CANADIAN NUCLEAR SOCIETY

bulletin

DE LA SOCIÉTÉ NUCLÉAIRE CANADIENNE

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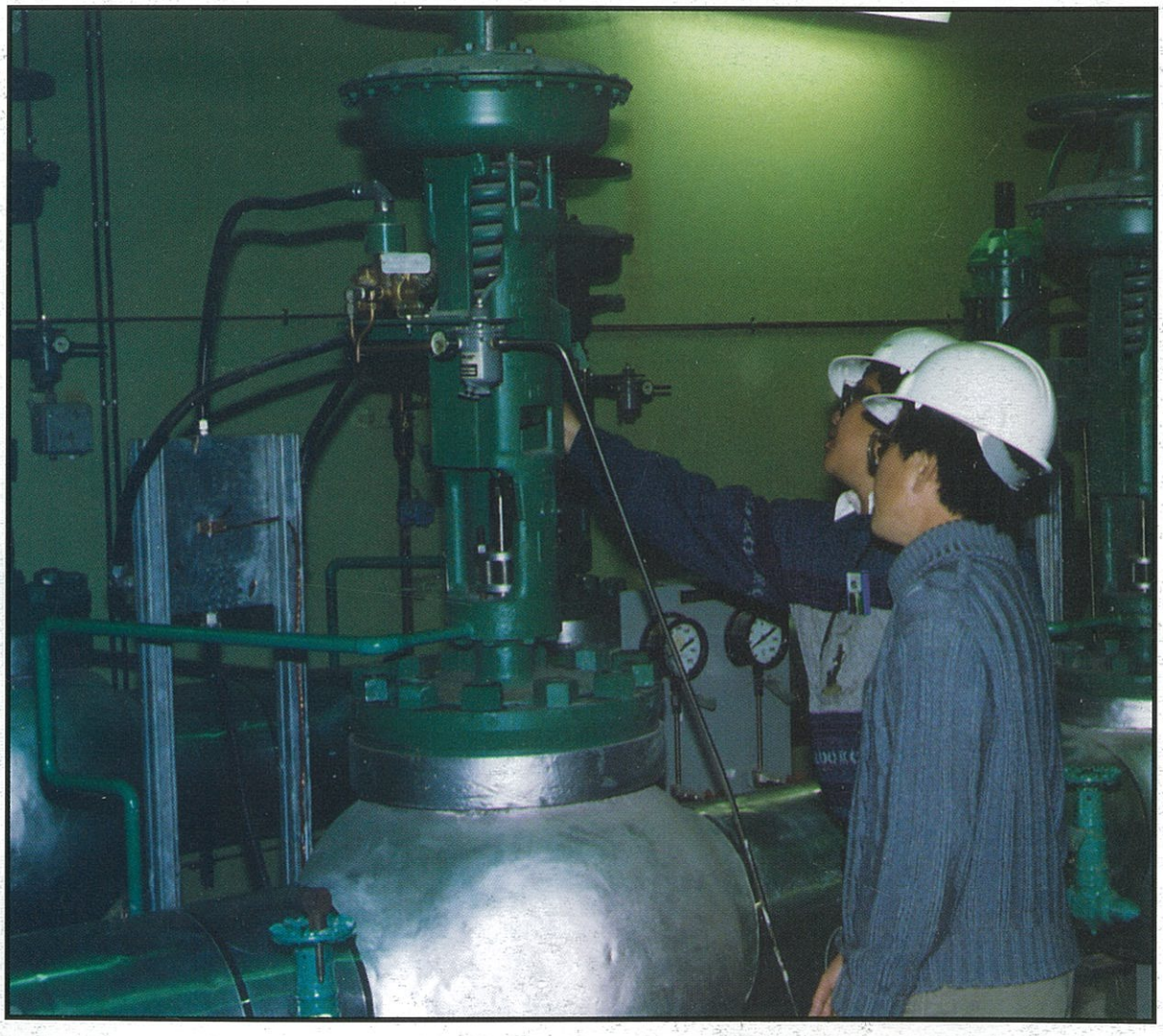

- A look at the AECB
- CNS Conference
- Four Decades of Radiation Protection
- Nuclear Power in the 21st Century

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Cover Illustration

The cover photograph shows AECB staff (unidentified) inspecting a motorized valve at the Darlington NGS.

(Photo courtesy of AECB)

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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.
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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. La cotisation annuelle est de 60.00$, 35.00$ pour les retaités, et 20.00$ pour les étudiants.

Editor / Rédacteur
Fred Boyd
Tel./Fax (613) 592-2256
e-mail: fboyd96@aol.com

Associate Editor / Rédacteur associé
Ric Fluke
Tel. (416) 592-4110
Fax (416) 592-4930

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EDITORIAL

Time to act

Now is the time for all good men to come to the aid of the party. Remember that old typing (keyboarding) exercise? It is a good dictum, now, for those concerned about the future of the nuclear industry in Canada.

In this issue, there is a short report on a Workshop held by Atomic Energy of Canada Limited and the National Research Council to promote the proposed *Canadian Neutron Facility.* The CRF involves a MAPLE type reactor with associated facilities for reactor component research and development and for neutron-based materials research.

While that Workshop focussed on the many benefits for material research to be gained through the use of neutrons from the facility's reactor the other objective for the facility is even more critical if the CANDU program is to continue.

That other objective involves the loops and other systems for testing and developing, under radiation conditions, equipment for CANDUs. Without such facilities it would be impossible to develop new instruments or components, or to analyse the failure of existing ones. Purchasers of nuclear power systems expect the primary supplier to have the capability for on-going technical support readily available. Without it, potential customers are likely to go elsewhere.

At this time the ageing NRU reactor serves as THE Canadian neutron source for both reactor research and development and for neutron research. Without it the development of CANDU pressure tubes or new fuels, for example, would not have been possible. But, NRU is scheduled to be shut down in the year 2005, just six years from now. Further, it is only by the efforts of the skilled and innovative operations personnel that the old plant continues to run. There is even the possibility that the Atomic Energy Control Board could close it because it does not meet the Board's current safety standards.

It is essential for the future of the CANDU program, as well as for the future of neutron-based materials research in Canada, that the CRF be approved soon.

This will be a challenge, given the many demands on the federal government's coffers. Some of the money may be found through other routes but, undoubtedly, the basic MAPLE reactor will have to be funded as a national research project.

This needs lobbying. If you believe in the CANDU program or in nuclear research in general, let the decision makers know. Contact the following Ministers and your local M.P.

John Manley	Minister of Industry	Fax 613-992-0302
Ralph Goodale	Minister, Natural Resources Canada	Fax 613-996-4516
Paul Martin	Minister of Finance	Fax 613-995-5176

IN THIS ISSUE

Before reviewing the contents of this issue of the *CNS Bulletin,* we wish to express our apologies for the delay in publication. The target date for distribution had been mid-January but that became impossible due to a compounding of problems - human (illness); environmental (weather); technological (computers and e-mail). Despite its lateness, we hope you enjoy the many articles and news items included.

The lead article continues our look at major organizations of the Canadian nuclear scene - in this case, the regulator, the **Atomic Energy Control Board.** This was intended to appear just before the Board was transformed into the *Canadian Nuclear Safety Commission* with the placing in force of the Nuclear Safety and Control Act but it now looks like that action will not take place until early summer. That overview is accompanied by an account of our **Interview with the AECB President,** Dr. Agnes Bishop, just before Christmas.

Then we have two papers that look forward and back. **Nuclear Power in the 21st Century,** presents the perceptive and informed prognostication of AECL's Gary Kugler. This is followed by a four decade retrospective by Richard Osborne in **From scientific evidence to radiation protection,** a fascinating and informative account of Richard's long involvement in that field.

A paper presented at the Meeting of the Americas on **Radioactive Waste policy in Canada** by Peter Brown and Geraldine Underdown is reprinted here primarily because it provides excellent background for the report, the **Federal Government Responds to Fuel Waste Panel,** to be found elsewhere in this issue.

Finally, in the general category, there is a report on the **1998 CNS Annual Conference,** the first one held separately from the annual meetings of the Canadian Nuclear Association. This is accompanied by **Conference Summaries,** reports of most of the sessions, as prepared by the session chairpersons.

A number of items are included in the "General News" section. While we do not pretend to be a "news" publication, a number of events and meetings have occurred over the fall months of 1998 that we felt would be of interest to readers of the *CNS Bulletin.* In particular, please note the report on the Workshop for the proposed **Canadian Neutron Facility.**

Also, the "CNS News" section is larger than normal, reflecting the many activities of the Society.

As always, we thank the many authors for permission to publish their papers and the many other people who have helped provide the material for this issue. We hope that you find something of interest and welcome your comments (or contributions).

Must develop public support

The two articles by Archie Robertson, Malice in Blunderland, Parts I and II, (in No. 2, and 3, of Vol. 19, of the CNS Bulletin) were a treat to read - precisely argued, logically developed and clearly presented. He is to be congratulated. As I had not followed the Panel proceedings, and have read only the summary of its report published in the CNS Bulletin (Vol. 19, No. 1), I am unable to judge whether or not Robertson's articles are fair and balanced in their critique; I assume they are. There are though, statements with which I take issue.

I can agree that apathy implies acceptance. But is it correct to assume that all those who did not speak up were apathetic? More likely large numbers - possibly the majority - were just unaware of what was transpiring. Only if the EAP did the utmost, i.e. everything reasonable considering the importance of its deliberations, to publicize (before the hearings) what it was about to do and what the likely consequences of various findings might be, could it then be argued that a lack of response, due either to ignorance of events or apathy could be construed as a lack of opposition with the implication of acceptance.

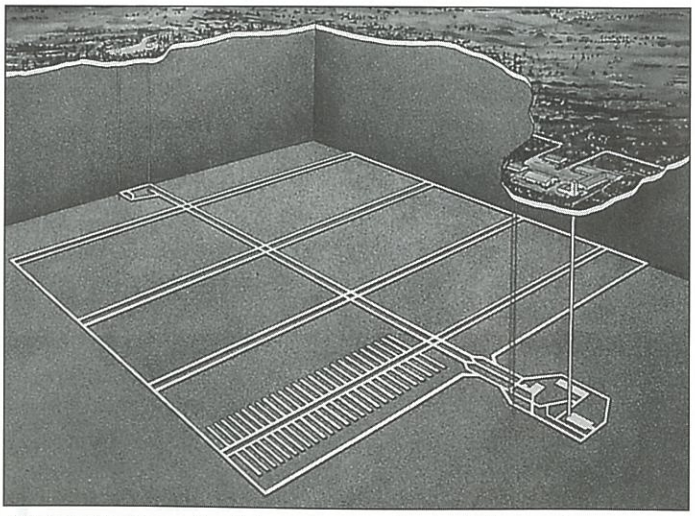
Although the EAP had gone beyond its mandate in concluding that the proponent had not shown there was broad public support, an EAP recommendation that broad public support be demonstrated would be valid; a conclusion that the concept is acceptable would not be contradicted by such a recommendation. Given the general lack of public participation, such a recommendation should come with a proposed criterion regarding how public support is to be judged. Presumably the EAP did seek, but failed to find a basis for judging public support since it put the onus on the Implementing Organization to do so. As Robertson states "the Panel tacitly admitted that it had not found a way". Notwithstanding that the EAP mandate was limited to enquire into safety and acceptance, surely it would fail in its duty if it did not identify in its recommendations aspects which in its opinion - rightly or wrongly - are germane to the debate.

Where do we go from here? Recently the government responded to the Panel's report; as I understand the response, the government has accepted the major recommendations of the Panel which could result in lengthy and costly delays before the matter is finally resolved. Robertson has suggested a means to salvage the situation, which if implemented might bring the matter to a conclusion within a reasonable time and without wasting funds already spent. I propose an additional activity that the stakeholders might evaluate, which could increase the probability of a timely and favourable conclusion.

As Robertson states: 1) the EAP was to determine acceptance, not whether or not there is broad public support, and 2) parliament should make decisions; they should not be made via polling firms. To ensure the likelihood of a final favourable decision within a reasonable time, it might be necessary for the stakeholders to demonstrate that there is indeed broad public support - then the politicians would realize the VOTERS support a nuclear program including its necessary adjunct, safe waste disposal. Politicians follow (the better ones lead but presumably make certain they are being followed) what they perceive as the will of the voters; after all without voter support, one does not a successful politician become!

Thus, we the stakeholders, must do what the EAP was apparently unable to do, demonstrate broad public support. To do so likely will require focus groups, "Gallop polls" sponsored by the stakeholders, and in parallel continuing efforts to educate (e.g. CNS program), and a resumption of marketing by the CNA (e.g. TV ads emphasizing the positive aspects of a nuclear program). With public support demonstrated, it would then be time to engage the politicians; first to persuade the minister responsible to adopt the substance of Robertson's "salvage" method in order to correct the consequences of the EAC report, and second to obtain a timely political decision that allows the waste disposal program as proposed by AECL (or a modified version which recognizes legitimate criticism) to proceed.

Duke Segel



An artist's view of a future deep geological disposal vault.

The Atomic Energy Control Board

a look at Canada's nuclear regulator on the eve of its transition into the Canadian Nuclear Safety Commission

Introduction

The oldest organization in the Canadian nuclear scene is soon to be transformed. Just over 52 years old, the **Atomic Energy Control Board** (AECB) (or often just referred to as the "Board") was created with the coming into effect of the *Atomic Energy Control Act* in October 1946. The AEC Act is the oldest remaining nuclear legislation in the world, but it will be replaced by the new *Nuclear Safety and Control Act,* which received Royal Assent in March 1997. That Act is now expected to be put into force by June 1999, at which time the AECB will be transmuted into the *Canadian Nuclear Safety Commission (CNSC).*

The following article is intended to provide a glimpse into the organization and diverse activities of our nuclear regulator as background for its imminent metamorphosis.

Background

When it was created, just after World War II, the AECB was essentially a "paper" organization. Although the AEC Act gave the Board sweeping powers over all activities considered to be related to "atomic" power, the actual organization was almost non-existent. For the first decade or so it had only one scientific officer, a part-time president and secretary, and a handful of administrative staff. Its original role was to be the governing board over Canada's nuclear program - then concentrated at the Chalk River Nuclear Laboratories (CRNL) operated by the National Research Council (NRC). The focus was on security and secrecy.

That changed in 1952 with the only significant change to the AEC Act, to accommodate the creation of Atomic Energy of Canada Limited (AECL) as the operating organization of the Chalk River Nuclear Laboratories and the government's instrument for the development of atomic energy. The AECB became primarily a regulatory organization, the role it has continued until today.

The decision, in 1955, to build the NPD nuclear power demonstration plant, and the proposal by McMaster University to install a large research reactor, led the Board to create the *Reactor Safety Advisory Committee (RSAC)* in 1956, the first of many committees established by the Board to provide advice. Dr. George Laurence, then head of development at CRNL and a Canadian nuclear pioneer, was appointed chairman of this influential committee. For years, the policy of the Board was that it would not licence a reactor without the positive advice of the RSAC. In those early years the small staff served primarily as staff of the committees.

It was not until December 1958, 12 years after the creation of the AECB that its scientific staff was doubled with the addition of a support person for the RSAC (your editor). A little over three years later, in 1962, after his appointment as the first full time president, Laurence, added three more scientific staff.

The AECB's first (part-time president was Gen. A. G. L. McNaughton, then Canada's representative to the Atomic Energy Commission of the newly formed United Nations. He was followed the next year by Dr. C. J. Mackenzie who was also the president of NRC. In 1952 Mackenzie relinquished that post to take on the presidency of the newly formed AECL. He retired from that role a little over a year later but remained as (part-time) president of the AECB until 1961. On Mackenzie's retirement, Dr. George Laurence was an obvious choice to become the first full time president and begin the long task of building the AECB into a reputable nuclear regulatory organization.

In 1970, Laurence was succeeded as president by Dr. Donald Hurst, a fellow senior scientist with Laurence at CRNL. By then the professional staff of the AECB had grown to 26 ! This while the it was licensing NPD, Douglas Point, and the construction of Pickering A, as well as having taken on the technical aspects of the licensing of radioisotopes which had been handled by the Department of Health and Welfare.

Hurst retired in October 1974 and, although he had given six months notice of his intention to retire, it took the government another four months, until February 1975, to appoint his successor, Dr, Alan T. Prince. (This was just the first of what became a pattern - that of a hiatus between presidents.) Prince was an Assistant Deputy Minister at the Department of energy, Mines and Resources, and, earlier in his research career, had directed the development of uranium oxide as a power reactor fuel.

It was in Prince's era that the first attempt was made to develop new legislation to replace the AEC Act, which was, even then, beginning to be considered as out-dated. (The major perceived problems with the AEC Act were that it made no reference to health and safety and that it gave the Board sweeping powers considered inappropriate in modern legislation.) A new Act was drafted and introduced into the House of Commons as Bill 14 in late

1977. However, opposition emerged, in particular from some provinces, and the bill "died" on the order paper when the House prorogued early the next year. The AECB did achieve something from the effort, it had been allowed to increase its staff from about 140 to almost 200 in anticipation of the new Act.

Prince retired in early 1978 and was followed later that year by Jon H. F. Jennekens, an AECB staff member who had been Director, Nuclear Plant Licensing.

Dr. Agnes Bishop

Not long after his appointment, Jennekens dissolved the many advisory committees that had been created over the years to augment the, originally small, staff. The move was particularly aimed at the RSAC which the AECB reactor staff considered too lenient and too sympathetic to the licensees (the utilities) and their major adviser (AECL), and had been (as noted earlier) directly involved in the licensing process. Two new advisory committees were created - the Advisory Committee on Radiological Protection (ACRS) and the Advisory Committee on Nuclear Safety (ACNS), but with a mandate to look only at generic issues.

By the time he retired, in early 1987, to assume the position of Deputy director General, Safeguards, at the International Atomic Energy Agency, Jennekens had convinced the government to increase the staff to 300. Another several months passed before his successor was named, Dr. Rene J. Lévesque, who had been at the École Polytechnique in Montreal. Lévesque's period as president lasted until late 1993. During this time he began the process towards a new Act and continued to increase the size of the AECB staff. It was also in this time period that the AECB introduced its most controversial regulation; that for cost recovery, which had been required of it by the government.

On Lévesque's retirement, another several months passed before the appointment of the current president, Dr. Agnes J. Bishop, in September 1994. As a medical doctor, specializing in child oncology, Dr. Bishop brought a new perspective to the position of president. Having been a (part-time) member of the Board for five years she was not unaware of the role and activities of the AECB, but, nevertheless, spent most of her first year becoming knowledgeable about the day to day operations of the agency. With that background she initiated an extensive and intensive internal review called *Project 96 and Beyond,* in which every member of the AECB staff participated. She also continued the work begun by Lévesque towards new legislation.

The proposed new Act, called the *Nuclear Safety and Control Act* was introduced into the House of Commons in the fall of 1996 and received Royal Assent in March 1997. At the time of writing (Jan. 99) it has not yet been put onto force, awaiting the completion of all of the necessary regulations to accompany it. That action is now expected by June 1999.

The Board

The actual Atomic Energy Control BOARD is made up of the five Board members (one ex- officio, the others appointed). The 400 plus staff are there to assist the Board in its deliberations and decisions.

Over the first three decades of the AECB's existence, the Board was a "closed shop", with membership held by the heads of the other government agencies involved in the atomic energy program - Eldorado Mining and Refining and Atomic Energy of Canada Limited. For years the presidents of these two organizations were members of the AECB. This fitted the concept of the day that atomic energy was a federal government activity and the AECB was the overseeing body.

The two post-war presidents of Eldorado, W. J. Bennett and W. G. Gilchrist were, between them, members of the AECB from 1948 to 1974. J. L. Gray, president of AECL, was a member from 1958 to 1973.

During that period there was always an "outside" member, usually from Quebec: Dr. Paul Gagnon of Laval University from 1946 to 1961; Dr. Henri Gaudefroy, École Polytechnique, 1961 to 1970; and Dr. Laurent Amyot, also from École Polytechnique, 1970 to 1979.

Gray stepped down in 1973 to be replaced by Sylvia Fedoruk of the Saskatchewan Cancer Foundation (the first health oriented person on the Board) in 1973, and Gilchrist was succeeded in 1975 by Roy Olsen, president of Phillips Cables (and formerly with the team that designed NPD) .

Reflecting that "in house" structure, the meetings of the Board over the first three decades were closed and secret. For many years, however, senior officials (e.g., deputy ministers) of departments having an interest in atomic energy matters were invited and Board meetings served as a special, high-level, Ottawa forum.

For the last year and a half Board meetings have been open to the public. In addition, Dr. Lévesque began holding some meetings in the vicinity of major sites (such as the Bruce Nuclear Development), a practice continued and expanded by Dr. Bishop. The Board now meets almost monthly for one or two days during which it receives submissions from applicants or licensees, reports from its staff, and hears interventions from interested parties. Over the past few years the audience (many of whom are AECB staff) has grown and over-taxed the capacity of the Board meeting room at its headquarters on Slater Street in Ottawa. A new room is being prepared to accommodate the expanded and somewhat more formal proceedings of the Canadian Nuclear Safety commission when the new Act comes into force.

Organization

The Board itself consists of five members, the President being the only full-time member. The President also is the Chief Executive Officer of the AECB and, as such, supervises and directs the work of the organization. One member is ex-officio, the president of NRC, the others are appointed by the Governor in Council. The current members are:

Dr. Agnes Bishop	President
Dr. Arthur Carty	President of the National Research Council
Dr. Christopher Barnes	Director, Centre for Earth and Ocean Research, University of Victoria

Dr. Yves Giroux	Assistant to the Rector, Laval University
Mr. Alan Graham	Chairman, Forest Protection Ltd., and Maritime Forestry Complex Corp.

After an extensive review of the voluminous outcome of *Project 96 and Beyond* by the AECB's senior management, over most of 1997, a revised organization was announced and out into effect on January 1, 1998. Under it, the staff of approximately 400 is organized into five directorates (Fig. 1), with roles as summarized below.

