Contact: M. Stephens, AECL
email: stephensm@aecl.ca

June 12 - 15
26th CNS Annual Conference and 29th CNA/CNS Student Conference
Toronto, Ontario
Contact: Denise Rouben, CNS
email: cns-snc@on.aibn.com

Aug. 7 - 12
SmiRT 18 18th International Conference on Structural Mechanics in Reactor Technology
Bejing, China
website: www.smirt-18.org.cn

Nov. 6 - 8
7th CNS Int'l. Conference on CANDU Maintenance
Toronto, Ontario
Contact: Denise Rouben, CNS
email: cns-snc@on.aibn.com

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Bill Schneider 519-621-2130
e-mail wgschneider@babcock.com

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e-mail walter.thompson@nuclearsafetysolutions.com

2nd Vice-President / *2ième Vice-Président*
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e-mail luxatj@mcmaster.ca

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Adriaan Buijs..... 905-823-9060 x3559
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Eric Williams ..... 519-396-2249 canoe.about@bmts.com

Education & Communication / *Education et communication*
Bryan White ..... 613-584-3311 whiteb@aecl.ca
Jeremy Whitlock .. 613-584-8611 whitlockj@aecl.ca

Finance / *Finance*
Ed Hinchley ..... 905-849-8987 e.hinchley@ieee.org

Fusion / *Fusion*
Murray Stewart . . 416-590-9917 stewartm@idirect.com

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International Liaison / *Relations Internationales*
Kris Mohan ..... 905-823-9040 mohank@aecl.ca

Internet/
Morgan Brown ..613-584-3311 brownmj@aecl.ca

Inter-Society / *Inter-sociétés*
Parviz Gulshani ..... 905-823-9040 gulshanip@aecl.ca

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NA YGN
Mark McIntyre .....506-659-7636 mmcintyre@ansl.ca

PAGSE
Ralph Green .....613-829-8156 dt139@ncf.ca

Past Presidents / *Presidents sortont*
Jeremy Whitlock ... 613-584-8811 whitlockj@aecl.ca

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Walter Thompson ..416-592-4349 walter.thompson@nuclearsafetysolutions.com

Universities / *Universites*
John Luxat .....905-525-9140 luxatj@mcmaster.ca

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- Fuel Technologies / Technologies du combustibles
  Joseph Lau 905- 823-9040 lauj@aecl.ca
  Erl Kohn 416-592-4603 erl.kohn@opg.com
- Nuclear Operations / Exploitation nucleaire
  Martin Reid 905-839-1151 martin.reid@opg.com
- Nuclear Science & Engineering / Science et genie nucleaire
  Dorin Nichita 905-823-331 nichitae@aecl.ca
- Environment & Waste Management / Environnement et Gestion des dechets radioactifs
  Michael Stephens 613-584-3311 stephensmi@aecl.ca

CNA Liaison / *Agent de liaison d'ANC*

Colin Hunt (613) 237-3010 elstonm@cna.ca

CNS Office / *Bureau d'ANC*

Denise Rouben (416) 977-7620 cns-snc@on.aibn.com

CNS Bulletin Editor / *Rédacteur du Bulletin SNC*

Fred Boyd (613) 592-2256 fboyd@sympatico.ca
Bryan White (Assistant Editor) (613) 584-4629 bwhite_cns@sympatico.ca

CNS Branch Chairs • Responsables des sections locales de la SNC

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Bruce	Eric Williams	519-361-2673	canoe.about@bmts.com
Chalk River	Morgan Brown	613-584-3311	brownmj@aecl.ca
Darlington	Jacques Plourde	905-623-6670	jacques.plourde@opg.com
Golden Horseshoe	David Jackson	905-525-9140	jacksond@mcmaster.ca
Manitoba	Jason Martino	204-345-8625	martinoj@aecl.ca
New Brunswick	Mark McIntyre	506-659-2220	mmcintyre@nbpower.com
Ottawa	Bob Dixon	613-834-1149	dixonrs@ftn.net
Pickering	Marc Paiment	905-839-1151	marc.paiment@opg.com
Quebec	Michel Rhéaume	819-298-2943	rheaume.michel@hydro.qc.ca
Saskatchewan	Walter Keyes	306-536-6733	walter.keyes@sk.sympatico.ca
Sheridan Park	Adriaan Buijs	905-823-9040	buijsa@aecl.ca
Toronto	Bob Hemmings	905-829-8808	rhemmings@canatomnpm.ca