The **Directorate of Reactor Regulation** is responsible for: the regulation of nuclear power reactors, including the development of safety standards and licence conditions; the assessment of licence applications and reactor operations; making licensing recommendations to the Board; and compliance activities. Director General: Jim Harvie

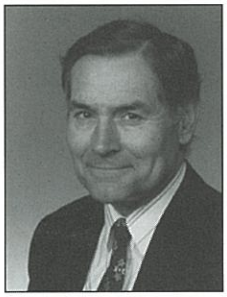
The **Directorate of Fuel Cycle and Materials Regulation** is responsible for the regulation of: uranium mining, including the processing of uranium into fuel; research facilities and particle accelerators; radioisotope production and use; radioactive waste management; and the transport of radioactive materials. This includes the development of safety standards and licence conditions, the assessment of licence applications and licensee operations, making licensing recommendations to the Board, and compliance activities. The Directorate also is responsible for technical aspects associated with the decommissioning of nuclear facilities. Director General: Murray Duncan

The **Directorate of Environmental and Human Performance Assessment** is responsible for the assessment of licensees' programs and performance in the areas of radiation and environmental protection, emergency preparedness planning, quality assurance, training and human factors. Other responsibilities include: technical training for AECB staff and for foreigners (under co-operation agreements); AECB obligations under the Canadian Environmental Assessment Act; assessment of unplanned events and performance at licensed facilities; incident investigation; research programs; and the development of standards. Director General: John Waddington.

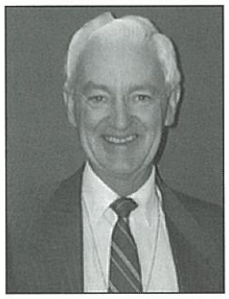
The **Secretariat** is responsible for: administrative support to Board members and advisory groups; external relations, corporate documents and public communications; coordination of corporate planning and of implementation of the Nuclear Safety and Control Act; non-proliferation, safeguards and security activities; liaison with Department of Justice legal counsel; and administrative responsibilities of the AECB under the Nuclear Liability Act, the Access to Information Act, and the Privacy Act. Director General and Secretary: Pierre Marchildon

Jim Harvie

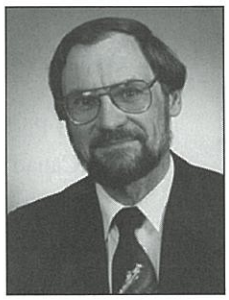
Murray Duncan



John Waddington



George Jack



Pierre Marchildon

The **Directorate of Corporate Services** promotes efficient and effective delivery of centralized corporate services to the other Directorates of the AECB. It is responsible for financial management, materiel and facilities management, technological services and human resources planning and services. Director General: George Jack

Each directorate has several divisions or groups, as shown in the accompanying chart.

Dr. Bishop has emphasized a "project" approach for any issue that could involve more than one division. The new Power Reactor Evaluation Division is specifically organized to apply that concept. In her message to AECB staff at the time of implementing the new organization Dr. Bishop wrote:

> This division (headed by Mike Taylor) is at the centre of our new approach in arriving at reactor licensing decisions and is of crucial importance to our success. [It] will very much work on a project management basis, ensuring that input from all divisions ... is fully considered in arriving at reactor licensing recommendations. ... This division will ensure that the AECB has a coordinated effort leading to an integrated response to power reactor issues.

Advisory Committees

The re-organization left the two advisory committees (ACRP and ACNS) essentially untouched. However, following a review by Board member, Dr. Giroux, the group of medical advisers will likely be disbanded when the new Act comes into force since there will no longer be a legal need for them. When that happens it is understood that the ACRP may be expanded to include more medical doctors.

The Advisory Committee on Radiological Protection has 14 members and is chaired by Dr. A. M. Marko, a former director of biology at AECL-CRL.

The Advisory Committee on Nuclear Safety has 11 members and is chaired by Dr. A. Pearson, also a former director at AECL-CRL

Functions

The AECB has chosen as its "Mission Statement" the following:

> *The Atomic Energy Control Board's mission is to ensure that the use of nuclear energy in Canada does not pose undue risk to health, safety, security and the environment.*

The scope of the AEC Act is such that the AECB is involved in all activities that may be considered as being associated with "the development, application and use of atomic energy", including, specifically, any dealings in ura-

nium, thorium, and deuterium. As a result the AECB controls, through its licensing system, everything in the nuclear field from uranium mining to waste disposal, including the production and use of radioisotopes and the transportation of radioactive material. Originally the focus was on security. But by 1960 the emphasis had turned to health and safety (even though they are not mentioned in the AEC Act.) and the first regulations in that area were issued.

Most readers of the *CNS Bulletin* probably think of the AECB as the regulating organization for power reactors. In some ways this does reflect the effort.. For the fiscal year ending March 31, 1998, regulatory activities related to power rectors and heavy water plants amounted to $26.6 million or 58% of the $45.5. million total regulatory expenditures of the AECB. (Another $3.1. million was spent on non-regulatory activities, most of which were cost recoverable.) The next largest activity was radioisotopes, where the licensing, inspection and compliance functions associated with the almost 4,000 licences in effect consumed $8.4 million.

Of the $48.7 total expenditures in the fiscal year ending March 31, 1998, $35.4 was recovered, most of it from licence fees. The percentage of costs recovered has been increasing each year and will continue to do so in 1999 with the 17% average increase in fees put into effect on January 1, 1999.

The AECB has project officers at each of the power reactor sites, a practice begun with the demonstration Douglas Point plant in the 1960s. A total of 27 officers are posted at five sites. A special group is being formed to monitor, in detail, Ontario Hydro's "Nuclear Asset Optimization Plan".

To oversee uranium mining activities, which are all located in norther Saskatchewan, the AECB has an office in Saskatoon where most of the Uranium Facilities Division staff are located.

Regional offices, primarily for compliance activities associated with radioisotope licences, re located in Calgary, Mississauga, Ottawa and Laval, and the AECB maintains a modest compliance laboratory in Ottawa.

The AECB plays an important role in support of Canada's nuclear non-proliferation policy and participates, with the Department of Foreign Affairs and International Trade (DFAIT) in the negotiation of bilateral nuclear cooperation agreements. There are, currently, 22 such agreements in force, covering 36 countries. The AECB also administers the agreement between Canada and the IAEA for the application of safeguards of Canadian activities, and directs the research and development work undertaken through the Canadian Safeguards Support Program.

The new Act

The *Nuclear Safety and Control Act* will do much more than change the name of the Atomic Energy Control Board into the Canadian Nuclear Safety Commission (although that alone is hoped to remove the confusion between "AECB" and "AECL"). Legally, the entity will change from a departmental corporation to a commission.

The new Commission can have up to seven members, two more than the AECB, some of whom can be full-time (although that is not, reportedly, contemplated at this time)and will have more defined powers regarding public hearings, and review and appeal processes.

While the AEC Act was aimed at security, the new NSC Act identifies protection of health, safety and the environment. It is expected that the new Commission will give particular attention to environmental protection over the next few years.

Other features of the new Act are:

- powers of inspectors are spelled out
- penalties are increased up to $1 million
- financial guarantees will be required to cover the cost of decommissioning
- provides for (formal) arrangements with other departments and provinces.

Many of the conditions and requirements previously stated in licences will be spelled out in regulations. The regulations necessary for the Act to be declared in force have been under preparation for about two years. They were issued for public comment in the early summer of 1998 and drew over 1500 responses. These were considered and the "final" proposed Regulations were published formally in the Canada Gazette in October 1998. This final round elicited a further 500 or so comments, which has, reportedly, surprised AECB senior staff and delayed the date for putting the Act into force until June 1999.

In closing

Although the faces around the "executive committee" table have not changed with the AECB's most recent re-organization, the Board appears to have a new, directed and focussed approach in anticipation of its transformation in to the *Canadian Nuclear Safety Commission.* In her role as president, Dr. Bishop is determined to continue to enhance the credibility of the Board (or Commission) and argues, convincingly, that the nuclear industry needs a strong, visible, and credible regulator if it is to retain public support.

For further information visit the AECB's Web site at < www.gc.ca/aecb >

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Organization of the AECB

President and Chief Executive Officer		**A.J. Bishop**
Advisory Committee on Radiological Protection	Chairman	A.M. Marko
Advisory Committee on Nuclear Safety	Chairman	A. Pearson
Group of Medical Advisers	Chairman	S. Vlahovich
Legal Services Unit	Senior Counsel	A. Nowack
Audit and Evaluation Group	Manager	R. Maddocks
Secretariat	**Director General**	**P. Marchildon**
Secretary of the Board		P. Marchildon
Communications Division	Director	S. Copeland
External Relations and Documents Division	Director	C. Maloney
Non-Proliferation, Safeguards and Security Division	Director	H. Stocker
New Act Implementation Group	Manager	R. Brown
Board Services Group	Manager	B. Gerestein
Directorate of Reactor Regulation	**Director General**	**J. Harvie**
Power Reactor Operations Division	Director	R. Leblanc
Power Reactor Evaluation Division	Director	M. Taylor
Safety Evaluation Division (Analysis)	Director	P. Wigfull
Safety Evaluation Division (Engineering)	Director	K. Asmis
Directorate of Fuel Cycle and Materials Regulation	**Director General**	**M. Duncan**
Uranium Facilities Division	Director	T. Viglasky
Wastes and Decommissioning Division	Director	R. Ferch
Materials Regulation Division	Director	R. Thomas
Research and Production Facilities Division	Director	A. Aly
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	Director General	**J. Waddington**
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Personnel Qualification Assessment Division	Director	G. Schwarz
Performance Evaluation Division	Director	K. Pereira
Technical Training Group	Manager	J. Didyk
Research and Support Group	Manager	I. Grant
Directorate of Corporate Services	**Director General**	**G. Jack**
Human Resources Division	Director	D. Vermette
Finance Division	Director	G. Bergeron
Information Management Division	Director	W. Goodwin

An Interview with the President of the AECB

Dr. Agnes Bishop

(Ed. Note: In connection with our review article on the Atomic Energy Control Board we requested, and were kindly granted, an interview with Dr. Agnes Bishop, the AECB's president. This was our second such interview, the first being three years ago in 1995 on the anniversary of her first year in that post. (See Vol. 16, No. 3)

Following is a selected and occasionally paraphrased account of our discussion, which took place December 22, 1998.)

CNS Earlier in 1998 the AECB issued draft Regulations under the new Nuclear Safety and Control Act for public comment and received a large number of responses. You have recently published proposed Regulations, formally in the Canada Gazette. Did you receive further comments?

Bishop Yes, there were close to 600 comments from 68 sources. Many of these were repeats of comments submitted earlier. AECB staff are reviewing these in detail and plan to meet with major commentators early in 1999. We still hope to finalize the Regulations so that the Act can be put into force about March 31 (1999). (Later, senior sources at the AECB reported that the target date had been set back to June 1999.)

CNS The new Act does not continue the ex-officio membership of the president of the National Research Council. What is the position of Dr. Carty when the transition occurs?

Bishop Because he is a member of the Board by virtue of being president of NRC Dr. Carty will not automatically become a commissioner in the Canadian Nuclear Safety Commission. The other [appointed] members of the Board will become members of the CNSC for the duration of their current appointment to the AECB.

CNS The new Act specifically permits arrangements with [other federal] departments and provinces. Do you expect to pursue these?

Bishop Yes. Discussions have already begun. We believe that it is important to minimize duplication and to harmonize requirements. Appropriate memoranda of understanding are needed and will be sought.

CNS Regarding relations with provinces, the particular area of uranium mining has always been a contentious one. Will you be proposing changes?

Bishop There is a need for further meaningful discussion with Saskatchewan. It will take good will of both parties to achieve the best system. In this context, AECB staff have met with uranium mining industry representatives and found there were many points of agreement.

CNS Will there be an increase in the size of the staff with the transition to the new Commission?

Bishop We are at about 425 now and I do not anticipate any significant increase. Thee will be some increases in special areas but not overall.

CNS Despite the major internal review that you conducted in 1996 the revised organization announced at the beginning of 1998 was not very different from the previous one. Does that imply there was no need to change?

Bishop Moving boxes [on an organization chart] is the least important aspect of a re- organization. What is important is to change the "culture", to break down barriers that have developed and to improve the management style. There will be more of a project approach, with more communication between divisions and between all levels of staff. As an

example of increased openness, the minutes of the Executive Committee meetings are now available to all staff. We also intend to improve communication with all of our stakeholders.

CNS Protection of the environment is now explicitly stated in the new Act. Does that imply there will be new regulations in that area?

Bishop No. Nothing is anticipated in the near future. However, the AECB or CNSC and the nuclear industry must demonstrate that the environment is being protected. It is not sufficient just to say so. The public is concerned and it is not unreasonable to expect licensees to demonstrate that they are protecting the environment, including non-human biota. It will be necessary to develop systems that will provide the needed demonstration. I am surprised by the [negative] attitude of some members of the industry.

Regarding dose limits for non-human biota, these are not envisioned at this time and would be instituted only if there were compelling reasons to do so.

CNS You have been active in the International Nuclear Regulators Association. Have you found that worthwhile?

Bishop Yes. It is important for the heads of the major nuclear regulatory organizations to sit together, discuss problems candidly and identify common problems. Through this I believe there will be greater harmonization [of standards] over the next decade, without removing individual national responsibility.

CNS What are some of the common problems?

Bishop A major one is market deregulation. Regulators wish to ensure that the increased competition that results from deregulation does not lead to decreases in safety. As for the re-structuring of Ontario Hydro, not all of our concerns have been addressed, although, we have been given assurance that the funds needed for the nuclear recovery plan will continue to be available.

CNS Three years ago you commented that enhancing the credibility of the AECB was a high priority. Do you still feel that way?

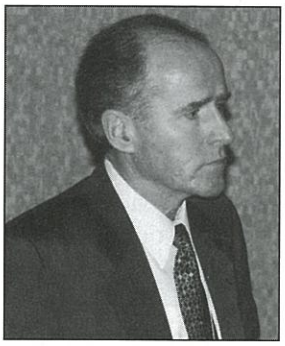
Bishop Yes. It is very important to have credibility with all stakeholders. This requires measurements of performance that can be communicated. A pilot program is underway.

CNS Finally, we are pleased that you have removed the restriction against AECB staff joining the Canadian Nuclear Society. Do you have any suggestions how they can be encouraged to do so?

Bishop I do not feel that I am in a position to push staff to join any professional society. It is up to the CNS to come up with ways to encourage AECB [or CNSC] staff to join.

Nuclear Power in the Twenty-First Century: A Reality Check

by Gary Kugler[1]



Gary Kugler

Ed. Note: *In his opening address to the plenary session of the 19th Annual Conference of the Canadian Nuclear Society, Gary Kugler gave an interesting look into the future of nuclear power. We felt that the readers of the CNS Bulletin who could not attend the conference would be as intrigued as we were with his perceptive analysis. The following is a slightly edited version of his notes for that presentation.*

Introduction

This paper has an ambitious target: to project 100 years into the future. As the end of the 20th century approaches, it is tempting to look ahead to the 21st, and to gaze into the proverbial crystal ball.

This paper is drawn from a number of reputable sources of energy-related information: recent papers from the World Energy Council, papers based on data from the IAEA, the OECD, the IEA, and the IIASA (International Institute for Applied Systems Analysis), as well as some very good papers from the Pacific Basin Nuclear Conference (held just last May in Banff). Reference was also made to a report prepared by the President's Committee of Advisors on Science and Technology Policy of the U.S., which was prepared last year, and to which I had the opportunity to provide some input. This panel included some "deep" thinkers who had no special preference for any energy source, but they did care about the well-being of future generations. These sources represent a wealth of information, but it isn't easy to sift through the diverse opinions and derive meaningful sign posts for the next century. To this information I add my own views and those of many decision makers in the energy sector whom I have met during my career. Their views and insight can not be ignored. They and their staff are setting the policies that will shape the future.

What emerges from reviewing this data is that the near-term and the long term future for nuclear power appear reasonably clear, whereas it is the mid-term that's cloudy. By near-term I mean the period to the year 2010, the mid-term to 2050, and the long-term to the end of the 21st century and beyond.

First, let us set the overall energy scene for the next century.

Drivers of Energy Demand

Population growth and socioeconomic factors are the primary drivers of energy demand. All others, such as economic growth, urbanization and electrification flow from these.

Population Growth

World population stands at 6 billion today and is increasing at 1.5% per year. Expecting that this rate will decline as nations develop economically, the World Health Organization projects world population to reach about 10 billion by 2050, and most of the growth will occur in developing countries that consume relatively little energy today.

Socioeconomic Factors

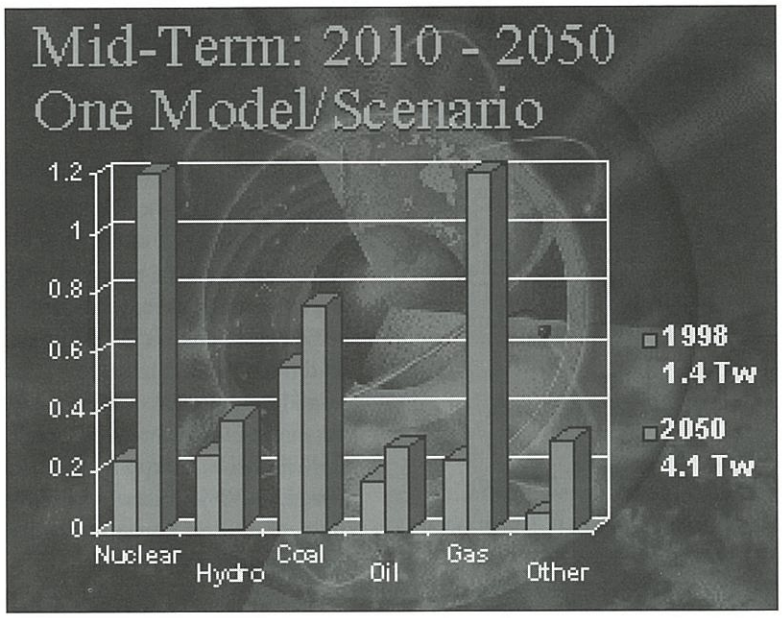
An equally important driver is socioeconomic in origin. The wide-spread availability of communications technology is leading to unprecedented dissemination of information and ideas around the world. Peoples in different countries are becoming increasingly aware of inequities in the quality of life among nations. And even amongst the poorest, a desire of a better quality of life is awakening. At the same time, the social conscience in advanced countries aims to reduce or eliminate famine and suffering. These forces will become major drivers for social and economic development in the next century. They are unstoppable because they are born of basic human need and desire. The improvements in quality of life that peoples in developing nations desire will require increased per capita use of energy, particularly electricity.

Overall Energy Consumption

Global energy consumption today is at a rate of 11 terawatts (1 terawatt = 1000 gigawatts). Thus, average per capita consumption is 2 kW. Based on studies by the World Energy Council, which take credit for improvements in energy conservation and efficiency, world energy consumption rate is expected to reach 32 terawatts, or about 3.2 kW per capita, by 2050. As reference points, Argentina, Mexico, and Portugal consume roughly 2 kW per capita today; Greece, Ireland, and Poland are at 3.2 kW per capita; and the U.S. and Canada are above 10 kW per capita.

1 Gary Kugler is Vice President, Commercial Operations, Atomic Energy of Canada Limited

Electricity consumption has traditionally been greater in developed nations than in developing nations. Therefore we would expect the share of electricity to increase in future, as developing nations will consume proportionately more energy. However, even in the conservative scenario where the ratio of electricity to total energy consumption remains constant, world average electric power demand, which is currently at 1.4 terawatts, will increase to 4.1 terawatts by 2050, i.e. a threefold increase.



Plans and Models for Energy Projections

The picture for the near-term (i.e. to 2010) is based on a country by country review of existing energy plans. As the period for planning and implementing new energy projects is of the order of ten to fifteen years, the current national plans are likely to be close to what will actually happen in this time frame.

The mid-term (i.e. to 2050) is more difficult to predict. The best that can be done is to run mathematical models of projected growth in population and gross domestic product of each nation, the degree of urbanization and electrification, the per capita use of primary energy sources and of electricity, and to make assumptions about consumer trends and the impact of new technologies.

There are very few dissertations on the long-term energy outlook (i.e. beyond 2050). In all the discussions on "sustainable" development it seems there is an implicit assumption that we don't worry about the future beyond fifty years. Yet, this is a very short time when we consider that in less than two centuries we may have depleted the earth of most of its recoverable energy resources and perhaps have caused irreparable damage to the global environment.

The Near-Term: To 2010

Country-Specific Planning

Plans to 2010 are already in place. (The year 2010 also happens to correspond to the time frame by which nations which signed the Kyoto agreement committed to reduce their CO2 emissions to specified levels.) The plans for each nation are country-specific, and they vary widely, depending on each country's distinct circumstances.

It is doubtful that any new nuclear plants will go into service in North America or Western Europe before 2010. Only one thing could change that: a deliberate government decision in these countries to build new demonstration plants based on advanced nuclear plant designs and to endorse nuclear power openly and fully as an essential component of the global future energy mix. That is unlikely. The word "nuclear" doesn't attract votes today.

New plants will continue to be built in a select few countries, namely Japan, China, Korea, Romania, Turkey, Russia, India, Pakistan, and possibly in one or two South East Asian countries, and in a small number of East European countries. In total, fewer than ten percent of all nations will bring new nuclear plants on-line before 2010.

These short-term projections are reasonably firm. Even in the most optimistic scenario, where nuclear power would be widely embraced, there will be little change in the foregoing scenario. The deliberations that shaped these plans are based on projected electricity demand, comparative economics, public perceptions, technologies and regional availability of resources that prevailed over the past few years, while these plans were being formulated. They are not likely to change. To see why not, it may be instructive to look at how nuclear power projects come together.

Time Period for Implementing New Nuclear Power Projects

The process from declaration of intent by a utility to build a new plant to a firm contract and start of work would typically take two to three years. Given a six to seven year project schedule, the time from plan to completion normally spans a decade. Given the current plans of the various member states of the IAEA, it is unlikely that any new plants will be put into service before 2010, except in the countries I mentioned previously.

Impact of Deregulation on New Nuclear Plants

Apart from the time needed to bring new nuclear plants into service, there are new realities at work in the global market that will discourage building new nuclear plants. Deregulation (or re-regulation, as some call it), privatization, and new, more efficient coal and gas technologies will also work against broader adoption of nuclear power before 2010.

Virtually all nuclear power plants built in the past were built by utilities that operated in a monopolistic electricity market. As such, the risk in financing and building a project could always be passed on to the ultimate customer, or ratepayer, i.e., the ratepayers were ultimately charged whatever the plants cost.

Canada and the U.S. are on the road to deregulating their electricity markets. Some countries, such as the UK and Argentina

have already done so and are ahead of us. Deregulation is unstoppable. It is consistent with the current ideology that competition fostered by deregulation and privatization leads to greater efficiencies in businesses, in markets and in the economies of nations. Increased deregulation will have the effect of shifting risk from ratepayers to utilities and their investors. No longer will utilities, whether private sector or government-owned, have monopolistic electricity markets that would guarantee repayment of their investments. Private money will not wait that long. This is the second reason why an early return to construction of nuclear plants in advanced countries is unlikely.