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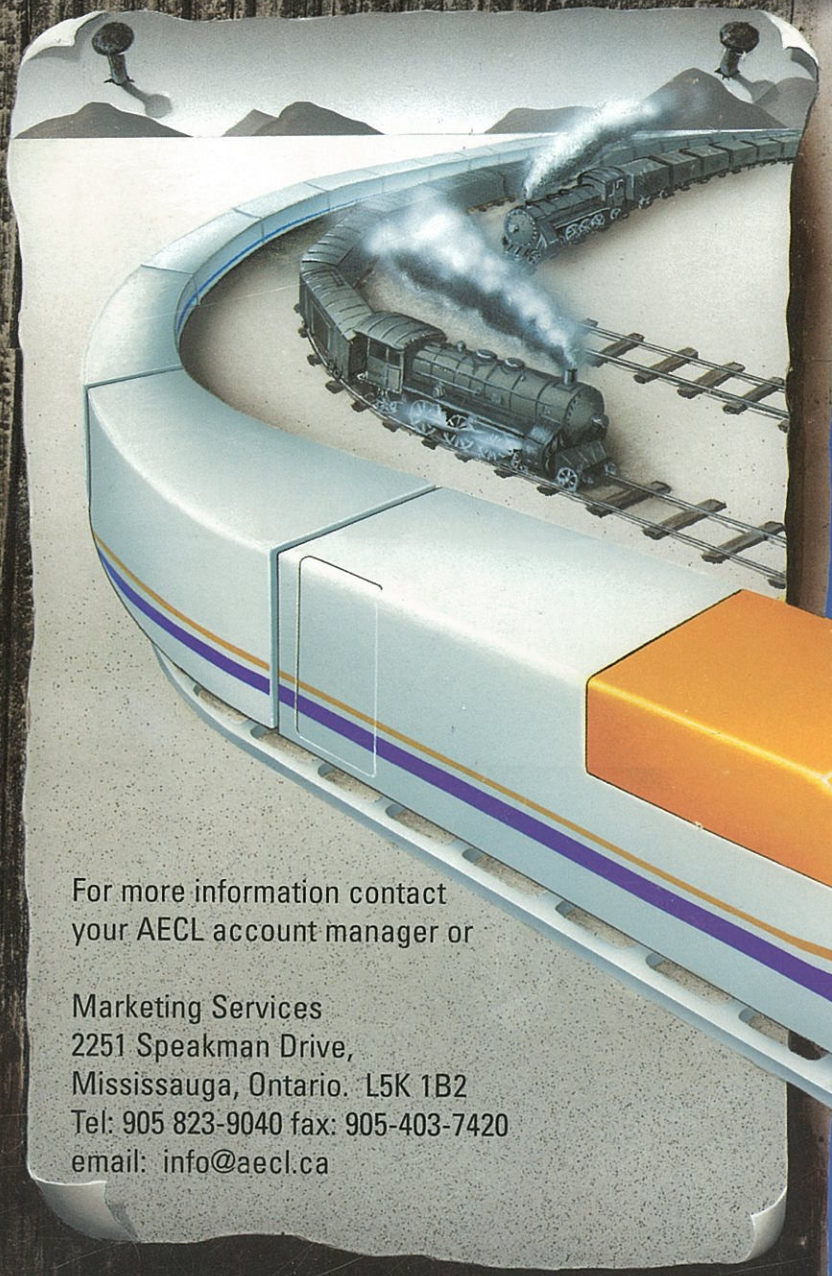

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