Only governments might take the longer-term view and only government-owned utilities could accept the long-term risk that construction of a new nuclear plant in a deregulated electricity market would entail. Governments ought to be concerned about the global climate and about security of electricity supply, and they ought to recognize that by burning the planet's finite supplies of fossil fuels they may be foreclosing a petrochemical future for the 21st century and beyond.

Impact of Deregulation on Currently Operating Nuclear Plants

What about the effect of deregulation on current, operating plants? The conventional wisdom appears to be that plants operating reliably and efficiently will compete well against coal, oil and gas. If you look at production cost alone (i.e. O&M and fuel cost), last year nuclear electricity for an average plant in the US was in the range of US 1.9 cents/kWh,, and somewhat less for operating CANDUs. This compared to about US 1.8 cents/kWh for coal, US 3.4 cents/kWh for gas, and US 4.4 cents per kWh for oil. Clearly, the production cost of current nuclear plants is competitive with fossil fuels.

What is not yet clear is the portion of stranded costs that will be recoverable. However, the reality is that these plants have already been built, and if they are competitive on production cost they will continue to operate as long as their production cost remains competitive. That brings up the question of life-extension of current nuclear plants, which leads into the mid-term, i.e. the period from 2010 to 2050.

The Mid-Term: 2010 - 2050

Life Extension of Operating Nuclear Plants

One half of currently operating reactors will reach their design life or licence limit by the year 2015. This represents about 200 reactors world-wide. Most of these reactors will probably continue to operate for a further 20 years.

Current estimates are that, for relatively small sums, the life of these reactors can be extended for two or more decades beyond their original design life or operating licence. Currently operating CANDUs would require replacement of pressure tubes, and, in some cases, of steam generators, in addition to other less costly upgrades. Pressure tubes have already been replaced in Pickering A reactors, and AECL has developed "fast-retube" technology, such that all the tubes in a CANDU 6 reactor can be replaced in less than a year. With pressure tube replacement, the operating life of a CANDU can be extended for another 20 to 30 years. This would buy 600 to 900 MWe of capacity at a capital cost lower than any available alternative, including new coal, oil, gas, or hydro. And production costs for nuclear being lower than those of most of the fossil plants, I am confident that utilities will decide to extend the life of these units.

Assuming that pressure vessels for light water reactors could be shown to be good for another ten to twenty years beyond their current design licences of 40 years, I would think that most of these units, as well, will be extended economically. But that would not be sufficient to meet the projected increases in demand in that period.

New Supplies of Nuclear, Gas and Renewable Energies

This is where the window to the future gets cloudy. The picture depends very much on the models assumed.

As noted earlier conservative projections are for global electricity demand to increase from a current level of 1.4 terawatts to 4.1 terawatts by 2050. Even the World Energy Council, which is traditionally dominated by fossil fuel interests, has acknowledged that nuclear power must play a greater role in the future. Assuming, therefore, that nuclear's share of electricity supply will increase from a current level of less than 20% of global usage to 30%, this would require the addition of 1 terawatt of nuclear electric power capacity, i.e. the equivalent of 1000 large nuclear units by 2050.

To put this into perspective, this would still leave the bulk of electric capacity to be provided by other means. If we assume that coal and oil usage are held constant, rather than reduced, and hydroelectric resources are expanded to their full potential, then roughly 1.5 terawatts of capacity would still remain to be supplied from gas, solar, and other renewable resources. Meeting this demand would require a tenfold increase in energy production from these sources.

Advances in Clean Fossil Fuel Technologies

The mix of energy supply will depend to a large extent on the degree to which government policies will place a priority on preserving a sustainable environment. Advances in coal and gas technologies will lead to new, more efficient plants that will substantially decrease the amount of greenhouse gases and other pollutants released to the atmosphere on a unit energy basis. A reduction in energy intensity will reduce the amount of energy needed for specific purposes.

Gains of 25% in energy efficiency for heating of new buildings are not unrealistic. The development of microturbines with even higher efficiencies than today's gas turbines is also likely. A one-fourth reduction in energy intensity of the major energy-consuming industries, such as forest products, steel, aluminum, metal casting, chemicals, petroleum refining, and glass, is also on the horizon. CO_2 capture and sequestration technology are being investigated. Passenger cars and trucks with gas consumption one-half to one-third of current rates are under development. All of these will reduce fossil fuel consumption and emissions of CO_2 and other pollutants. But the total amounts consumed and emitted will continue to increase still.

Shift from Coal to Gas

There, likely, will be a shift from coal to gas for electricity production, as the latter is unquestionably cleaner. But it won't be overnight. Coal plays a very large role in electricity production today. It will continue to play a very large role for several decades, especially in developing countries such as India and China, which have more than one-third of today's population. Gas is not widely available to substitute for coal in these countries. And the existing capital, industrial infrastructure and human resources for nuclear can not fill the gap that a large scale movement away from coal would require in this relatively short time frame.

Fossil Fuel Resources

As for resources, proven reserves of oil and gas are measured in terms of two to three decades at current consumption rates. However, the gas and oil industries' projections, based on past experience, are that new reserves will be found as quickly as they are depleted. They point to the fact that proven recoverable reserves today are greater than they were thirty years ago. Based on this reasoning, and adding the resources locked-up in tar-sands, they claim there will be adequate supplies to last the next century and for some time beyond. Therefore, fossil fuel resource limitations will not be a factor in the mid-term.

Impact of Government Policies

Left to itself, the energy sector will respond to market forces. If government policies put a premium on the environment and require those burning fossil fuels to internalize their pollution and waste costs, as nuclear plants are doing today, nuclear will compete effectively in the market place of the next century. If prudence is to be exercised and the risk of global climate catastrophes avoided a level playing field is needed . Government leadership is imperative to achieve this. In democratic societies governments generally reflect the will of the people. Therefore the key to getting government action is to mobilize public opinion to make this happen.

Global Warming Concerns

Consistent with public opinion, global climate change and other environmental concerns are high on the agenda of policy makers, and they will, likely, become the most important factors in deciding the share of nuclear power in the mid-term. Other papers [at the conference] discuss this issue.

The Long-Term: Beyond 2050

The long-term view is clearer than the mid-term. The logic is simple:

- energy demand will increase substantially;
- large scale combustion of fossil and carbon based fuels, even with cleaner and more efficient technologies, is not environmentally sustainable in the long-term;
- hydro power is limited by available rivers and has its own environmental drawbacks;
- solar, wind and other renewables are not yet economical and even a tenfold increase in their current share of energy supply will not obviate the need for replacing sizable fossil fuel capacity.
- save for a new technology not yet discovered, the increased application of nuclear to allow for a reduction in fossil fuel burning is imperative and, indeed, inevitable, in my view.

Sustainable Development

"Sustainable development" is the guiding principle for energy policy makers of the present generation. It is understood to mean that, as nations grow in population and develop economically, a sustainable balance must be achieved and maintained between human activities and the natural environment. In more practical terms, "sustainable development" would require that in any human activity:

- the least amount of material should be used;
- alternative materials should be used where possible;
- the least amount of waste should be produced;
- waste should be recycled where possible;
- and, this should be done profitably.

Nuclear power satisfies these criteria better than any other energy generating process currently known to mankind. Nuclear power uses uranium as a fuel, and:

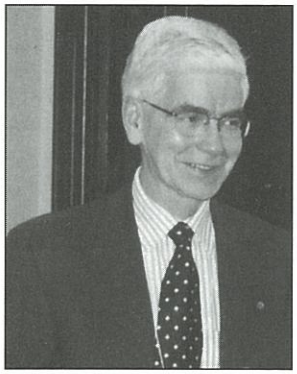
- for the same amount of energy generated, nuclear power plants use less material than any of the alternative processes, by several orders of magnitude;
- uranium is an Alternative@ material, in the sense that it has no other major uses, and hence depletion of this resource is not a concern;
- nuclear power produces the least amount of waste;
- when required, the bulk of the waste can be recycled; and,
- given a level economic playing field, nuclear power can be profitable for its investors. In particular, a level playing field would require the cost of containing or neutralizing the wastes from combustion of fossil fuels to be internalized, as they are for nuclear energy.

A realistic scenario for the 21st century means diversification. No single technology known today can deliver sustainable energy throughout the next century. More efficient and less energy intensive means of using fossil fuels are needed. And our reliance on fossil fuels must be reduced. Hydro, where it is available and acceptable, is needed, as are renewables, where their application is economical and appropriate. And, more nuclear is needed because it is available, and, above all, it is environmentally acceptable.

When I ask people about nuclear power for the long-term: some say "maybe", some say "maybe not". I say "absolutely".

From scientific evidence to radiation protection: A perspective of four decades

by R.V. Osborne[1]



Richard Osborne

Ed. Note: The following paper is the text of a special invited presentation by Richard Osborne at the Annual Conference of the Canadian Nuclear Society in Toronto, October, 1998, to lead off a session, co-organized with the Canadian Radiation Protection Association, to recognize Richard's forty years of contribution in the field of radiation protection.

After his talk Richard was presented with a special gift from the CNS and CRPA. (See CNS News section.)

Preamble

I have had the good fortune to have been involved in a wide spectrum of radiation protection activities - instrument development, dosimetry and biokinetics, environmental radioactivity and biological effects (these four, the "evidence" side of my title), and developments in practical radiological protection. In this short presentation, I shall highlight just some of these involvements. First will be the measurements of fallout and natural radioactivity that in 1959 started me in the business of radiological protection; second will be the R&D on tritium-related matters that occupied much of my hands-on research career through the 1960s and 1970s with AECL at Chalk River; and the final topic will be the studies involving the application of collective dose in radiological protection. The first two are examples of the R&D around the world that now supports the complex system of protection recommended by the ICRP. The third raises fundamental issues in the protection system, related to the assumption of linearity of response to dose, to individual variability and to the uncertainties in predictions of exposures and doses over long times. The current rapid advances in biological understanding of genetics and disease, while resolving some of these issues, may well lead to a more complex approach to protection, with a concomitant need for new directions in R&D.

Introduction

In the late 1950s, concern about radioactive fallout from nuclear weapons testing in the atmosphere was prompting research on methods for measuring radiation and radionuclides, on environmental transport of radionuclides, and on their biokinetics and health effects. There was also great interest in the development of atomic power plants that would, it was realized, lead to many more people being occupationally exposed. The incidence of leukemia was recognized as being significantly increased in radiologists, as was that of bone tumours in groups contaminated with bone-seeking radioactive substances. There was insufficient information to estimate a threshold for these effects; it was thought that the permitted lifetime dose of the 1950s (7.5 Sv) would likely exceed it, particularly for some susceptible individuals. Genetic damage was seen as the main concern for populations and it was seen as highly desirable to keep the exposure of large populations at as low a level as practical. In 1958, the first report of UNSCEAR, whose formation in 1955 had been prompted by concerns about the effects of fallout from nuclear weapons, provided some early estimates of the doses from fallout and natural radionuclides in the environment [1]. In 1960 a committee of the UK Medical Research Council revised the fallout doses downward but continued to express misgivings about the behaviour and impact of fallout and noted the likely usefulness of learning more about the natural radiation environment [2].

Fallout and natural radioactivity

When I went to work as a graduate student in the Institute of Cancer Research in London in 1959, the search for fission products and fissile materials in the environment was bringing a much greater awareness of the ubiquity of natural radionuclides in the biosphere and of the high exposures that there could be from some materials and in some areas. Professor W.V. Mayneord=s department in the Institute was taking a leading role in these explorations. One challenge was to distinguish the weapons-related plutonium-239 from the naturally-occurring alpha-emitter polonium-210, that was held up by the longer-lived lead-210 in most environmental materials. I was faced with either a lot of chemistry or

1 Dr. Richard Osborne retired as Director, Health and Environmental Sciences Division, AECL-CRL, in the spring of 1998.

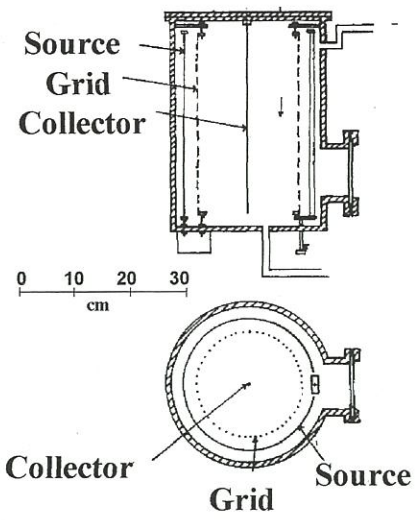


Figure 1: Alpha particle spectrometer, a cylindrical gridded ionisation chamber with 1500 cm2 source area [3]. The counting gas was a 90/10 mix of argon/ methane, at 2 atmospheres, circulated through a purifier. The best resolution obtained was 40 keV full-width at half maximum peak height.

with designing a spectrometer that could achieve the resolution needed with sources of very low concentrations of activity. With a physicist's natural disinclination to do any chemistry and following Kit Hill's lead in alpha spectrometry, I built a large-area, gridded ionization chamber with 40 keV resolution (Figure 1), sufficient to resolve these radionuclides [3], and was able (Figure 2) to follow the 1962 spring peak in plutonium fallout [4]. With the results from measurements I made on human lungs (where I did have to do some chemistry), I was able to verify that

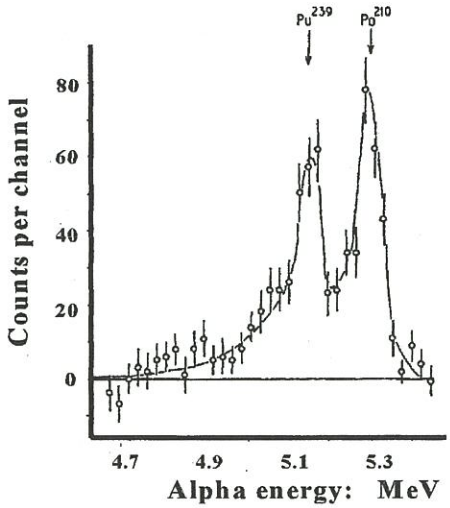


Figure 2: Spectrum of plutonium-239 in atmospheric dust in the UK, 1962 May 7-9 [4]. The sample was collected from 500 kg air and was counted for 116 hours. The ^{239}Pu concentration was ~ 7 μBq/kg of air.

the "standard man" model of the time for plutonium inhalation was reasonably consistent with observations.

The spectrometer design found its way around the world. Merril Eisenbud and Bob Drew of the Institute of Environmental Medicine at NYU applied it in their work in the high natural background area of Brazil. Also, I was astonished to find a replica of the design in Crocodile Dundee country, near Darwin, Australia, in 1988, in the uranium mining district.

In the early 1960s there was not much known about doses to soft tissues from natural radionuclides so, taking advantage of being associated with a large hospital, I obtained and assayed human kidneys and other soft tissues to measure polonium-210 and lead-210. The results led to some early estimates of the biokinetics and doses to soft tissues from these radionuclides [5]. The values published in Nature were in the range of the many values later measured by others such as Richard Holtzman at the Argonne National Laboratory in the 1970s. We also realized

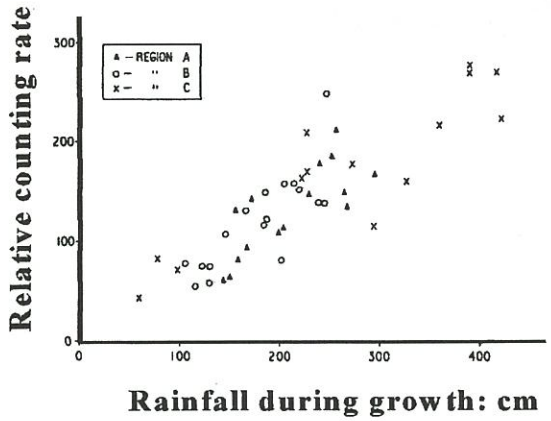


Figure 3: Natural fallout on grass, showing the correlation of alpha activity with rainfall during growth. The grass samples were collected from various locations in Wales in 1960.

that natural radionuclides could be tracers for environmental processes. A pleasant grass-sampling tour of Wales provided results that demonstrated washout of natural radionuclides (Figure 3).

Now, nearly 40 years later, the dominant contribution that natural radioactivity and radiation makes to most people's exposures is well documented. The radiation doses received from natural background have provided B and I suspect always will B a helpful perspective in managing small, man-made, increments in radiation doses, given the continuing uncertainty in their biological consequences.

Tritium

Developments in instrumentation, in describing environmental processes, and in biokinetics and radionuclide metabolism continued apace around the world through the 1960s and 1970s, particularly in well-funded national nuclear research laboratories B of which Chalk River was one and where I arrived in 1963. These were the halcyon days of R&D related to radiological protection.

Semiconductor technology enabled great strides to be made in the portability and capabilities of instruments, and these improved measurement capabilities led to sounder protection practices as well as enabling many tracer experiments to be carried out in the environment, in animals and in people. The result was that by the end of the 1970s, there were extremely detailed biokinetic models available for internal dosimetry and there were local, regional and global models for estimating the environmental transport of radionuclides. Many types of radiation instruments that earlier had been only of the homemade variety had become commercially available.

At Chalk River through this period, prompted by Art Marko and George Cowper, my interest shifted from fallout and natural background radiation to tritium. We set out to define the hazard from tritiated water vapour (HTO) B and here I certainly depended on many of my colleagues who volunteered, not only to be subjected to exposures to traces of HTO vapour in a small instrumented chamber, while near-naked or in a variety of

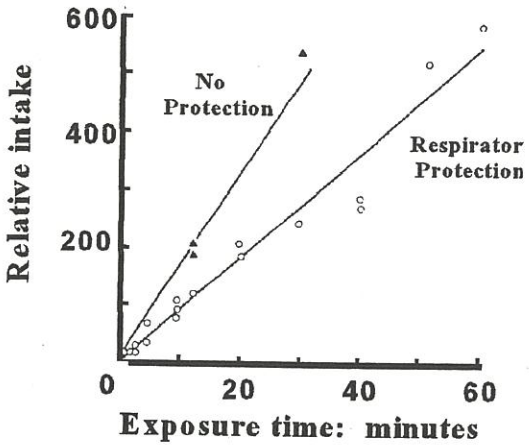


Figure 4: Intake of tritiated water vapour by inhalation and through the skin as determined experimentally [6]. Providing respiratory protection reduced the intake by about a factor of 2 as shown. Other results showed that overalls provided essentially no protection, that a single, unventilated 4 mil plastic suit provided a protection factor of 20 – 200, and a sandwich of two such suits with a wet overall between provided a protection factor of at least 1900.

protective garbs, but also to producing urine samples serially for the next few hours [6] (Figure 4). The volunteers can be pleased that the permeation properties of their skins are reflected in the ICRP model for tritium.

The skin is remarkably well behaved in its permeation properties. Fickian diffusion kinetics are closely followed, with a lag time through the skin of about 10 to 20 minutes. I obtained these estimates from the whole person exposures and also from a series of exposures of small areas of various volunteers= skin, where the lag time could be obtained from an analysis of the desorption curves after the end of an exposure [7]. One question was whether increased blood flow in the skin capillaries would enhance tritium intake. I sought to find this out on myself by exposing part of my arm to HTO vapour under conditions of high vaso-dilation, brought about pharmaceutically. I did not have the nerve to seek a volunteer for this. I can remember being incredibly beet-root red all over for some time afterwards, to the consternation of colleagues who saw me running between the lab and the washroom to provide urine samples. The answer, incidentally, was that it did not make any difference to the eventual intake.

My colleague, Bill Bush, and I were able to get a measure of the protection provided by various non-ventilated suits in this exposure chamber. One suit that we tried, a sandwich of a wet cotton coverall between two thin plastic layers, provided by far the highest protection. We had to use exposures to many thousands of DACs (or MPCs as they were then) for an hour to get a measurable intake [6]. I have always been disappointed that we never managed to exploit this idea.

Operating experience at NRU, at NPD, and then at Douglas Point NGS, brought home to us the need for portable and fixed tritium-in-air monitors that could work in gamma backgrounds and could discriminate against radioactive noble gases, and the need for tritium-in-water monitors for effluent and for bioassay. Of course, this is still a perceived need. Why it is so provides a useful lesson.

George Cowper, Doug Simpson and Bill Merritt in the late 1950s and early 1960s had tried ionization chambers and proportional counters for monitoring tritium in air [8, 9]. Through the next two decades Art Coveart, Norm Tepley, Mike Wood, Ric Surette, Bob McElroy and I designed and built a variety of devices B with varying degrees of success. Gamma-compensated ionization chambers have the advantage of simplicity and they can achieve moderate gamma compensation - and they have proved to be reliable, as indicated by some of the original models [10] still being in operation at Chalk River after more than 33 years (Figure 5). Noble gases, if present, mask the tritium signal and one solution, employed at Douglas Point to combat the argon-41 interference, was to have a second pair of ionization chambers that measured the sampled air after the

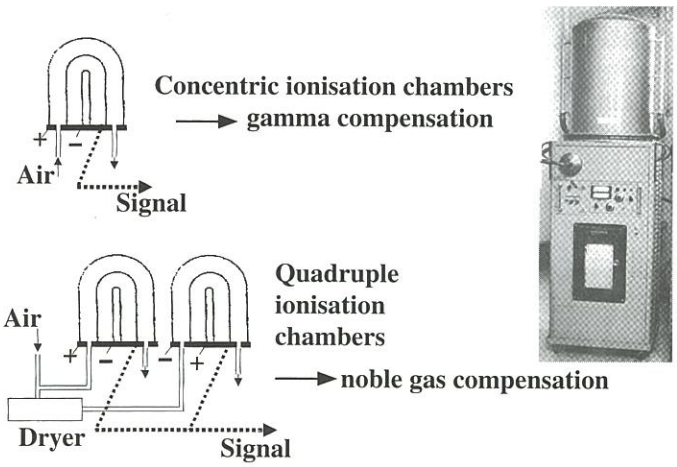


Figure 5: Tritium-in-air monitoring with ionisation chambers. The monitor illustrated has been in use at Chalk River since the 1960s.

HTO had been removed by dryers [11]. We also put this one on wheels as a transportable monitor [12]. In another design, HTO vapour was captured in a water stream and the tritium detected in a flow cell containing sheets of plastic scintillator [13] (Figure 6). A similar flow design was used for monitoring tritiated water streams directly in the early CANDU-6 stations [14]. We also tried semi-permeable membranes to separate HTO from noble gases [15] and also tried detection cells with a mixed

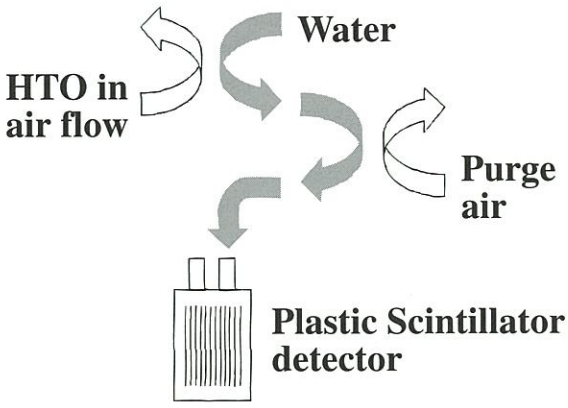


Figure 6: Tritium-in-air monitoring with scintillators. In the method shown, HTO vapour is captured in water flowing to a detector containing plastic scintillator [13]. In other devices, the HTO vapour has been captured directly by liquid scintillator or has been introduced into liquid scintillator through a semi-permeable membrane.

flow of tritiated water and liquid scintillator [16]. Liquid scintillator detection was also the basis of the automatic urine analyzer that saw extended service in NPD but only a brief one in Pickering NGS [17,18].

The difficulty we had B and I think is still a difficulty B was in keeping fluid processing systems clean when these instruments were deployed in generating stations. Regular preventive maintenance was essential B to change filters, to clean sampling lines, to maintain insulators in ionization chambers, and to keep good optics in scintillation detectors. At Douglas Point, Ranjit Mohindra was a local champion for the ionization chamber-based design and ensured it was looked after. Similarly, the complex urine analyzer at NPD was well maintained by a succession of local champions, but at other stations we never managed to get preventative maintenance routines in place for any of the instruments and most devices in these places eventually plugged up and became in-operable.

My younger colleagues have continued with new detection methods, taking advantage of the computer chip technology of the last decade. Detector signal processing can now achieve far more than used to be possible and the greater control possibilities that this technology offers means that far more in the way of self-diagnosis and even self-cleaning is possible. Nevertheless, I believe that unless there are local champions for these necessarily-complicated instruments in nuclear power stations, future designs may not be that much more successful.

The most successful of the suite of designs we produced in the 1960s and 1970s has been the simplest one. Despite being pushed for more sensitivity and better gamma compensation than was provided by an early design of portable ionization chamber-based instrument [19], I decided we would aim for low cost and reliability with a no-frills, lightweight device, that would measure an MPCa (as it was then) with reasonable gamma compensation. Art Coveart and I went on to develop the prototype of such an instrument [20] and, brought into com-

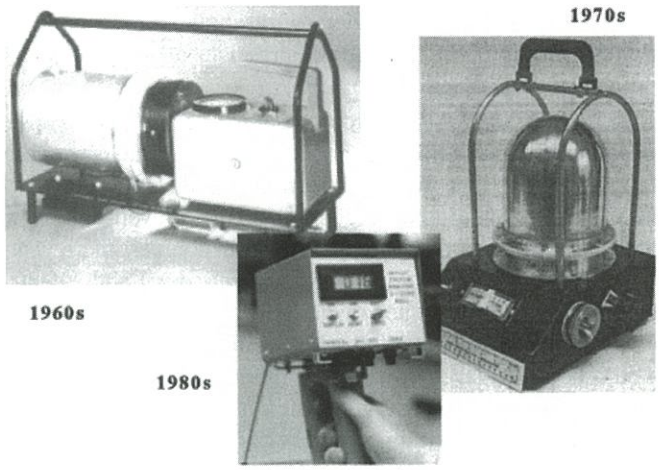


Figure 7: Evolution of portable tritium-in-air monitors [10, 19, 20]. The 1980s model is the prototype of the current Scintrex Model 209.

mercial production by Scintrex, it continues to be a best-seller as their Model 209 (Figure 7). The unusual orange colour that it still has, by the way, is a carry over from the prototypes that we painted to match the battery pack that we used; one that was available from Black and Decker for its range of power tools.

Practical applications of ICRP recommendations; the collective dose problem

We have seen an enormous increase since the early 60s in our ability to measure our radiation environment, to estimate the distribution of doses in tissues from internal and external sources, and to predict the behaviour of radionuclides, both in the environment and in people. An important part of that ability has been an appreciation of the magnitude of uncertainty in predictions, gained particularly in the last decade through programs such as BIOMOVS (and more recently in the IAEA's BIOMASS) that we and the AECB strongly supported from its initiation, and in which Peter Barry and his colleagues at Chalk River have had leading roles. I think it was something of a shock to some modellers to find out just how disparate predictions by reputable modellers could be, both from one another and from actual observations. The reappraisal of models and implicit assumptions has led, now, to much better definition of the envelopes of uncertainty in predictions.

The envelope of uncertainty between small increments of radiation dose and consequences to health remains frustratingly large though, despite the extremely detailed insights that we now have about cellular processes (and carcinogenesis in particular) and about the influence of genetics on disease. Radiation protection for decades has been predicated on the concept that, for practical purposes, an increment in dose, albeit with many modifying factors, is the appropriate quantity to estimate as a measure of impact on health. There have always been caveats on this and it is the ignoring or misunderstanding of these caveats that has led often to misapplication of protection principles and also to unjustified criticism of the principles of protection enunciated by the ICRP.

In 1962, UNSCEAR provided estimates of the average dose to populations from various sources, most notably nuclear weapons fallout that was then the big concern as noted above [21]. It was very cautious in doing this, recognizing that if average dose was to be a measure of comparative risk from sources, there was an implicit assumption of linearity between dose and effect on health. UNSCEAR argued that there was good evidence for linearity in the relationship for genetic effects (that is, effects that would be inherited), which at that time were of greater concern than were somatic effects for which it acknowledged linearity was much more uncertain. In its 1972 report, UNSCEAR introduced the quantity "man-rad" as a measure of comparative risk, although it stressed that it did not intend to imply that "man-rad" was a measure of total harm because of non-linearities in response, non-uniformities in exposures, time distribution of irradiation and radiation quality [22]. By 1977, the ICRP felt there was enough evidence from accumulating epidemiological data on humans to justify, for protection purposes, continuing the assumption of linearity between incremental dose and somatic effects, which were, by then, seen as the more important. It launched a more comprehensive system of radiological protection with its Publication #26 [23]. By introducing tissue weighting factors and the concept of detriment, ICRP formally set collective dose as a measure of impact on public health. This led to many attempts to apply collective dose in optimizing protection and, unfortunately, to many misapplications.

While it was realized that the collective dose associated with long-lived, globally dispersed radionuclides could be large, it was not evident how practical it would be to employ this quantity in cost-benefit or other types of formal analyses in the management of such radionuclides. I became involved with a group convened by the Nuclear Energy Agency (of OECD) to examine the implications of global collective doses in the management of tritium, carbon-14, krypton-85 and iodine-129 arising from the nuclear fuel cycle, which reported in 1980 [24], and with another one concerned with wastes from uranium mining and milling, which reported in 1984 [25,26]. These studies made very evident the large uncertainties involved in global and regional modelling and in the long-term performance and costs of retention technologies, and the difficulties of dealing with doses far into the future. The overall conclusion, written in the latter report in the circumspect language of international agencies, was that "the cost-benefit approach to optimizing radiation protection can only provide limited inputs to decisions on tailing management." Note that this was irrespective of any inappropriateness of collective dose as a measure of health detriment. The Canadian Radiation Protection Association's workshop on collective dose in 1985 came to much the same conclusion on the difficulties of applying collective dose [27].

There is now a much better understanding of the application of the principle of optimization to practices (for example, in controlling effluents from a nuclear power station) and the role that collective dose can play in it (some may disagree), reflected by the more cautious wording in ICRP 60 [28]. There remain difficulties and misunderstanding, though, when it comes to what the ICRP calls interventions B for example managing the evacuation from, remediation of, or return to a contaminated area. Dose limits intended for protection against new practices are inappropriate in these circumstances, optimization being the recommended approach, but they are often applied and lead to unnecessary worry B and inappropriate decisions. Why is there a problem?

One reason for the problem is the tension between basic ethical approaches B one that puts the individual well-being first and one that puts societal interests first, the so-called utilitarian ethic. This was apparent in the group I chaired for ICRP on protection against radon and progeny in homes and at work (excluding uranium mines). We recommended decisions on remediation in homes or workplaces should be based on levels of individual exposure despite this not necessarily being the most cost-effective way to reduce collective exposures. It was a pragmatic recommendation B if there were high exposures, then you fixed up the home or the workplace; if the exposures were not above a recommended action level, then you did not worry about them. This was very much an "individual-related" approach and was incorporated into the broader ICRP recommendations on radon-222 [29].

The confusion in dealing with interventions and the difficulties associated with the utilitarian approach, has led the ICRP to ask whether there may be a better way to ensure protection of the public; one that puts greater emphasis on the individual and perhaps reflects more the totality of an individual=s exposure from radiation. I am currently chairing a working party on this topic. The intention here is not to bring about a change in the level of protection currently afforded by the present system; rather, it is to provide a way of protecting against exposures to radiation that is more understandable and better accepted by those involved. It is not directly connected to the current arguments over the appropriateness of linearity as a model for radiation protection purposes. Nevertheless, any de-emphasis of the application of collective dose that may come about in such an approach will reduce the temptation to carry out nonsensical estimations of global health effects over millennia.

A final comment

The next decade is likely to produce a leap in our understanding of the genetic control of biological processes and of disease, and of the spectrum of perturbations in this control that radiation damage can produce. This is because of the unprecedented power of the molecular biological tools that are now

available. It is unlikely that there will be found any single simple relationship between a measure of initial damage such as dose and an overall effect on health B beneficial or deleterious. Whether a practical model for protection purposes can be derived that more accurately reflects the actual response of any individual or of a hypothetical composite individual in a population than does the current linear model will be a continuing question. A linear model may remain the best compromise as Norman Gentner and I have suggested elsewhere [30]. We need to be clear that radiation measurements, dosimetry, and environmental modelling would become much more complicated with a departure from an assumption of linearity of dose and response for protection purposes. The instruments and models would need to be much more clever than the ones with which I have been involved in my near four decades. Operational protection, too, would be much more complicated.

Whatever the outcome, it promises to be an exciting time. I hope that my former colleagues at Chalk River will be able to continue to contribute to these advances.

We have, there, a fine animal and irradiation facility in which to ask many of the pertinent radiobiological questions, we have the expertise in dosimetry and instrumentation to meet the measurement challenges that the new biology is likely to bring, and we have the environmental expertise, based on decades of field research, to continue to develop and establish the credibility of the more complex environmental models that will be needed over the next decade.

I acknowledge my indebtedness to all my former colleagues through these four decades. I retain my enthusiasm in the R&D that we undertook and I feel proud of our accomplishments. I hope that those still in R&D will continue to enjoy the support of the industry so that we can be assured of a sound base for radiological protection in the Canadian nuclear industry.

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Radioactive Waste Policy in Canada

by Peter A. Brown and Geraldine A. Underdown[1]

Ed. Note: The following is a slightly edited version of an invited paper given by Dr. Brown at the first Meeting of the Americas *held in Washington, D.C., in November 1998. Although it was written to inform those from other countries in the Americas about Canada's radioactive waste policy and was delivered before the announcement of the federal government's response to the report of the environmental panel on nuclear fuel waste (a summary of which is included in this issue of the* CNS Bulletin *the paper provides useful background and context for that response.*

Introduction

Canada is a federation of ten provinces and two territories. Under its constitution, the provinces have control over natural resources and the production of electricity. Under the *Atomic Energy Control Act,* which was proclaimed in 1946, the federal government has responsibility for the development and control of nuclear energy.

The *Nuclear Safety and Control Act* (NSCA), which received Royal Assent on March 20, 1997, will replace those sections of the *Atomic Energy Control Act* of 1946 establishing the AECB and providing the regulation of the nuclear industry with a modern statute. The new Act provides for more explicit and effective regulation of the nuclear industry, including the management ofœradioactive waste. It will enable the Canadian Nuclear Safety Commission, the successor to theœAtomic Energy Control Board (AECB), to require financial assurances of waste producers as a licence condition, thereby ensuring that the costs of decommissioning nuclear facilities and wasteœmanagement are borne by the licensees and not taxpayers.

There are currently 14 CANDU nuclear reactors in service in Canada and nuclear power accounts for 14% of Canadian electricity distributed amongst the three nuclear energy producing provinces: Ontario, Québec and New Brunswick. Ontario Hydro is the largest nuclear utility with 12 operating reactors (plus 7 reactors that are presently laid up and 1 that is out of service). Hydro-Québec and New Brunswick Power each operate one reactor in their respective province.

The operators of nuclear facilities are responsible for the safe management of the facilities andœmust comply with the regulatory criteria set out by the AECB. AECB licensing is required for the construction, operation and decommissioning of nuclear facilities. Although nuclear energy is an area of federal jurisdiction, the federal regulatory and environmental assessment processes takeœprovincial and territorial concerns into consideration as well.

Radioactive wastes are a by-product of the peaceful uses of nuclear energy, from mining and milling uranium ore through to fabricating uranium fuel and generating electricity. The wastes also result from activities that are undertaken in the many regions of Canada that produce and use radioisotopes in research, industry and medicine. Radioactive wastes are categorized as:

- uranium mine and mill tailings;
- low-level radioactive waste; or,
- nuclear fuel waste.

Producers and owners of radioactive waste are responsible for the management and disposal of their radioactive waste. In certain instances, the federal government has accepted a residual responsibility, when the original producer can no longer be held responsible.

In Canada, radioactive waste is presently stored safely and in a manner that meets the licensing requirements of the AECB. However, there are pressures to move from storage to disposal andœseveral environmental assessment panels have made recommendations to the federal government to move towards a permanent solution for these wastes. Canada must now translate its technical knowledge into the implementation of long-term, cost-effective solutions for radioactive waste. The costs of disposal, estimated to be in the order of $12 to $15 billion over the next 70 to 100 years, represent a small fraction of the cost of electricity production.

While there are many stakeholders involved in the waste management issue, for economic andœother considerations, it is important that a coordinated plan for the long-term management, including disposal, of radioactive waste evolve rather than have each waste

1 Dr. Peter Brown is Director of the Uranium and Radioactive Waste Division of Natural Resources Canada and Geraldine Underdown is a senior officer in that division.

owner or producer develop their own solution in isolation. The federal government recognized this need andœdeveloped a comprehensive and integrated policy framework for radioactive waste. Articulating such a framework was a necessary step in the development of institutional and financial arrangements that will lead to appropriate and effective solutions for radioactive waste in Canada.

Status of Radioactive Waste Management Programs

Uranium mine and mill tailings are a specific type of low-level radioactive waste generated during the mining and milling of uranium ore for the production of fuel for both domestic and foreign nuclear reactors used to generate electricity. Because of their large volumes, these wastes are generally held in containment areas close to the mine sites, and decommissioning is done on site.

In Canada, the waste producer or owner is responsible for funding and carrying out all required decommissioning activities under the regulatory control of the AECB. In the case where an owner or producer cannot be found or cannot fulfill its financial obligations (resulting in so-called abandoned sites), governments are ultimately responsible for the management of these sites to ensure that they do not cause any undue environmental and health risks now and for future generations. A milestone was reached in January 1996 when the Government of Canada entered into an agreement with the Province of Ontario on respective cost-sharing and long-term management responsibilities for abandoned uranium mine sites.

Proposed decommissioning plans are submitted to the federal Minister of Environment under the *Canadian Environmental Assessment Act.* In 1993, for the first time in Canada, an Environmental Assessment Panel began an environmental review of proposed decommissioning plans for uranium mine sites located in the Elliot Lake region of northern Ontario. Public hearings began in 1995 and the Panel submitted its recommendations in mid-1996. The federal government responded to the Panel in March 1997 and announced, in April 1997, that the decommissioning licensing process could proceed. The AECB takes into account the Panel recommendations whileœproceeding with its normal licensing process.

Low-level radioactive waste in Canada is low-level radioactive waste from the application of nuclear energy and includes intermediate-level and decommissioning waste. The latter waste results when nuclear facilities are dismantled at the end of their operational life. For administrative purposes, the waste is classified into two broad classes or categories:

- waste from historical activities
- waste from ongoing activities.

A large proportion of the existing inventory of low-level radioactive waste consists of historic wastes. The wastes, mainly consisting of contaminated soils, are managed in a manner no longer considered acceptable and for which the original producer cannot be held responsible for disposal. In 1982, the government established the *Low-Level Radioactive Waste Management Office* as the federal agent with responsibilities that include the clean-up of sites contaminated with historic wastes.

The bulk of Canada's historic wastes are located in and around the southern Ontario community of Port Hope. These wastes relate to the longtime operations of a radium and uranium refinery in the community.

The federal government was negotiating with the Town of Deep River on the possibility that it would be willing to host a facility for the disposal of low-level radioactive wastes from the communities of Clarington, Hope Township, and the Town of Port Hope. In October 1997, Council of the Town of Deep River passed a resolution withdrawing from the negotiations.

The federal Minister of Natural Resources is now assessing options for resolving this historic waste issue. Discussions are progressing with communities where the wastes are now located to determine if a local solution is a viable option.

Waste from ongoing activities is the non-fuel waste currently being produced from Canada nuclear reactors, nuclear fuel processing and fabrication facilities, and from medical, research and industrial uses of radioisotopes. The three largest waste producers are Ontario Hydro, Atomic Energy of Canada Limited (AECL) and Cameco, a Canadian uranium mining, refining and conversion company. The two other nuclear utilities, Hydro-Québec and New Brunswick Power, the two nuclear fuel fabrication companies, General Electric Canada and Zircatec Precision Industries, and radioisotope producers and users represent most of the remaining producers.

One or more disposal facilities may be required for ongoing waste, and major waste producers are working toward solutions. Ontario Hydro is assessing options that include developing an independent Ontario Hydro facility or working in cooperation with other waste producers to develop a multi-user disposal facility. The other major producer, AECL, is in discussions with the AECB to license a prototype below-ground concrete vault known as IRUS (Intrusion-Resistant Underground Structure) for relatively short-lived waste. At the present time, AECL provides a waste storage facility for small volume producers on a fee-for-service basis.

To dispose of ongoing waste, waste producers need to identify suitable sites, design the disposal facility in accordance with site requirements, and submit their disposal plans for regulatory approval to the AECB before building and operating the disposal facility.

Nuclear fuel waste is the spent fuel that results from generating electricity from Canadian nuclear reactors. Ontario Hydro, with 12 operating CANDU nuclear reactors and 8 reactors that are presently either laid-up or out of service, is the largest producer of the waste, about 90 per cent of the Canadian total. The utility, as a result, has a significant interest in the long-term management, including disposal, of its waste. In addition, small amounts of other fuel waste result from reactors used for research (including prototypes) and for the production of radioisotopes for research, medicine and other industrial applications.

Nuclear fuel waste is safely stored in water-filled pools or dry concrete canisters at the nuclear generating stations. It could

remain safely in storage for several decades. The total volume isœsmall when compared with other radioactive waste, and with hazardous waste from other industries.

Over the last 20 years, a concept for disposal of nuclear fuel waste was developed by AECL in collaboration with Ontario Hydro under the Canadian Nuclear Fuel Waste Management Program, a Canada-Ontario R&D program. The AECL disposal concept is based on burying the used nuclear fuel bundles at a depth of 500 to 1,000 metres in stable rock of the Canadian Shield. The concept is based on a multi-barrier approach, with a series of engineered and natural barriers that include the waste fuel bundle, the container, the buffer, backfill material and the rock itself. As part of this program, a conceptual design of a disposal facility for nuclear fuel waste and methodologies to evaluate the safety of the operational and post-closure phase of such a facility were developed.

In 1989, a federal Environmental Assessment Review Panel was appointed by the Minister of the Environment to carry out a comprehensive environmental review of the disposal concept and related waste management issues. In the Fall of 1994, AECL, the proponent for the concept, submitted the Environmental Impact Statement (EIS) on the Concept for Disposal of Canada Nuclear Fuel Waste to the Panel. The EIS provided a detailed description of the disposal concept and anticipated impacts. Public hearings were held between March 11, 1996 and March 27, 1997 in the provinces of New Brunswick, Quebec, Ontario, Manitoba and Saskatchewan. More than 500 individuals and groups made presentations and more than 500 written submissions were received.

The Panel provided its report with recommendations on the safety and acceptability of the disposal concept and the next steps for the long-term management of nuclear fuel waste in Canada to the federal government on March 13, 1998.

The main conclusions of the Panel Report were that:

(1) while the disposal concept was technically safe the concept does not have the required level of public support to be adopted as Canada's approach for managing nuclear fuel waste, and

(2) a Nuclear Fuel Waste Management Agency be established quickly, at arm's length from the utilities and AECL, with the sole purpose of managing and coordinating the full range of activities related to the long-term management of nuclear fuel waste in Canada.

The Government of Canada is expected to provide a response to the recommendations of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel sometime in the Fall, 1998. *(Ed. Note: See a summary of the government s response elsewhere in this issue of the CNS Bulletin.)* This will provide the specific future policy direction for nuclear fuel waste management in Canada.

The Policy Framework for Radioactive Waste

The federal government recognized that, given the diversity of ownership and location of radioactive wastes as well as the timetable for implementing disposal solutions, there was a need for a comprehensive and integrated policy framework to guide the implementation of waste disposal activities into the next century.

Pressures to move to disposal include:

- the need to manage wastes in a manner consistent with sustainable development,
- the desire to relieve future generations of the disposal burden,
- the long lead times needed to prepare for disposal, and the benefits of disposing of some wastes sooner rather than later.

In addition, in his May 1995 Report to Parliament, the Auditor General of Canada recommended that Natural Resources Canada, which has the federal responsibility to develop policies for disposing of radioactive waste, should work toward establishing an agreement among the major stakeholders on their respective roles and responsibilities, and on the approaches and plans for implementing disposal solutions.

In July, 1996, the federal Minister of Natural Resources announced a *Policy Framework for Radioactive Waste* that lays out the ground rules and sets the stage for the further development of institutional and financial arrangements to implement the disposal of all radioactive waste in a safe, environmentally-sound, comprehensive, cost-effective and integrated manner. The federal government has the responsibility to develop policy, to regulate and to oversee radioactive waste producers and owners in order that they meet their operational and funding responsibilities in accordance with approved waste disposal plans.

The Framework, a set of three principles, was developed in consultations with a cross-section of major stakeholders from federal government departments as well as provincial governments of energy and environment in the nuclear provinces, the AECB, AECL, nuclear utilities, nuclear fuel processing and fabrication companies, uranium mining companies, isotope users and representatives of small radioactive waste producers.

Principle # 1

- *The federal government will ensure that radioactive waste disposal is carried out in a safe, environmentally sound, comprehensive, cost-effective, and integrated manner.*

This principle addresses the fundamental jurisdictional responsibility of the federal government. The government needs to bring stakeholders together to ensure that radioactive waste disposal takes place in a safe, environmentally sound, comprehensive, cost-effective, and integrated manner.

Principle # 2

- *The federal government has the responsibility to develop policy, to regulate and to oversee producers and owners to ensure they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved waste disposal plans.*

The policy role for the management and disposal of radioactive waste lies with the federal government consistent with its responsibility for promoting the orderly, sustainable development of nuclear energy in Canada. This would involve the federal government carrying out a periodic review of waste producers institutional and financial arrangements to confirm that

arrangements continue to meet the intent of the principles of the Policy Framework.

The federal regulatory and oversight role is needed to ensure that radioactive waste disposal takes place in a safe, sustainable, comprehensive, cost-effective, and integrated manner.

Principle # 3

- *The waste producers and owners are responsible, in accordance with the principle of polluter pays , for the funding, organization, management, and operation of disposal facilities and other facilities required for their wastes. This recognizes that arrangements may be different for nuclear fuel waste, low-level radioactive waste andœuranium mine and mill tailings.*

Waste producers and owners need to meet the requirements of federal regulation and oversight for planning, funding and implementing waste disposal in a safe, sustainable, comprehensive and integrated manner. Institutional and financial arrangements may be different for the different categories of radioactive waste. Clearly, specific arrangements, organizations and financing for each waste type will be defined through negotiations with relevant stakeholders.

Implications

The 1996 Policy Framework for Radioactive Waste sets the stage for Canada to translate its technical knowledge into the implementation of long-term, cost-effective solutions for its radioactive waste, while ensuring that funding arrangements are in place to meet the financial requirements of future solutions. The federal government recognizes its important role in making the transition from safe, temporary storage to long-term solutions for uranium mine and mill tailings, low-level radioactive waste and nuclear fuel waste. In addition to providing policyœdirection, the federal government, in its oversight role, will work towards establishing an agreement among the major stakeholders on their respective roles and responsibilities and the approaches and plans for implementing solutions.

Uranium mining companies are well organized to manage and fund the disposal of their uranium mine and mill tailings. The tailings, because of their relatively large volumes, are usually disposed of where they are deposited, in tailings ponds or mined-out open pits. The final decommissioning of the facilities, including the financial arrangements for long term monitoring, is the responsibility of the companies, in accordance with the requirements of the federal nuclear regulator. The Uranium and Thorium Mining Regulations, under the *Atomic Energy Control Act,* require companies to provide financial assurances for the eventual decommissioning of their sites.

Producers and owners of low-level radioactive waste, like other radioactive waste producers, are responsible for establishing acceptable institutional and financial arrangements for the long-term management, including disposal, of their waste. While there are many owners, the federal government, with its historic waste primarily located in the Port Hope area, is the largest among them and will have a major role in implementing a solution for these wastes. The government role as an owner will clearly be separate from its oversight role.

For nuclear fuel waste, Canadians have expressed a clear desire that nuclear fuel waste be managed in a safe, environmentally sound, comprehensive, cost-effective and integrated manner by a stable and trustworthy organization and they expect the federal government to ensure that this takes place. The Government of Canada response to the recommendations of the Nuclear Fuel Waste Management and Disposal Concept Environmental Assessment Panel will provide the specific future policy direction for nuclear fuel waste management in Canada.

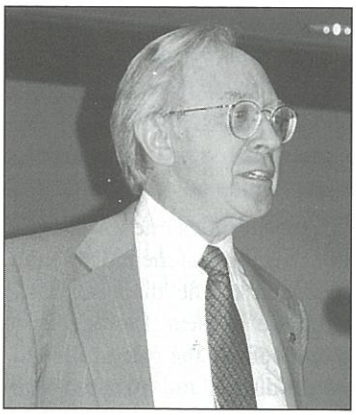
Conclusion

The Policy Framework is an important milestone towards the goal of ensuring a safe, comprehensive, environmentally sound, integrated, and cost-effective approach to the disposal of all radioactive waste associated with the nuclear fuel cycle in Canada. It lays the ground rules and defines the role of the federal government as well as waste producers and owners. With the Policy Framework in place, the context is set for the further development of the financial and institutional arrangements for the management of their waste.

The role of the federal government is to develop policy, to regulate, and to oversee waste producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved waste disposal plans. The waste producers and owners are responsible for the funding, organization, management and operation of disposal facilities and other facilities required for their waste. Arrangements may be different for uranium mine and mill tailings, low-level radioactive waste and nuclear fuel waste.

The Policy Framework for Radioactive Waste reinforces the Government of Canada commitment to the principles of sustainable development. Nuclear energy is an environmentally sound energy option that does not contribute to climate change. Clearly assigning the roles and responsibilities, and taking action to safely manage and dispose of radioactive waste from the entire nuclear fuel cycle, is an environmentally responsible initiative that will ensure that the costs related to nuclear activities are not simply passed from one generation to the next. Resolution of radioactive waste management issues will both increase the attractiveness of nuclear energy and its contribution to Canada s efforts to achieve an energy supply that is based on sustainable development.

CNS Annual Conference



Romney Duffey

The special format of 1998 Annual Conference of the Canadian Nuclear Society, held in Toronto, October 18 to 21, 1998, proved to be very successful.

For the first time in its 19 years existence, the CNS did NOT hold its Annual Conference in conjunction with that of the Canadian Nuclear Association. The innovation resulted from the CNA's decision to cancel its conference in favour of supporting the 11th Pacific Basin Nuclear Conference which was held in May in Banff, Alberta.

The very well organized and run meeting included the presentation of over 100 technical papers in 17 sessions. Except for the opening Plenary there were three or four parallel sessions. Despite this all sessions were well attended, even the closing ones on the Wednesday afternoon. *(The program was included in the last issue of the CNS Bulletin and summaries of most of the session, by session chairmen, are printed elsewhere in this issue.)*

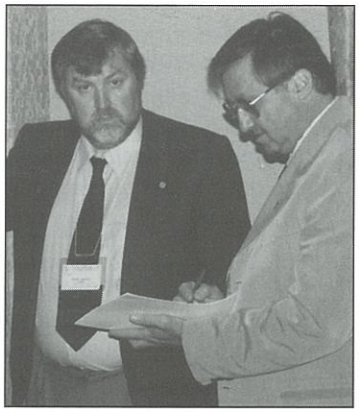
The opening paper, by Gary Kugler, V.P. at Atomic Energy of Canada Limited, was an intriguing look into the future of nuclear energy (and a slightly modified version is reprinted in this issue of the *CNS Bulletin.*) His paper was followed by an invited presentation by Mike Haynes, president of the Canadian Radiation Protection Association, in which he outlined the objectives and activities of that organization and explored areas in which the CNS and CRPA could cooperate.

The recently appointed AECL Principal Scientist, Dr. Romney Duffey then gave his optimistic vision of the future of CANDU based on his critical review of its design features and the potential for evolutionary development.

Rounding out the Plenary session were papers by NB Power's Rod White et al (presented by Paul Thompson), on *Improving Performance in a Competitive Environment;* by Jean-Paul Labrie of AECL, *MAPLE Isotope Reactors: Status Report;* and by Murray Stewart of the CNA, *the Nuclear Option and Climate Change - A Necessary Part of Canada's Kyoto Implementation Strategy.* (The two sessions on "environmental" issues proved to be the most popular ones of the conference.)

CNS President, Paul Thompson, presents a special gift to Sylvie Carron of the CNS office for her exemplary service to the Society, at the Annual Luncheon, CNS Annual Conference, Toronto, October 1998.

At the first Conference Luncheon, on the Monday, Dr. A. B. McDonald gave an engaging talk on the background and current status of the Sudbury Neutrino Observatory (SNO) of which he is director. That facility, located deep in INCO's Creighton mine at Sudbury, makes use of 1000 tonnes of heavy water loaned by AECL to detect neutrinos from space. It began to make observations in late 1998. (For those interested in further information there is a Web site <www.sno.queensu.ca >.) The other luncheon, on the Wednesday, was devoted to presentation of CNS Awards for 1998 (see separate article).



Program Chairman, David Jenkins and General Chairman, Ben Rouben, confer during the CNS Annual Conference in Toronto, October 1998.

At the conference banquet, on the Tuesday, attendees were entertained by an excellent stand-up comedian, Larry Horowitz, followed by a "nuclear trivia" game. Since the winning table (which included the editor and members of the CNS Executive) scored only about 50 % it is evident that few members are really up on the history of nuclear science and technology.

The organizing committee for the 19th CNS Annual Conference is to be congratulated for a very well planned and executed conference. The General Chair was Ben Rouben, Technical Program Chair, David Jenkins and other members included: Eric Davey, Frank King, Ray Lambert, Mitch Ohta, Judy Tamm, Glenn Harvel, Isabel Franklin, Jennifer Gerardi, Greg Shikaze, David Buss, Peter White, Peter Laughton, and from the CNS office, Sylvie Caron and Caroline Rouben.

The success of this "independent" conference has prompted consideration of repeating the format. However, the 1999 CNS Annual Conference has been in planning for some time and, as has been the pattern over the previous 18 years, will be held in conjunction with the Annual Conference of the CNA, in Montreal, May 30 to June 2, 1999.

1998 CNS Annual Conference

- Summaries of Sessions

*Ed. Note: Following are summaries of most of the sessions of the **19th Annual Conference** of the **Canadian Nuclear Society,** held in Toronto, Ontario, October 18- 21, 1998, as prepared by the session chairmen (with slight editing).*

Sessions 1A and 2A
Waste Management I and II **Mitch Ohta**

The objectives for the Waste Management Sessions 1A and 2A were achieved with high quality papers, on topics of interest to CNS members, being presented. Debate and discussion between the presenters and the audience were lively and frank. This interaction reinforced the important role of the Canadian Nuclear Society as a forum for considered technical discussions on issues surrounding the back end of the fuel cycle.

Session 1A

Session 1A continued the international sharing of experience and views on the subject of long-term fuel waste management which was begun at the CNS ***International Conference on Deep Geological Disposal of Radioactive Waste*** held in Winnipeg in September 1996. The session was well attended. Invited papers were presented by the Chairman of the Environmental Assessment Panel that reviewed the Canadian concept, from Ontario Hydro and from France, Japan and Sweden:
"Insights from the Panel Review Process" Blair Seaborn;
"Lifecycle Management of Used Nuclear Fuel in Ontario Hydro" Ken Nash;
"Siting a Used Fuel Disposal Facility in Sweden" C. Thegerstrom;
"Status of the High-Level Waste Disposal Programme in Japan" H. Umeki
"Status of Siting a High Level Repository in France" D. Auverlot.

In the open question period, a number of questions and/or comments were raised by the audience, including the following:
- Requiring public acceptance across Canada (before beginning the siting process for a used fuel disposal project) is stupid. Public acceptance should be sorted out during the siting process.
- What if no community in Sweden wants a disposal facility? Do you have broad public acceptance in Sweden? What is the split in resources between technical development and public acceptance?
- What are the alternatives to disposal in Japan ?
- If an underground laboratory site were chosen as the preferred disposal site in France, would the local community have to vote again?
- Has there been a discussion in France regarding the ethics of offering support for target communities?

The session culminated with the speakers participating in a lively 30 minute panel discussion which centred around the following questions:
- What is your recommended approach to public involvement in siting?
- What is the future of nuclear power in your country if there is no permanent solution to HLW disposal?
- What is your view on the likelihood of an international repository?

Session 2A

Session 2A was a summary of some recent AECL work on low level waste identification, spent fuel storage technology and nuclear fuel waste disposal. The five papers and their presenters were as follows:
- *Simulating Thermal Behavior of AECL's Spent Fuel Storage System with CATHENA* by G. Sabourin;
- *Current Status of the Waste Identification Program at AECL's Chalk River Laboratories* by G. Csullog;
- *Assessing Inventories of Past Radioactive Waste Arisings at Chalk River Laboratories* by G. Csullog;
- *Seismic Qualification of Spent Fuel Storage Stacks* by L. Lee
- *The Tunnel Sealing Experiment: In Situ Demonstration of Technologies for Vault Sealing* by N. Chandler.

These papers reflect the breadth of Canada's program on waste management. The presenters are technical experts in their field and they shared their work with the Conference participants. Although the three papers scheduled to be given by speakers from Romania were not presented, the questions and answers on the other papers quickly filled the available time.

Session 1B
Thermalhydraulics I **Bill Garland**

This session was comprised of four papers, three from AECL-WRL on CATHENA and one from New Brunswick on unbalanced deuterium in the heat transport loop.

Thomas Beuthe, in his paper, *On the Importance of Valve Modelling, Reflected Pressures, and Wall Friction, in CATHENA Water Hammer Simulations,* definitively showed the importance of modelling such details as valve area vs. stroke and dynamic wall friction in achieving accurate water hammer simulations. As noted in the discussion that followed, the work is far from complete because the wall friction models are uncertain and because other effects, such as fluid wall interactions, have not been incorporated. Nonetheless, the paper bears heeding.

Thomas' second paper, *CATHENA Validation in support of Large Break LOCA Analysis*, illustrated some of the extensive validation work that is underway. He focussed on Large LOCA analysis and found good agreement except for the usual areas of difficulty for codes of this ilk: high void under low flow, low pressure conditions - the results are sensitive to small differences between the models and the experimental rigs, such as channel sag, similitude issues and so on.

Darryl Dormuth's paper, *A Parallel Virtual Machine Interface for CATHENA,* showed, using a modified version of CATHENA as an example, how coupled codes can interact using the Parallel Virtual Machine (PVM) software that is available on the open market at no charge. PVM utilizes TCP/IP to allow codes to communicate in a loosely coupled architecture and promises to be a route to easier QA, code extensibility, faster and more extensive computing schemas. *(I agree with the author - this is the way of the future.)*

Finally, **Lie Tai Yang,** in his paper co-authored with M. Hare and D. Loughead of NB Power, *The Unbalanced Distribution of Deuterium in the Two Heat Transport Loops and the Flow through the Pressurizer Inter-Connect Pipe at Point Lepreau Generating Station,* convincingly showed how small interconnect flow leads to substantial differences in deuterium concentrations in the two heat transport loops of Pt. Lepreau due to the preferential concentration in the liquid phase compared to the vapour phase central. This was a nice piece of detective work. The author showed that the effect was easily controlled by selective purification valving and speculated that this effect could be used to detect interconnect flow and the onset of bulk boiling.

All in all, the session was well attended and discussion was lively. Well done all.

Session 1C
Advanced Concepts **Jerry Hopwood**

This session featured an extremely broad group of topics. It covered, not only innovative features for the next generation of CANDU, but also leading ideas for alternative pressure tube designs; research reactors; the future of fusion; and alternate energy partnering between CANDU and gas-turbines or desalination. The range of investigation, the enthusiasm of the speakers and the interest from the audience, all bode well for an innovative nuclear future.

P. Hejzlar (Czech Technical University of Mechanical Engineering) presented two papers:

- *Innovative Fuel Elements with Enhanced Decay Heat Removal Capability for Passive, Pressure-Tube LWRs*
- *Concepts of Passive, Light Water Pressure-Tube Reactors;.*

describing work at MIT to identify and evaluate alternate pressure-tube reactor designs, based on the use of light-water coolant. While still at a very early stage of study, the ideas presented do indicate a great deal of development potential for the concept.

J.J. Whitlock (AECL) presented the proposed approach to design of the future Canadian Neutron Facility (originally the Irradiation Research Facility) to permit CANDU fuel-bundle test irradiations in his paper; *Utilizing the IRF for CANDU Fuel Bundle Irradiations.* This was a good example of an effective solution to a multi-dimensional design problem.

A. Panarella (ALFT), in his paper, *On the Ignition of the ITER Machine,* presented an update on the prospects of the proposed ITER (International Thermonuclear Experimental Reactor) fusion project. His iconoclastic view indicates there is much work to be done to establish if ITER can truly achieve its ambitious objectives.

J. Vecchiarelli (AECL) presented a paper co-authored with E. Choy (AECL) and Y. Peryoga, N. A. Aryono (BPPT, Indonesia), *CANDU Combined cycles Featuring Gas-Turbine Engines,* which described an original pairing of CANDU with combined-cycle gas turbines acting as both turbine topping-cycle energy and standby station electrical power. The gains in efficiency suggest this approach is well worth exploring in certain electrical supply markets.

J.R. Humphries (CANDESAL) presented an update on the work carried out jointly with AECL and BPPT to evaluate desalination options in conjunction with a CANDU project in Indonesia, in a paper co-authored with K. Davies, T. D. Vu, N. A. Aryono and Y. Peryoga, *A Technical and Economic Evaluation of Reverse Osmosis Nuclear Desalination as Applied at the Muria Site in Indonesia.* Desalination is an important side-benefit of energy projects in an increasingly water- short world.

Finally, D. Arapakota (AECL) presented a review of the advanced Human-Machine Interface being developed for the CANDU 9 fuel-handling system, in a paper co-authored with A. Xing, *Advanced Control and Operator Interface Systems for CANDU 9 Fuel Handling Systems.* This innovation is a real-world application of much new thinking in information technology.

Overall, a session which highlighted a wealth of new ideas and initiative for the future Canadian nuclear industry.

Session 2B and 3B
Environmental Management I and II

Session 2B
Environmental Management I ***Judy Tamm***

This, the first of two sessions dealing with environmental issues, discussed environmental assessment (EA) practices, greenhouse gas emissions and the AECB's proposed Environmental Protection Program.

Application of the Canadian Environmental Assessment Act to Nuclear Research Projects: Lessons Learned at AECL, by **D. Grondin,** AECL-CRL, discussed the challenges of interpreting the requirements of the Canadian Environmental Assessment Act with the AECB, as Responsible Authority.

K. Johansen, OH, in a paper co-authored with J. H. Peters and W. R. Fitzgerald, *The Path to "Jiibegmegoong": Lessons Learned in Working with Aboriginal People on Archaeological Assessment of the Bruce Nuclear Power Development Site,* described Hydro's successful public participation program with aboriginal groups for the EA of the used fuel dry storage option at the Bruce nuclear power plant site.

L.Cattrysse, ICF Kaiser, presented the challenges of applying Canadian EA practices for overseas projects, in his paper, *Practising Environmental Assessment Overseas: Experience and Lessons Learned.*

D. Pendergast, AECL-SP, presented two papers on greenhouse gas emissions - those produced from the life cycle of CANDU reactors in comparison with other electrical generating industries, and the credits the nuclear industry is trying to obtain under the Kyoto Protocol:

- *Canada' Nuclear Industry, Greenhouse Gas Emissions, and the Kyoto Protocol*
- *CANDU reactors and Greenhouse Gas Emissions*

Lastly, L. Chamney, AECB, described the anticipated guides and procedures, including the schedule for their production, under the Board's proposed Environmental Protection Program, in a paper co-authored with R. J. Maloney, *Development if a Regulatory Environmental Protection Program at the Atomic Energy Control Board.*

Session 3B
Environmental Management II ***J. Torok***

Paul Wiancko, Ontario Hydro (OH) presented R. Claudi's informative paper, *Prevention and Control of Zebra Mussels: Proactive and Reactive Strategies,* describing OH's 10 years of experience in the prevention and control of zebra mussels at their power generating stations. While chlorine is effective in removing the mussels, OH is adopting alternative treatments such as the use of ozone or UV treatments as their use has less impact on the environment.

The paper by Don Wismer, OH, *Receiving Environmental Effects Monitoring: Why, what, How, and So What?*, discussed environmental effects monitoring programs at OH's reactors: the purpose, the methodologies used, how to present the results (the Darlington Environmental Effects Final report served as an example), the costs and the challenges. Considerable planning is needed to design a useful monitoring program.

Two papers dealt with ^{14}C management issues.

Carbon-14 Management: *The Implementation of Stack Emissions Monitoring at Ontario Hydro Nuclear,* by Jon Holtorp, outlined OH's plan to improve monitoring of stack emissions, and initiatives to respond to the ACRP-14 report on 14C management.

Carbon-14 at CANDU Stations, presented by Jack Cornett, AECL-CRL, and co-authored by P. J. Allsop, F. Caron, D. Evans, R. R. Rao, J. Torok and S. Vijayan, described the results of the COG program in quantifying ^{14}C production, inventory and emissions and the development of an understanding of the factors leading to higher than normal emissions.

The Priority Substances List 2, under the Canadian Environmental Protection Act, requires the assessment of impacts of radionuclides from nuclear facilities on non-human species. In her paper, *The Environmental Assessment of Releases of Radionuclides from Nuclear Facilities (Impacts on Non-Human Species) Under the Second Priority Substance List of the Canadian Environmental Protection Act,* Patsy Thompson, AECB, gave a progress report on Environment Canada's effort. Assessment of the chemical toxicity of uranium is nearing com-

pletion and scientific and stakeholder review of the results is expected to be held during Summer 1999.

Session 3A
Detector Systems **Ken Serdula**

Session 3A, Detector Systems consisted of six papers, all focusing on innovations in the verification and the application of data from current detector systems.

Three papers addressed innovations in use of data from existing detector systems.

One paper discussed application of "noise analysis" techniques to detector signals to determine detector degradation, process system performance and vibration of reactor core internals. Another presentation was on development of a code to optimize number and location of in-core detectors to maximize core power while maintaining required margins to-trip and level of regional-overpower trip protection.

A third presentation gave results of measurements of dynamic response and relative sensitivity of Vanadium in-core detectors and lead cables. This information is required to assess uncertainty in use of only the "prompt response" fraction of the Vanadium detectors in computing prompt core power maps.

Three papers on verification of data from existing detector systems addressed development of a program to analyze in-core detector responses, assessment of the accuracy of Darlington NGS digital compensation of SDS2 detectors and accuracy of neutron bubble detectors to measure in-flight radiation.

Papers:
- *Development of a Portable Micro-Environmental Cell for the Testing of the Neutron Bubble Detectors in a Simulated Jet-Aircraft Environment* by P. Tume, L.G.L Bennett, B. J. Lewis, H. K. Wieland and M. K. Reid (Royal Military College) and T. Cousins (Defence Research Establishment, Ottawa)
- *Reactor Noise Analysis Applications in Ontario Hydro: A statistical Measurement Technique for Validating Instrumentation Dynamics* by O. Glöckler, D. Cooke, G. Czuppon, K. Kapoor (Ontario Hydro)
- *ROP Optimization Modules in ROVER-F* by J. Pitre (AECL)
- *MDRAP - A MATLAB-Based Detector Response Analysis Package* by G. Gomes (AECL)
- *Dynamic Response and Relative Sensitivity of Vanadium In-Core Flux Detectors and Lead Cables in Pt. Lepreau* by B. Sur, G. Gomes (AECL); J. Handbury (ANSL); C. W. Newman, E. G. Young (NB Power)
- *Numerical Accuracy of NOP SDS2 Detectors Dynamic Compensation in Darlington Trip Computers* by A. P. Firla (Ontario Hydro)

Session 3D
Control Room Operation **Eric Davey**

The objective of this session was to provide a forum for discussion of topics concerning control room operations. Recent industry initiatives have re-emphasized the importance of control room staff to plant operations and the key influences that control room information systems can have to assist or limit operator performance.

This session attracted seven papers providing a mix of speakers from utility operations groups (3), CANDU vendors (2) and industry consultants (2). Two human performance topics were covered: a study of factors affecting operator stress (Patterson), and experience in development of operational standards and a station culture of 'operations focus' (Lane). Four papers discussed near-term information system improvements: identification of annunciation improvement priorities (Hartley), an approach for improving alarm prioritization (Basso), the results from an operational assessment of critical safety parameter monitoring (McIntyre), and recent developments in computer-based logging (Davey). One paper discussed a vision for the future: integration of plant information technologies to better support all aspects of plant operation (DeVerno).

Papers:
- *An approach for Improving Alarm Prioritization Analysis* by R. Basso and E. Davey (AECL)
- *AECL's Plant Information Technologies* by M. DeVerno, L. Lupton, R. Didsbury and R. Judd (AECL)
- *Conduct of Operations: Establishing Operational Focus and Setting Operational Standards* by L. Lane and K. McGuigan (Ontario Hydro)
- *Computer Based Logging - Simplifying Station Log Preparation, Access and Use* by E. Davey, M. Thompson, R. Basso (AECL) K. Herzog, L. Lane, R. Chatterton (Ontario Hydro)
- *Operator Stress* by B. K. Patterson, W. G. Artiss (Human Factors Practical), M. Bradley (UNB)
- *Control Room Annunciation - Problem Assessment and Selection of Improvement Priorities* by P. Hartley, D. Yaraskavitch (Ontario Hydro), E. Davey (AECL)
- *Operational Assessment of Critical Safety Parameter Monitoring - Findings and Lessons Learned* by C. McIntyre, S. Howard (Ontario Hydro), e. Davey, M. Feher (AECL)

Sessions 4A and 5A: Radiation I and II **Norman Gentner**

Session 4A: A Tribute to Richard Osborne's Contribution to Radiation Protection in Canada

This special session was organized as a tribute to R. V. Osborne's many contributions to radiation protection, both in Canada and internationally. Dr. Colin Allan of AECL, in introducing Dr. Osborne (the keynote speaker), summarized these.

Richard provided a perspective, from four decades of involvement, on the links between scientific evidence and radiation protection. Richard's career contributed substantially to the "evidence" side: measurements of fallout, and issues related to tritium and its dosimetry, are two examples. On the radiation protection management side, his inputs on how best to deal with the application of the collective dose concept in radiation protection have been long-standing. Fundamental issues at present include the controversy over the appropriateness of assuming low-dose linearity, and how one might incorporate genetic susceptibility into radiation protection management. *(Ed. Note: A slightly modified version of Richard Osborne's paper is reprinted in this issue of the CNS Bulletin.)*

Following Dr. Osborne's presentation, a gift was presented to Richard by the CNS (Paul Thompson, *President*) and the CRPA (Harry Johnson, its *Board of Directors*) as a memento of the occasion.

Akilesh Trivedi's paper, co-authored with R. E. J. Mitchell, *How Relevant to Radiation Protection is the Adaptive Response Mechanism?,* dealt with whether the "adaptive response" was likely to be relevant to either risk assessment or radiation protection. There is little evidence so far of an influence on radiogenic cancer. The adaptive response is unlikely to influence current radiation protection management; it might, in future, if better understood.

Recommendations as how to estimate effective doses from diagnostic x-ray procedures were presented by Harry Johnson, in a paper co-authored by J. Sandeman, *Effective Doses from Diagnostic X-Ray Procedures.* The information in ICRP Publication 74 was applied to

derive absorbed dose equivalents from air kerma for x-ray procedures.

Philippe Duport, in his paper, *Non-Linearity Between Dose and Cancer Risk for Internally Deposited Alpha Emitters in Animals* discussed a number of animal studies, involving internally- deposited alpha emitters, which exhibited non-linearity for cancer risk *vis-à-vis* dose. He concluded that, at least in the case of alpha emitters with long physical and biological half-lives, the "linear-no threshold" [LNT] theory is not a good predictor of cancer risk.

Norman Gentner presented a paper co-authored with Richard Osborne, *LNT theory: A Credible Middle Ground,* which summarized "pro's and con's" of the debate concerning the LNT theory from three recent international meetings on the topic: the meeting in Seville sponsored by IAEA, WHO and UNSCEAR (Nov '97) on "Low doses of ionizing radiation: Biological effects and regulatory control"; the Pacific Basin Nuclear conference (Banff; May '98); and the American Statistical Association (San Diego; June '98) biennial Radiation & Health meeting, this year on "Radiation effects at low doses".

Practical issues that arise in risk management from unqualified use of the LNT model were discussed by Doug Chambers in a paper co-authored with l. m. Lowe and N. C. Garisto, *Practical Issues in the Risk Management of Low Dose Radiation.* Society tends to divert resources towards theoretical or absolute radiation risks that are small, and away from other activities which in fact represent greater risks. A practical dose truncation level would be about 0.1-0.5 mSv/y.

Session 5A: Radiation II

This was the second technical session on radiation. This session emphasized technical and practical aspects of estimating and controlling radiation exposures, of how our bodies protect us against adverse effects from most instances of absorption of radiation energy, and how to use radiation as a tool.

Kevin Lenton presented a paper co-authored with C. L. Greenstock, *Antioxidants and Biological Radiation Protection,* which discussed how antioxidants and antioxidant enzymes act against oxidative radicals, such as produced by ionizing radiation, and thus mitigate formation of the sorts of damage that may initiate or promote cancer. Individuals differ in levels of these antioxidants; this might be a factor in variations in individual radiosensitivity.

Brent Lewis of RMC, Kingston, described impressive and detailed measurements done on cosmic radiation exposures on Canadian commercial airline routes in a paper with a number of co-authors, *Cosmic Radiation Exposure on Canadian Based Commercial Airline Routes.* These were performed in anticipation of possible regulations on aircrew doses resulting from ICRP-60 recommendations. It appears that most Canadian-based crew members, whether domestic or international, are likely to exceed the ICRP-60 value of 1 mSv/y recommended for members of the public, but not the ARW limit of 20 mSv/y.

Mohammed Ousmoï described the "detective work" his group at École Polytechnique in Montreal was doing, comparing neutron activation analyses on ancient Amerindian ceramic artifacts with those from clays in various nearby regions; this allows one to determine if the ceramics were made with local ("in situ") or imported clays (the latter indicating trade or population movements). *Neutron Activation Analysis of Ancient Amerindian Ceramics and Clays* by M. Ousmoï, G. Kennedy, C. Chapdelaine.

Ricky Khaloo of AECL (Sheridan Park) outlined how radiation doses to members of the public from a CANDESAL [CANdu DESALination] plant were conservatively estimated. Use of the desalinated water would contribute less than 20 μSv/y to a member (adult or child) of the critical group; most of this dose was from HTO or DTO. *Public Radiation Exposures from a CANDESAL Co-Generation Facility,* by R. Khaloo, A. Simanjuntak.

Session 4B: Ageing Issues and Containment — R.J. Fluke

Part 1: Ageing Issues

Three papers were presented that focussed on the problem of ageing of components of CANDU Heat Transport Systems. Corrosion, especially Flow Accelerated Corrosion, is slowly "scalloping" material from the inside of the feeder pipes, and the material lost from the feeder pipes is deposited in other parts of the circuit. This leads to a gradual thinning of the outlet feeder pipes and increased surface roughness throughout the circuit. Deposited oxide material inside the boiler tubes also inhibits heat transfer. In some cases, divider plates in the boilers are bypassing some flow. As a result, the reactor inlet temperature is creeping up and heat transfer to the boilers is diminishing to the extent that this ageing process can lead to a de-rating in reactor performance. In addition to this economic penalty, safety is a concern. The feeder pipe wall thinning increases the risk of a leak, and the deposited material is radioactive leading to increased radiation exposure to workers during maintenance. The three papers described work in progress and reactor experience in minimising ageing effects and restoring performance.

Dr. Lietai Yang (Centre for Nuclear Energy Research, Fredericton, NB) presented the paper *An On-Line Electrical Resistance Corrosion Monitor for Studying Carbon Steel Corrosion Under Feeder Pipe Conditions,* co-authored by D. Sun, and F. Steward. The corrosion monitor is an electric circuit that measures the electrical resistance across a calibrated probe. As the probe material corrodes, its electrical resistance increases. The precision of the monitor is enough to measure between 0.04 to 1.0 micron in thickness change. Work is proceeding to qualify the device for installation at the Point Lepreau reactor.

Dr. Doug Miller (Chalk River Laboratories, Chalk River, ON) presented the paper, *Primary Coolant pH for Control of CANDU Plant Aging,* co-authored with K. A. Burrill, E. L. Cheluget and C. W. Turner. Iron is the primary element of concern for corrosion and deposition processes in the CANDU Heat Transport System, and water chemistry plays an important role. The solubility of iron is sensitive to pH and water temperature. Dr. Miller described the theoretical process like this: the reactor inlet side is saturated with dissolved iron (magnetite). As the solution passes through the core it heats up and the solubility increases. Thus, on the outlet side, the iron concentration is below the solubility limit and corrosion of the outlet feeders occurs. A higher concentration of iron then passes the U-bend region of the boilers where the water cools down and becomes supersaturated with iron. The dissolved iron then deposits inside the boiler tubes and inlet feeder pipes. It is the sensitivity of solubility with temperature, and the change in temperature throughout the heat transport circuit, that allows the corrosion and deposition to occur. However, as Dr. Miller explained, the sensitivity of solubility with temperature is also dependent on pH. He showed the effect of reducing the pH from 10.8 to 10.3 and concluded that reactor operation at a pH of 10.3 can reduce the rate of corrosion by 25-45%.

Guy Hotte (Sûreté nucléaire, Hydro Québec, Montréal, PQ) presented the paper, *Identification and Mitigation of Heat Transport Ageing Mechanisms at the Gentilly-2 Generating Station,* co- authors, M.-A. Petrilli, A. Baudouin.. Since commissioning, the reactor inlet header (RIH) temperature at Gentilly-2 rose gradually from about 262°C to 268°C between 1984 and 1995. Corrosion and fouling were considered as the likely mechanisms but in 1995, the boilers were inspected and it was determined that divider plate by-pass flow was occurring. After replacing the bolted divider plates with welded ones, the RIH temperature improved somewhat, to around 265°C. Despite this, other ageing mechanisms contribute to de-ratings to between 95% and 98% of full power. The increased surface roughness from corrosion and deposition, combined with diametric creep of the fuel channels has reduced

the margin to critical heat flux and dry-out. Investigations are underway to improve the margin to dry-out.

Part 2: Containment

Two papers were presented that focus on the problem of hydrogen generation during a severe Loss of Coolant Accident, and the means to assess the potential for a damaging hydrogen burn inside containment. (A third scheduled paper was not presented.)

Nick Dinadis (Containment Response Analysis Section, Ontario Hydro, Toronto, ON) presented the paper, *"GOTHIC Modelling of Large Scale Gas Mixing Phenomena* (co-authored by K, Yim, R. Wong, R. Fluke). The potential for a damaging burn depends on the distribution of hydrogen in containment, and tools such as GOTHIC are available to assess this. However, validation of the 3D mixing phenomena represented in the code is needed. As presented by Mr. Dinadis, the modelling of a large-scale apparatus is affected by user selected options in the code, the sensitivity of which must be quantified before embarking on a detailed validation exercise. Both temporal and spatial convergence were examined and optimised to compare code predictions to measurements of helium distribution in a large-scale facility, with good results.

Soon Min Lee (Korea Power Engineering Co., Inc., Kyunggi-Do, Korea) presented the paper, *Optimization Study for Hydrogen Control During Severe Accidents in KSNPP,* co-authored by K.K. Jee, S. H. Yoon, B. C. Lee. The Korean Standard Nuclear Power Plant (KSNPP) is a PWR design that includes hydrogen control measures to safeguard the plant from damaging hydrogen burns. Mr. Lee described the code calculations to demonstrate that these safeguards will be effective for selected severe accident scenarios and showed how the calculations were used in optimising the location of hydrogen control devices.

Session 4D: Fuel **B.J. Lewis**

In Session 4D, four papers covered various aspects of nuclear fuel design and assessment during normal and off-normal situations

P.J. Reid, in presenting the paper, *A Standard Approach to special Fuel Irradiation at Point Lepreau Generating Station,* co-authored with R. G. Steed, R. A. Gibb and R. W. Sancton, discussed the Point Lepreau Generating Station (PLGS) experience in the area of special fuel irradiations, including the irradiation of coupon-carrier, T-pad, CANLUB and CANFLEX bundles in support of CANDU fuel development This work details the approval process at the PLGS and provides a means by which the cost/benefit of the fuel modification can be assessed.

The paper, *Validations, Verifications and Applications of the FEAT Code,* by Z. Xu, C. Manu.M. Tayal and J. H. Lau,. described the validation of the FEAT (Finite Element Analysis for Temperature) code used for the thermal design and assessment of CANDU fuel. This work considered a validation matrix approach in which the validation data sets were derived from analytical solutions, solutions from other codes, and experimental measurements.

The analysis of Q.M. Lei et al. in the paper, *Assessment of Fuel Fitness for Service Following Standing Start Process During Gentilly-2 Annual Outage,* investigated the fuel and fuel channel fitness-for-service after repeated standing start cycles when only the back-up heat sink is available It is shown in this analysis that if the fuel sheath temperature is limited to below 450 degrees Celsius, the fuel channel will also remain below 400 degrees Celsius so that both the fuel and fuel channel can be returned to full power after intermittent buoyancy-induced flow cycles.

Investigation of Fuel-Bundle Vibration in the Chalk River Single-Channel Test Rig, presented by V.P. Janzen for co-authors T. G. Whan, J. L. Gerardi, I. E. Oldaker, B. A. W. Smith, C. E. Taylor, J. H. Tromp,. detailed the investigation of fuel bundle vibration in the single-channel test rig at the Chalk River Laboratories The results of these tests were used to evolve the design of the Maple-type fuel.

Session 5B: Pressure Tubes **Douglas E. Teed**

Five interesting papers were presented in this Session.

AECL are developing a new channel closure for future CANDU reactors as described by W.T. Diamond in the paper *A New CANDU Channel Closure with a Conical Seal.* It takes up less radial space by using a conical all-metal sealing element that rotates and flexes for insertion and retraction. Experiments have been completed that demonstrate reliable operation of the seal element for three different end fitting diameters and over the full operation range of temperature and pressure of the primary heat transport system. Some of the benefits are: elimination of guide sleeves and insertion tools, reduced ram loads and clamping loads, and possibly reduced lattice pitch between adjacent fuel channels.

In situations where pressure component designs are complex enough to render inelastic analysis impracticable, repeated linear elastic finite analysis methods can now be used with confidence. Babcock and Wilcox Canada have been using the elastic analysis for verifying designs at a fraction of the time and cost of inelastic finite analyses. The method was described in a paper by S.P. Mangalaramanen and N. Idvorian, *Limit Analysis of Pressure Components Based on Repeated Elastic Analyses.*

Safety/licencing assessments are systematically done for hypothetical channel failures. However, in order to support these assessments, an experimental program has been ongoing by Ontario Hydro at Stern Labs. A paper by P.S. Kundurpi, *Experimental Investigations into Consequences of Pressure tube Rupture,* discussed the significance of these experimental investigations into consequences of pressure tube rupture. The full-scale experimental program has provided useful data for verification of the safety analyses codes. The tests have also demonstrated that any hypothetical failure of a fuel channel will not lead to cascading channel rupture.

The modelling of fuel-coolant interaction following a severe flow blockage in a single channel of a CANDU reactor is assessed in a paper by N.N. Wahba and M.H. Bayoumi of Ontario Hydro, *High Pressure Melt Ejection Relevant to CANDU Reactors.* It is concluded that it is appropriate to employ the forced fuel-coolant interaction methodology in analyzing CANDU single channel flow blockage event with a severe power-cooling mismatch. The hydrodynamic transients are conservatively determined for various amounts of molten fuel available for discharge. The magnitude of the pressure transient and impulse loads decrease as the distance from the rupture site increases. The higher discharged mass produces more energy deposited in the bubble over the transient which results in a faster and greater pressurization of the moderator and results in higher impulsive loads on adjacent structures.

AECL are using "Electrical Impedance Spectroscopy" (EIS) to describe multidimensional features of oxide films formed on Zr-2.5 Nb. The EIS technique is nondestructive and is used on pressure tube materials to reveal characteristics of existing dense oxide and its changes with time and environment. Examinations by M.A. Maguire revealed that H-pickup of removed pressure tube was related only to oxide porosity features and not dense oxide thickness. EIS holds great promise as a screening technique for pressure tubes as well as for providing mechanistic insights.

GENERAL news

Federal Government Responds to Fuel Waste Panel

Ed. Note: *On December 3, 1998, Ralph Goodale, Minister for Natural Resources Canada announced the response of the federal government to the report of the Nuclear Fuel Waste Management and Disposal concept Environmental Assessment Panel that had been issued in the spring. (See, Vol. 19, No. 1 of the CNS Bulletin for a summary of that report and the two insightful reviews by Archie Robertson in the subsequent two issues.)*

Following is the official summary of the "Government of Canada Response".

The Minister stated that his department is seeking further input, especially on other options to those in the government's response. Comments are requested not later than February 28, 1999, and can be sent by e-mail to: < waste@nrcan.gc.ca >.

The full government response, and other background documents, can be obtained on the Web at: < http://nuclear.nrcan.gc.ca >

See the paper Radioactive Waste Policy in Canada, in this issue of the CNS Bulletin, for helpful background and context.

The 1996 Policy Framework for Radioactive Waste outlined the principles governing the institutional and financial arrangements for the disposal of radioactive waste by waste producers and owners. It clearly recognized that arrangements may be different for nuclear fuel waste, low-level radioactive waste and uranium mine and mill tailings.

For nuclear fuel waste, the Government of Canada expects that:

- The producers and owners of nuclear fuel waste in Canada will establish a waste management organization, incorporated as a separate legal entity, with a mandate to manage and coordinate the full range of activities relating to the long-term management, including disposal, of nuclear fuel waste. The waste management organization will:
  - have a Board of Directors, representative of producers and owners of nuclear fuel waste;
  - have an advisory council; and
  - be comprehensive, i.e., allow for the participation of all producers and owners of nuclear fuel waste.
- The producers and owners of nuclear fuel waste in Canada will establish a fund to fully finance all activities and operations of the waste management organization including the costs for developing and comparing waste management options, for designing and siting the preferred approach for the long-term management, including disposal, of nuclear fuel waste, for implementation, and ultimately for decommissioning waste management facilities.
- The waste management organization will report to the Government of Canada setting out its preferred approach for the long-term management, including disposal, of nuclear fuel waste, with justification, as well as:
  - a comprehensive public participation plan;
  - an ethical and social assessment framework;
  - an Aboriginal participation process;
  - practicable long-term waste management options for Canada, including the following: a modified AECL concept for deep geological disposal; storage at reactor sites; and centralized storage, either above or below ground;
  - a comparison of risks, costs and benefits of the options along with proposed siting territories; and
  - future steps.

The Government of Canada will determine whether it accepts the report and the preferred approach proposed by the waste management organization, and future steps.

Recognizing that there is a need to ensure that the preferred approach for the long-term management, including disposal, of nuclear fuel waste is carried out in a comprehensive, cost-effective and integrated manner, it is the intent of Natural Resources Canada to initiate, as soon as possible, a consultative process with appropriate federal departments, the Atomic Energy Control Board, producers and owners of nuclear fuel waste, the provinces, and other stakeholders to develop options, including legislative options, to meet three key objectives:

(1) require that a dedicated fund be established, to which only the producers and owners would contribute, to fully finance long-term management, including disposal, of nuclear fuel waste;

(2) establish a reporting relationship between the federal government and the waste management organization, and the producers and owners, to review progress on a regular basis; and

(3) establish a federal review and approval mechanism to provide oversight and access to funds.

The Minister of Natural Resources will return to Cabinet within 12 months with the preferred option to ensure key federal objectives will be met.

COG Update

- a report on the current status and future direction of the CANDU Owners Group

Ed. Note: Because of the various stories that have circulated in the nuclear community and beyond about the future of the CANDU Owners Group, we asked ***Paul Fehrenbach*** *of AECL if he could provide the real story for the benefit of the readers of the CNS Bulletin. Paul graciously agreed, and, with the cooperation of his fellow members of the COG Directing Committee, sent us the following report.*

Status of The CANDU Owners Group (COG)

In recent months there have been numerous rumours, and occasional incorrect newspaper articles, on the future of the CANDU Owners Group (COG). The following information is intended to clarify the situation.

Background:

COG was formed in 1984 by the three Canadian utilities operating CANDU nuclear generating stations and Atomic Energy of Canada Limited (AECL). Since then, COG has expanded so that other offshore CANDU utilities participate in some of its programs. The mission of COG is to establish a framework for cooperation, mutual assistance and exchange of information for the successful support, development, maintenance and economics of CANDU technology. Three programs (Information Exchange, Joint Projects, and Research and Development) have been established to achieve this mission.

The Information Exchange program promotes and facilitates the sharing of information related to the safe and efficient operation of CANDU nuclear power stations. One focus of this program is a CANDU information service for all member utilities which includes an Internet forum and report databases. Other Information Exchange Program activities include the preparation and distribution of Station Performance and Chemistry Newsletters; COG Bulletins to highlight events, problems, or good practices which could have implications or benefits for other CANDU stations; and organizing Workshops, Seminars, and Technical Meetings of interest to COG members such as the biennial COG/IAEA Technical Committee Meeting on PHWR Operational Safety Experience.

Activities within the Joint Projects Program result from decisions of the COG members to act together to meet common needs relating to the operation and maintenance of CANDU stations. Examples of recent projects include the design, development and production of special purpose maintenance tooling, and determination of the cause and remedies for outlet feeder thinning.

The COG Research and Development Program addresses the needs of the members for additional data, understanding, methodology, or equipment to satisfy station operating or licensing requirements. Working parties and technical committees, comprised of research, design and operations staff from the funding organizations, plan and monitor R&D programs in accordance with plans approved by the COG Directing Committee. The R&D activities are carried out primarily at the laboratories of AECL and Ontario Hydro, with complementary programs in place at several university and private research facilities. For 1998/99, the total authorized COG R&D expenditure was $73.5M.

Status and Future of COG:

Since its inception COG has evolved to meet changing circumstances and priorities. For example, funding of underlying or longer term research , once a significant part of the COG R&D program is now an AECL-only responsibility. The CANDU Nuclear Fuel Waste Management program progressed from a COG research program to a Used Fuel Disposal Project defined and funded by Ontario Hydro.

All of the current COG members strongly support the continuation of a CANDU Owners Group. However, there are several aspects of the existing organization and programs in which several of the members would like to see changes. These include the Ontario Hydro responsibility for administration of COG, the dual roles of COG member and R&D contractor played by both AECL and Ontario Hydro, the methodology of identifying and awarding R&D contracts, an increased reliance on WANO to coordinate CANDU station operating experience, and the increased participation by offshore CANDU utilities in the R&D programs.

In response to this desire for change, the COG Directing Committee decided to conduct a thorough review of COG, both its structure and its programs. A facilitator, who has significant utility and COG experience, was contracted by COG Operations to obtain member input with respect to desired changes to COG structure and programs and to prepare a set of recommendations. This report has now been tabled with the COG Directing Committee with an intent to have the most important changes implemented by 1999 April 1.

The main structural change being considered is that COG should become an incorporated, not-for-profit entity, with its own President, staff, bylaws, and operating procedures, rather than continuing to be administered by one of the member organizations.

The three main COG programs are likely to continue with some changes. The Information Exchange program will be

modified to accommodate the participation of the CANDU utilities in the new PHWR operating experience program of WANO Atlanta Center.

The Joint Projects program is highly regarded by the COG members and will likely continue on an as-required, project by project basis, as at present.

AECL and utility participants in the COG funded R&D program agree they have benefited significantly from this shared cost activity. It is therefore expected to continue with some changes in operating and funding procedures which remain under discussion. The future level of COG R&D project funding will be determined by the need to address operating or licensing issues at each of the CANDU stations and by AECL, and by affordability. Each member is expected to have the option whether or not to participate in any of the COG R&D projects.

It is the intent of the existing COG members that the CANDU Owners Group will remain in existence as a valuable method for supporting one another and the CANDU technology for the foreseeable future, and to provide a framework for sharing the cost of projects to address industry needs.

New member appointed to AECB

On December 18, 1998, Ralph Goodale, Minister of Natural Resources Canada, announced the appointment of **Mr. Alan R. Graham** to the Atomic Energy Control Board (AECB).

Mr. Graham was Minister of Natural Resources and Energy in New Brunswick from 1991 to 1998 and, in that position, responsible for the New Brunswick Power Corporation which owns and operates the Point Lepreau Generating Station the only nuclear facility in the region.. He is a successful businessman and is currently the Chairman of the Board for both Forest Protection Ltd. and the Maritime Forestry Complex Corporation.

Mr. Graham will replace Dr. K. K. Oglivie, Vice-Chancellor, Acadia University.

The Minister also announced the reappointment of **Dr. Yves Giroux** to the Board.

Dr. Giroux was first appointed to the Board in 1994. He is a leading civil engineering teacher and researcher in Canada. He had an extensive career at Laval University where he was Chairman of the Department of Civil Engineering from 1967 to 1977 and Associate Vice-Rector from 1977 to 1987. In the latter position he was responsible for Research Management at the University. Before being appointed to the Board, Dr. Giroux was a member of the AECB's Advisory Committee on Nuclear Safety from 1988 to 1994.

Dr. Giroux has also been active in many organizations, including the Canadian Standards Association and the Natural Sciences and Engineering Research Council of Canada. He was the founding President of the Association des administrateurs de recherche universitaire du Québec and is a Board member of the Fonds pour la formation de chercheurs et l'aide à la recherche, which grants funds to university researchers in Quebec.

The other members of the Board are: Dr. Agnes J. Bishop, president; Dr. C. R. Barnes, Director, Centre for Earth and Ocean Research, University of Victoria; and Dr. A. J. Carty, who, as President of the National Research Council, is an ex-offcio member.

NP Power restructuring discussed

The Select Committee on Energy of the New Brunswick legislature began holding public meetings in November 1998 on the possibility of restructuring the electricity industry in the province. A discussion paper, *Electricity in New Brunswick Beyond 2000,* was issued to encourage debate on the future on the future of the electricity in the province. Copies are available from the Web at < www.gov.nb.ca/dnre/electric/elec2000 >

Also a task force report on *Electricity in New Brunswick and Options for its Future* is available from the Office of the Clerk of the legislature and can be seen on the Web at

< www.gov.nb.ca/legis/reports/energ98 >

Neil Craik, a long time member of the CNS, has already made a presentation. In it he submitted information to counter the claim of a professor from UNB that the Point Lepreau NGS had no value, pointing out that the operating cost of power from Point Lepreau is much lower than that from the oil-fired Coleson Cove plant.

It is expected that Roger MacKenzie, former manager of the Point Lepreau plant, will also appear before the Committee.

Reportedly, the thrust appears to be towards deregulation and privatization, following the move in Ontario.

Anyone wishing to contact Neil Craik on this issue can do so through his e-mail address: < CraikN@aecl.ca >.

Obituary

William Nils (Bill) Selander, a long time staff member of AECL's Chalk River Laboratory and an active, popular, participant in the life of Deep River, died suddenly December 12, 1998, near his home at Point Alexander, just outside of the town, just weeks before his 65th birthday.

Bill first came to the Chalk River Laboratories, then called CRNL (Chalk River Nuclear Laboratory) as a summer student in 1958. After obtaining his Masters degree in mathematics he returned the following year, again as a summer student, before joining full-time as a reactor physicist with NRX in the fall of 1959. In 1964 he returned to the University of Toronto to pursue Doctorate studies in mathematics, obtaining his Ph.D. in 1970 after a period of combined work and study from 1966 to 1970.

From then until 1988 he was with the Mathematics and Computation Branch as a mathematical analyst. That year he became section head, storage and disposal technology, in the Waste Management Branch, until his retirement in 1994.. He continued to do some occasional contract work.

His mathematical analyses covered a wide range of topics, such as: sheath temperatures of NRX fuel; motion of electrons in an RF field; phot-acoustic techniques for infrared multiphoton absorption; mechanical properties of "O" rings for the space shuttle.

Bill was active with the Deep River Symphony and the local Historical Society and a long time member of St. Barnabas Anglican Church, where there was standing room only at his funeral, December 17.

Decommissioning of Whiteshell Announced

On December 16, 1998, the federal government announced that it had decided to concur with the decision of Atomic Energy of Canada Limited to decommission Whiteshell Laboratories to closure.

AECL officials stated that the federal government's Program Review funding reductions had made it impossible for AECL to continue operation of Whiteshell Laboratories. AECL and the federal government sought a private sector company to assume operation and develop a new business direction for the site. Unfortunately, these efforts proved unsuccessful.

The AECL officials also stated that there will not be any layoffs associated with the decision. Work will continue at Whiteshell Laboratories for the next three to five years, depending on the program.

It is understood that the Nuclear Fuel Waste Management Program will continue to be based in Whiteshell and at the nearby Underground Research Laboratory. The level of activity will be determined by the nuclear utilities, who are responsible for the program, and other commercial customers. In its response to the report from the Environmental Assessment Panel on Nuclear Fuel Waste Management and Disposal Concept (see elsewhere in this issue of the *CNS Bulletin*) the federal government states that it intends to engage the private sector in the future development of the program. Program staff will have regular updates on this initiative and will have the opportunity to participate in its development.

AECL officials stated that the Reactor Safety Research program work will continue at Whiteshell for three years until December 2001. The complex process of transferring the program at Chalk River and Sheridan Park will be taking place throughout the whole three year period. Staff will be involved in developing the plans to make these moves.

AECL will proceed with decommissioning plans for Whiteshell Laboratories. These will be subject to approval by the AECB and will include an environmental review process. R&D involving radioactive materials will be brought to an orderly conclusion as rapidly as possible consistent with the decommissioning plan. The majority of this work will be completed by March 31, 1999, and the active facilities will be closed.

The site operations workforce will continue at current levels to support continuing Reactor Safety Research, Nuclear Fuel Waste Management, and Decommissioning work, and in future years will be sized according to the level of support required for these programs.

The Economic Development Authority of Whiteshell (EDAW) and AECL have signed a Memorandum of Understanding to work together to use the existing, non-CANDU skills and assets at Whiteshell to help generate new economic opportunities in Eastern Manitoba. This agreement is supported by the federal and provincial governments. (Acsion Industries has purchased and operates the 10 MeV electron irradiator.)

In their statement AECL officials noted that over the 36 years since the creation of the Whiteshell Laboratories, the R&D performed there has contributed important technological innovation and knowledge not only for the CANDU program, but also for the Canadian and international nuclear industry as well as non-nuclear sciences.

Canadian Neutron Facility

- AECL and NRC hold workshop on proposed project

Over 150 scientists, academics, government officials, and some industry representatives, from across Canada gathered in Ottawa, November 3, 1998, to participate in a workshop on the proposed *Canadian Neutron Facility.*

This project, jointly proposed by Atomic Energy of Canada Limited and National Research Council, includes a 40 MW(th) pool-type reactor with associated neutron beam facilities. It would replace the ageing NRU reactor which is the only major source for neutron radiation testing research in the country. NRU is scheduled to be decommissioned in the year 2005.

David Bromley

reactor for CANDU
nent while NRC's
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the Neutron Program for Materials

ed by short speeches by Dr. Arthur
en Kilpatrick, AECL president, and
sident of the Natural Sciences and
ncil (NSERC), the primary physical
the country. Carty commented that
e essential for materials research and that such facilities around the world are over-subscribed. Kilpatrick stated that the CNF was "critically important" to AECL if there is to be an on-going CANDU business. Brzustowski emphasized the need to convince decision makers of the need for the facility which, he stated, was the only feasible approach. If NSERC had the money the project would already be underway, he stated.

They were followed by an enthusiastic presentation on *Materials for the Economy; the Role of National Facilities* by Dr. Indira Samarasekera, director of the Centre for Metallurgical Process Engineering at the University of British Columbia. The "electronic age" enabled researchers to work at long distances, she noted, adding that the CNF would allow Canada to stay abreast of other countries and help keep young researchers here. International views were given by Dr. Andrew Taylor, director, ISIS at the Rutherford Appleton Laboratory in the UK, and Dr. Dieter Richter, director, Forschungszentrum Jülich, Germany, both of whom noted the world need for neutron research facilities.

Considerable discussion ensued after the talk by Dr. William Buyers, of NRC's Neutron Program for Materials Research, located at AECL's Chalk River Laboratory, who described the facilities associated with the NRU reactor. Researchers in the room asked how the facility was operated, with several expressing skepticism about the role of "outsiders" in the program. Much of the discussion later in the day returned to this point, with the proponents stating that there would be an independent "peer review" of research projects associated with the neutron beam facilities.

A "keynote" luncheon address was given by Dr. D. Allan Bromley, Dean of Engineering, Yale University. Dr. Bromley was born in the Ottawa valley, obtained three degrees from Queen's University, and spent five years at the Chalk River Laboratories. He is a former senior scientific adviser to the president of the USA. He pointed out that, of the G-7 countries, only Italy spends less (as a percentage of GDP) than Canada on R&D. Separating out "non-defence" R&D, Germany and Japan spend twice as much as Canada and the USA about fifty percent more. (The USA spends much on "defence" R & D.) Bromley spoke highly of the quality of Canadian research and researchers, with particular reference to what he called the "golden age"of experimental physics at CRL in the 1950, noting the contributions of people such as John Robson, Doug Milton, Bert Brockhouse and others (including himself).

Bromley's most pointed remarks were about AECL's closure of the Tandem Accelerator at CRL. "The way in which the Chalk River TASCC facility was closed down, and the manner in which its senior staff were treated in that closure, has sent a most unfortunate, negative, message to Canadian students and young scientists .... that Canada did not place a very high value on some of its best scientists." As host, AECL president Allen Kilpatrick commented softly that there were reasons for the action but declined to pursue the issue.

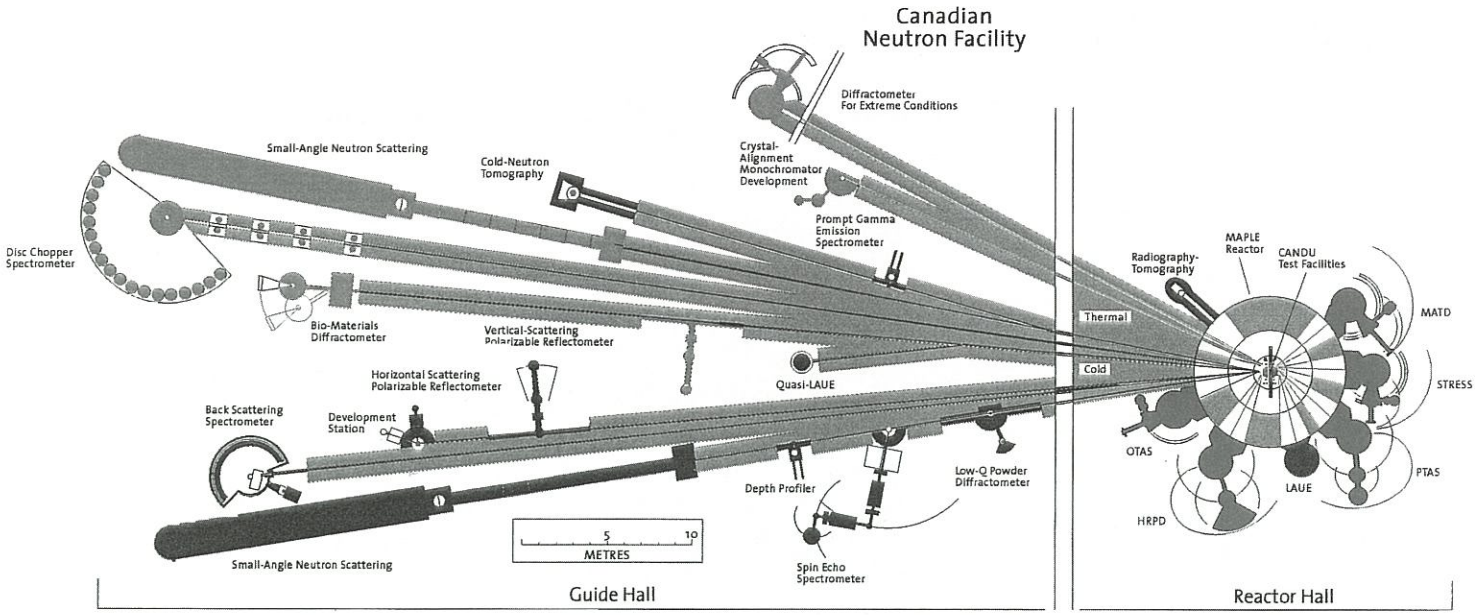
The major focus of the day, especially the discussion, was on the neutron beam research facility, largely ignoring the need for the reactor as a basis. Whether or not the proponents won the support of most of the audience was unclear, although there did appear to be a relatively positive tone to the discussion at the end of the day.

The "executive summary" of the proposal states two purposes for the facility:

- to provide the advanced materials research capability to meet the needs of Canadian universities and industry
- to provide an essential testing facility to advance the CANDU power reactor design and ensure the future competitiveness of the Canadian nuclear industry.

On the first point the proponents note that neutron beams can provide unique information for the understanding and control of advanced materials. A 1998 report on the future prospects for neutron beam research concluded:

> "Neutron beam sources are part of an essential suite of materials probes to which advanced industrial economies must have access in order to respond to the challenges of materials research.... Future access to



Canadian Neutron Facility

high flux neutrons is a cortical issue for the future growth of the Canadian neutron scattering and materials research community at large."

In the case of support for CANDU, it is recognized that Canada needs an engineering scale, high thermal flux, high fast neutron flux reactor to provide the essential support to ensure long-term competitiveness of the CANDU product. It is stated that without AECL's continued (and enhanced) capabilities in these areas, it is likely that the CANDU technology and the Canadian nuclear industry would diminish over time. This is especially critical given the significant support for light water reactor technology in the USA, France, Japan and Germany.

The proposal calls for a 40 MW(th) pool-type reactor based on the MAPLE design such as used for the HANARO research reactor in Korea and for the two isotope production reactors being built at AECL-CRL for MDS Nordion.

For neutron based research, there would be:

- six thermal beam tubes in the reactor hall
- one cold source feeding seven neutron guides
- one thermal source feeding two neutron guides
- one new spectrometer directly viewing the cold source
- five instruments relocated from NRU
- five new instruments in the Guide Hall, and
- provision for 23 instrument stations.

The total estimated cost is $388 million, made up of $208 million for the reactor; $90 million for the CANDU development facilities; and, $90 million for the neutron beam facilities.

Packages of material have been sent to all participants, with a request that they distribute the information to colleagues. A covering note from Dr. Carty and Mr. Kilpatrick notes: "given that the CNF will take six years to build, a decision to proceed is needed early in 1999 to have the CNF in place by 2005 by which time the NRU reactor will no longer operate".

Work on Pickering A approved

In November 1998 Ontario Hydro announced that its Board of Directors had approved the expenditure of $50 million to maintain the option of restarting the Pickering A units. The work will include:

- the assessment of the condition of systems and equipment
- the development of estimates of the cost of restarting the units
- the development of a project plan for restarting.

The actual decision to proceed with restarting Pickering A to service will not be made until late 1999 after a review of the progress of the Integrated Improvement Plan.

A review of the adequacy of electricity supply in Ontario had indicated that additional sources will likely be needed for the winter of 2000 / 2001 and the analysis concluded that putting the Pickering A units back into service would be the most economical option to met the demand.

After Ontario Hydro

The Ontario energy competition Act, 1998, often referred to as Bill 35, was passed by the Ontario legislature on October 26, 1998. It calls for the dismemberment of Ontario Hydro and the creation of two new companies; one for generation and the other for transmission and retail sales, by April 1, 1999

The two new companies were identified as:

- Ontario Electricity Generation Company (referred to as "Genco"), And,
- Ontario Electric Services Company (referred to as "Servco").

In addition, a separate, not-for-profit, organization, the Independent Electricity Market Operator (IMO) will be established to enable consumers to contract with different generating companies for the supply of electricity, which would be delivered over the wires of "Servco".

In December 1998, the Boards of Directors and senior officials of the two new corporations were announced and the companies renamed . Genco will be formally called Ontario Power Generation Inc. and Servco, Ontario Hydro Services Company Inc. They will be incorporated as normal businesses, not as crown corporations.

Current OH chairman Bill Farlinger will become chairman of Genco and current OH president, Ron Osborne, its president. The members of the Board of Directors are all senior executives of major Canadian companies, except for John Murphy, president of the Power Workers Union.

Servco chairman will be Sir Graham Day of the UK and formerly chairman of Cadbury Schweppes plc. Eleanor Clitheroe, currently vice-president Ontario Hydro Services, will be president.

Canadian Nuclear Society Sociètè Nuclèaire Canadienne

Call for Papers

for the

Twentieth Annual Conference of the Canadian Nuclear Society

(to be held in conjunction with the 39th Annual Conference of the CNA)

Hilton Bonaventure Hotel, Montrèal, QC, Canada May 30 - June 2, 1999

Papers in all fields pertaining to nuclear science and technology are invited for the Canadian Nuclear Society's 20th Annual Conference in Montrèal, Quèbec, Canada, May 30 - June 2, 1999.

Deadlines

- Abstracts or Intents of Presentation, including title and subject matter, must be received no later than February 5, 1999.
- Full "papers" in electronic form must be received no later than April 16, 1999
  (For those still wishing to submit material on paper media, full papers must be received no later than April 2, 1999.)

Abstracts and Papers

- Abstracts should be about 800 words long.
  Name, affiliation, mailing address, phone number, FAX number, Email address should appear on a cover sheet.
- Full papers should be of reasonable length, about 8 to 10 pages.
  Please forward the electronic version of your abstract and/or your full paper by Email to: <jkoclas@alum.mit.edu>
- Supported File Formats are: Acrobat PDF as the preferred file format, TEX, Postcript File, Word,WordPerfect, PageMaker, FrameMaker, NisusWriter.

If you elect to send the abstract or full paper on paper media, please mail to:

Professeur Jean Koclas
Institut de Gènie Nuclèaire, Ècole Polytechnique de Montrèal
C.P. 6079, Succ. Centre-ville, Montrèal, QC, Canada, H3C 3A7

Proceedings

Proceedings will be produced on CD-ROM only, and will be available at the Conference.

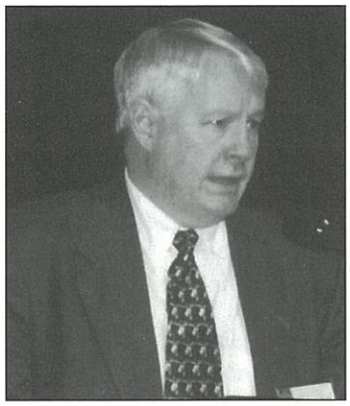
Looking forward to seeing you in Montrèal, 1999 May 30 - June 2, - at the last CNS Annual Conference of this millennium!
Dr. Jean Koclas
Technical Program Chairman

meetings

Meetings of the Americas

The first Meeting of the Americas was held in Washington, D.C. November 16 - 19, 1998, in parallel with the Winter Meeting of the American Nuclear Society. The Canadian Nuclear Society was one of the many societies from North and South America sponsoring the event.

This inaugural meeting was intended to bring together senior representatives of the nuclear communities from the countries of the two Americas. After several iterations during the planning phase the final format consisted of five panel sessions: an overall plenary one, and one each on the topics: nuclear power; radioisotopes; radioactive waste; nuclear regulation.



Michael Cleland

The CNS had arranged for a strong representation from Canada. Speaking at the opening plenary session was Michael Cleland, Assistant Deputy Minister, Energy, at Natural Resources Canada, the country's senior government official in the energy field. He provided an excellent overview of the Canadian nuclear programs.

Dr. Ken Hedges of Atomic Energy of Canada Limited, presented the paper by Dr. David Torgerson, vice-president, Research and Product Development, AECL, in the panel on nuclear power, which was chaired by former AECL president, Dr. Stan Hatcher.

Grant Malkoske, vice-president, MDS Nordion, gave an upbeat overview of the use of radioisotopes in industry and medicine, noting the important role of his company as a major world supplier.

Dr. Peter Brown, director Uranium and Radioactive Waste, NRCan, summarized Canada's policies and practices in dealing with the various categories of radioactive waste, from uranium mine tailings to spent reactor fuel. (His paper is reprinted in this issue of the *CNS Bulletin.)*

Finally, John Waddington, director general, at the Atomic Energy Control Board provided a philosophical look at the regulation of nuclear power plants, with particular emphasis on the importance of the organization.

The representation from the other countries involved: Argentina, Brazil, Chile, Mexico, USA, was of a similar senior level.

Unfortunately, the physical arrangements for the four topical panel sessions was very poor – a small room in a remote corner of the very large hotel complex. Consequently, the audiences were small. To partially compensate for this the organizers are compiling the papers into a set of proceedings which will be available from the participating societies early in 1999.

Y2K Nuclear Workshop

A major international workshop on The Impact of the Year 2000 on the Nuclear Industry will be held in Ottawa on February 8-10, 1999. This workshop is sponsored by the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD), through its Committee on Nuclear Regulatory Activities, and is timed to coincide with the mid-phase of Y2K implementation programs. The meeting will be hosted by the Atomic Energy Control Board.

This will be an opportunity for participants to discuss regulatory and industrial strategies on Y2K issues and update each other on the status of Y2K program implementation and corrective actions. The workshop will emphasize actual problems found and how they are being handled to allow attendees insights on where they may need to concentrate their efforts. There should still be time to incorporate any new lessons learned into national programs. There will also be a session on contingency planning.

Registration for this workshop is being coordinated by the OECD. Further information can be obtained from the OECD NEA Web site at: < http://www.oecdnea.org >

The AECB issued a statement on the Y2K problem just before Christmas, 1998. This reviews the essence of the problem in the nuclear context and presents a status report on the readiness of the Canadian nuclear industry. It can be obtained at the AECB's Web site: < www.gc.ca/aecb >

INSC releases major studies

The International Nuclear Societies Council (INSC) held its second semi-annual meeting of 1998 in Nice, France, October 25, during the ENC'98 conference. The previous meeting had been held at Banff, Canada, during the PBNC'98 meeting.

Among its international relationships, the Canadian Nuclear Society is a charter member of the INSC. As the name implies, the INSC is an international group with membership of almost all of the nuclear societies around the world. (Phil Ross-Ross, the CNS' second president was very much involved in the formation of a prior organization and its evolution into the present structure.)

The major event of the meeting was the final approval of a set of papers prepared by international working groups over the previous 15 months. Drafts had been reviewed at the Banff meeting and the papers finalized in the interval.

A special open session was held the following day at which the then chairman, Dr. Manuel Acero, of Spain, publicly presented the document, entitled, *Worldwide Integrated View on the Main Nuclear Energy Issues.*

Seven papers are included:

- Nuclear Safety
- Public Understanding
- Nuclear Role in the Coming future
- Radioactive Waste
- Non-proliferation
- Risk
- Low Doses

Each is a thoughtful, comprehensive, overview of the particular topic prepared by working groups with representation from around the world.

The publication is currently being printed by the European Nuclear Society for the INSC, with the intention of having wide distribution through the member societies. It will be available from the CNS in the spring of 1999.

A companion report, sponsored by the INSC but prepared separately by a group called the Young Nuclear Generation, entitled, Report of the Younger Generation of Professionals within Nuclear Science and Technology, was presented at the same session. This will also be available from the CNS.

New officers of the council were elected for the years 1999 - 2000. As follows:

Chair	Dr. Gail de Planque	(USA)
1st Vice-chair	Dr. Chang Kun Lee	(Korea)
2nd Vice-chair	Mr. Jorge Spitalnik	(Brazil)
Sec. Treas.	Mr. Conrad Helmut	(ENS)
Past-chair	Dr. Manuel Acero	(Spain)

An agreement of cooperation with the International Nuclear Engineering Academy was approved.

Later in the week, at a special awards luncheon, Dr. Acero presented the first INSC Global Award to Dr. Hans Blix, former director general of the International Nuclear Energy Agency.

The next INSC meeting will be held during the Annual Meeting of the American Nuclear Society in Boston, June 6, 1999.

Meeting planned on future of nuclear energy in Canada

Drs. Bob Morrison and Bruce Doern of the Carleton Research Unit for Innovation, Science and Environment (CRUISE) at Carleton University have announced plans for a conference on the Future of Nuclear Energy in Canada to be held in Ottawa, September 30, October 1, 1999. The emphasis will be on government policy.

Dr. Morrison recently completed a review of federal government policy on nuclear energy for Natural Resources Canada. (See Vol. 19, No. 3 of the CNS Bulletin.)

For information, contact Dr. Morrison at his e-mail address: < morriso@cyberus.ca >

CNA / CNS
Nuclear Winter Seminar
Ottawa
8, 9 February 1999

Basically a one-day intensive review of the Canadian nuclear program (with an evening dinner on Feb. 8) this seminar presents an opportunity to meet with Cabinet Ministers, Members of Parliament and senior federal government officials, as well as obtaining the most recent information from industry and government leaders.

Contact: Sylvie Caron
CNA / CNS office
144 Front Street West, Suite 475
Toronto, Ontario
M5J 2L7
Tel: 416-977-6152, ext. 18
Fax: 416-979-8356
e-mail: < carons@cna.ca >

ENC '98

The largest (in the terms of participants) nuclear conference of the past few years took place in Nice, France, in late October 1998.

ENC '98 (European Nuclear Conference - 1998) together with RECOD '98, which ran in parallel, drew over 1,200 attendees (about half from France) and was accompanied by a large, impressive, exhibition at which almost all of the major players in the nuclear power industry were represented (excluding AECL). ENC '98 focussed on the nuclear power industry while RECOD '98 dealt with reprocessing, waste treatment, and decommissioning. Despite being, primarily, a European meeting, and located in France, the official language of both conferences was English.

A view of the large exhibition associated with the ENC '98 Conference in Nice, France, October 1998.

Similar to most such meetings, ENC '98 opened with a large plenary session, with speeches from several leading figures from the world nuclear arena. Reflecting the demographics of the nuclear industry, the scene on stage was of a long row of older men, with one exception, a young, attractive woman, Astrid Gisbertz of Germany, chairperson of the ENS Young Generation group. Both her presence and her message were refreshing changes from the usual. She emphasized that if there are to be any young people to carry on the nuclear industry there must be an on-going R and D program. Perhaps supra-national organizations are needed, she suggested. After the session, the few media persons present crowded around her.

The other plenary speakers included: Dr. Hans Blix, former director general, IAEA; Pablo Benavides, director general, European Commission; Zack Pate, chairman, WANO; Yves Cousin, head of engineering and construction EdF; Ding-Fan Li, vice-president, China National Nuclear Company. Blix gave the same message he has been emphasizing over the past few years, of the need for nuclear energy for sustainable development and to meet the commitments made in Kyoto for reductions of "greenhouse gas" emissions.

There were only six sessions in the basic conference, with a total of 42 papers presented orally. Another 150 were displayed in three poster sessions.

A number of special sessions and workshops, held by companies and organizations, were held in parallel with the official conference program, covering topics such as: Young Generation; Risk-based Inspection; Future of Fast Neutron Reactors; Training.

The exhibition was the most impressive part of the event. There were 240 stands representing over 400 companies. Fifteen countries had "pavilions", the most impressive being those from France and Germany. Almost 2,000 exhibitor passes and another 1,700 visitor passes were issued.

Despite the high cost of registration (approx. $1,000) there were no meals or social functions as part of the program, other than a modest opening reception which was hosted by the city of Nice.

Proceedings are available from the ENS, P.O. Box 5032, CH-3001, Berne Switzerland, fax 41-31-320-68-45.

CNS news

CNS President severely injured in car accident

Paul Thompson

Paul Thompson, president of the Canadian Nuclear Society, suffered severe injuries in a car accident near Saint John, N.B., the evening of December 8, 1998. He is expected to be in hospital for at least two months and unlikely to return to work until summer.

The accident happened about 6 p.m., Dec. 8, when Paul was returning home from the Point Lepreau Nuclear Generating Station where he is head of safety and licensing. As he was entering Highway 7 from Highway 1, his car was hit, head on, by a car travelling the wrong way on the divided highway. The force of the accident destroyed the two cars and killed the other driver.

Paul suffered a broken neck, two broken legs (one seriously) and a broken wrist. He is wearing what he calls a "halo" to immobilize his head and neck and has many pins in, and a brace on, the one leg. *(Ed. Note: The thought of Paul Thompson in a "halo" stretches credibility for many!)*

A newspaper article described the other car as a "twisted piece of rubbish". Paul's car was also badly smashed and he was pinned by the dash. Paul attributes the action of a bus driver, Chris Langille, who was first on the scene, as saving him from even more severe injuries. When he saw Paul, Langille immediately stabilized his neck to prevent possible further damage to Paul's spinal column.

In a telephone conversation in early January Paul revealed again his high spirits and optimism. He warned that as soon as he had the brace on his right hand removed (which he hoped would be soon) he would be able to get onto his beloved laptop and begin communicating with everyone by e-mail. In the meantime he said he is "learning patience". That, for someone as energetic and enthusiastic as Paul, must be quite a revelation.

Paul said he has been overwhelmed with the outpouring of well wishes, through cards, telephone calls, etc and he thanks everyone for their concern. It has kept his spirits high.

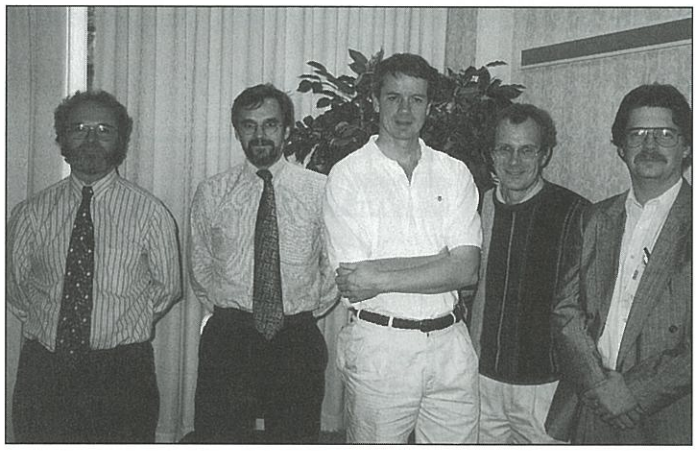
Lattice Physics Course a success

A Canadian Nuclear Society sponsored course for physics specialists, held at the Sheridan Park Centre, November 4 to 6, 1998, attracted fifty people, primarily from the nuclear utilities

The course covered lattice cell physics, in particular the WIMS-AECL, DRAGON, and related physics codes. The feedback from the attendees was quite favourable and requests were received for further courses.

Given the success of this course, the organizers and the CNS Council propose another course for the year 2000.

The course organizer was Glenn Harvel from AECL-SP. Others involved in organizing and presenting the course were: Jim Donnelly, AECL-SP; Peter Laughton and Stephen Douglas, AECL-CRL; and Guy Marleau, École Polytechnique.



The "faculty" for the CNS Lattice Physics Course presented in November 1998. Left to right: Jim Donnelly, Guy Marleau, Peter Laughton, Stephen Douglas, Glenn Harvel.

Council adopts policy on "briefs"

Ed. Note. At its December 3, 1998 meeting, the governing Council of the Canadian Nuclear Society, adopted the following Policy regarding official briefs or submissions from the Society. Members are invited to comment on this Policy by communicating with any member of the Council (see inside back cover of the CNS Bulletin.)

CANADIAN NUCLEAR SOCIETY /
SOCIÉTÉ NUCLÉAIRE CANADIENNE

POLICY ON OFFICIAL SOCIETY BRIEFS
Rev. 0 - 1998/12/03

Preamble

From time to time it may be deemed appropriate for the Society to submit an official brief to public hearings, governments or other bodies. The purpose of this policy is to set out the spirit in which Society briefs should be written. Implicit in the mandate of any Society is that its representatives act as a responsible voice of the Society. For the CNS, a "responsible voice" includes the promotion of clear and critical thinking on issues relating to nuclear science and technology. The CNS is a society of individuals and it is important, if it is to be effective in carrying out its mandate, that it act as, and be perceived as, such a free and unencumbered society. The CNS does not have industry advocacy, per se, as an objective.

Briefs may advocate a specific technology (e.g., waste disposal technologies, burning of MOX, etc.) on the merits of the technology. Briefs must, however, refrain from commenting on specific commercial activities or endeavours of individual companies. Thus, briefs which discuss nuclear (or other) technology should restrict discussion to the facts and methodologies of the technology as we understand them.

In all things, Society briefs should be written in the spirit of an open forum and in such a way as to establish and reinforce the image of the CNS as a competent and responsible source of expertise, ideas and opinions on nuclear topics.

Text of Policy

1.0 This policy is meant to provide guidelines on the preparation and submittal of official Society briefs.

2.0 The Society may prepare briefs on:
- issues dealing with general or specific topics relating to nuclear science and technology
- technical or scientific issues generally
- issues of general societal importance on any subject
- issues of public policy

A proposal to prepare a brief may be initiated by any Branch, Division, or Committee, or by any individual member. The proposal must be submitted to Council for review and concurrence that a brief would be appropriate.

3.0 The Society shall NOT submit briefs:
- on issues which pertain to the way in which specific companies conduct their business affairs
- on issues which pertain to the way in which countries conduct their political affairs
- on non-technical issues pertaining to the way in which specific companies manage their human resources and/or physical resources (e.g., staffing up or down, opening or closing of offices, etc.)
- on licensing applications
- which contain statements that might reasonably expose the Society to actions for libel or other types of legal liability

4.0 The draft brief shall be reviewed by at least two other individuals who are recognized specialists in the field, and then vetted by the Executive Committee before it is submitted to Council for approval. No Society brief shall be issued until it has been formally approved in final form (including stated authorship) by Council.

5.0 Society briefs shall be submitted with a covering letter on CNS letterhead or in a manner which clearly indicates the CNS as its source. Every \ Society brief shall clearly indicate the names of the authors and their titles or positions within the CNS.

6.0 This policy does not cover communication of personal views or opinions by CNS members who choose to act individually. Such communications shall clearly indicate the personal nature of the author's views and shall NOT be on CNS letterhead.

BRANCH ACTIVITIES

Ed. Note: The following is drawn from reports from the various branches. Some of the Branches are very active, others less so. As a result of the pressures of the Ontario Hydro recovery program there is essentially a hiatus at the Bruce, Darlington and Pickering Branches. The Saskatchewan and Manitoba Branches face difficulties because of the changing nature of the nuclear programs in their areas and the Toronto Branch has also suffered from the Ontario Hydro situation

CHALK RIVER Branch (Al Lane)

The Chalk River branch started off the season on Sept 14 with a very up-beat talk by **Paul Thompson** on the demonstration irradiation of CANFLEX bundles in the Point Lepreau reactor. The extra operating margins provided by these bundles offer the opportunity for an economically attractive extension of the life of the Point Lepreau plant prior to the eventual need to re-tube the reactor.

This was followed on October 29 with a talk by **Peter Boczar** (Director of Fuel & Fuel Cycle Division of AECL) on the *"CANDU Fuel Cycle Vision"*. This talk outlined AECL's current view of the evolution of fuel cycles through the use of the CANFLEX bundle, to slightly enriched uranium, recycled LWR fuel, thorium and fast breeder reactors.

Frank Saunders, Manager, McMaster Nuclear Reactor, spoke at a Branch meeting on December 3. His topic was: *" The Rise and Fall and Rise of the McMaster Nuclear Reactor"*. The McMaster Nuclear Reactor (MNR) is a 5 MW pool-type research reactor, which was commissioned in 1959. MNR differs from other Canadian university reactors in that it is not of the AECL-designed SLOWPOKE design. In 1994 the MNR suffered a criticality incident leading to overpowering of the core. A decision to permanently shut down the reactor was made in 1995, but reversed less than a year later. The reversal decision was based upon a restructured financial plan for the facility, which included a profitable expansion of MNR's isotope-production business. The MNR is currently preparing to convert its core to LEU fuel.

The current vision for seminars at the Chalk River branch is for a seminar every six weeks. Anyone who has a good idea for an interesting seminar subject, is asked to contact the program coordinator at: <whitlockj@aecl.ca>

GOLDEN HORSESHOE Branch (Dave Jackson)

A branch seminar was held on November 10, 1998 with **Dr. Bill Hogan** of Lawrence Livermore National Laboratory speaking on the *"National Ignition Facility"*. It was a very good talk that had been presented the previous day at the Sheridan Park Branch. Unfortunately, the attendance at the Golden Horseshoe seminar was disappointingly small.

NEW BRUNSWICK Branch (Mark McIntyre)

On October 15, **Dr. Michaela Fairman-Wright** spoke to a crowd of CNS members at the Saint John Regional Library on the topic *"What Does Radiation Actually Do to Cells?"*. Dr. Fairman-Wright has done post-doctoral work at Cambridge University examining external influences on cell development and DNA. She discussed the types of damage that cells encounter and the repair mechanisms. The talk described how cells react to cigarette smoke and radiation with varying amounts of toxicity.

On Oct. 27, the VP Nuclear for NB Power, **Rod White,** delivered a presentation to a combined group of CNS NB and the APENB F (Association of Professional Engineers of New Brunswick, Fredericton Branch). The presentation was entitled *"Point Lepreau (Nuclear) Generating Station: Performance Improvement Initiatives"*. It was held at the University of New Brunswick campus in Fredericton. The presentation was well attended with an audience surpassing 40 listeners. Those in attendance included PLGS employees, APENB members, consultants, professors, students, and other interested members of the public.

Mr. White started his presentation with a brief explanation of the basics of a CANDU reactor for the benefit of those not familiar with the plant. He went on to discuss several events that put PLGS in a reactive problem solving situation. The Performance Improvement Program was the result of NB Power realizing the importance of PLGS to the success of NB Power. The program is intended to help improve the plant's efficiency, safety and performance so that NB Power can operate PLGS with a proactive approach, where problems are identified and resolved before they become incidents. Mr. White also compared the operating and capital costs of all the different types of generation for NB Power and showed the cost comparisons of running PLGS until 2008 (when pressure tubes would need to be replaced), 2020 (when the boilers would need to be replaced) and to 2032 (end of life).

Dr. Aniket Pant of Zircatec Precision Industries Inc. (ZPI) spoke to the New Brunswick Branch on November 19 at the Saint John Regional Library, on *"Nuclear Fuel Manufacture"*.

Dr. Pant structured his talk as a virtual walk through of the two Zircatec plants with some excellent pictures of the various machines and people that construct the fuel. First we followed some of the UO2 powder; its arrival on site, initial densification, pellet forming, sintering and grinding at the Port Hope facility. He then showed us the machinery at their other facility in Cobourg, Ontario which constructs the Zircaloy sheaths for the fuel bundles. The walk through continued with a discussion of the assembly of the bundles; loading of the pellets into the sheaths, brazing the appendages onto the sheaths, the resistance welding of the endcaps, the assembly of the bundles and finally the visual inspections. Dr. Pant stressed the importance of Quality Assurance (QA) at the facility and their rigorous testing and sampling of their product. He then fielded questions from the floor, the topics included helium leak testing, testing of the endcap weld, surface roughness of the pellets and how Zircatec deals with worker boredom. Dr. Pant's talk provided an excellent impression of how the CANDU fuel is made, second only to a visit to the plant itself.

A planned invitation function as part of the Branch membership drive, scheduled for December 14, was called off because of the serious accident suffered by CNS President Paul Thompson.

The new Branch executive is: Chairman: Mark McIntyre; Vice-

Chairman: Kamal Verma; Secretary: Tom Chapman; Treasurer: Ray Quan; Fredericton representative: Neil Craik; Past Chairman: Dave Reeves; Members at large: Graham MacDonald, Doug Coleman, Bryan Patterson, Rick Sancton.

OTTAWA BRANCH (Sadok Guellouz)

The Ottawa Branch held its first meeting of the season on Nov. 12 with **Jon Jennekens,** former president of the AECB, as guest speaker. His topic was the *Technical Advisory Panel on Nuclear Safety* of Ontario Hydro, of which he is chairman. From that perspective he gave an insightful account of the situation at Ontario Hydro Nuclear. The meeting drew about 30 people, including about five from AECB. We had hoped for more and will keep trying to attract them.

On January 14, 1999, **Dr. Bob Morrison,** former director general of the Uranium and Nuclear Energy Branch of Natural Resources Canada, spoke on the evolution of *Nuclear Policy in Canada,* based on a recent study he conducted for NRCan.

The Branch executive for 1999 will be: Chair - Sadok Guellouz; Vice-chair - Bob Dixon; Treasurer - Fred Boyd; Past Chair - Mohamed Lamari. The Branch is working on its program for 1999. It will likely continue its practice of supporting the Regional Science Fair and offering a special CNS award (cash prize plus certificate). A high school field trip is planned.

SASKATCHEWAN Branch (Walter Keyes)

The branch activity has been focused on publishing and distributing the pamphlet on nuclear technology in Saskatchewan. It is intended to distribute them to all grade 11 students at 490 high schools in Saskatchewan as well as to several other targeted audiences. We hope to introduce them to the schools via an essay contest but we are still negotiating funds for that activity. The plan is to do up posters, establish contest rules and get prize donations for winning essays. We will be offering a few CNS watches as part of the prize package.

There are plans to have a speakers program in the new year for the uranium companies. (Any suggestions for dynamic "non-establishment" speakers would be welcomed.)

SHERIDAN PARK Branch (P. Gulshani)

On Oct 19, the invited speaker was **Dr. David Lee** from AECL CRL. Dr. Lee, a Hydrologist with the Environmental Research Branch, spoke about the contamination of groundwater and its impact on the environment. He discussed the methods developed at CRL to detect, analyze, and remedy this contamination. The presentation focussed on a novel technology, using sponge of granular clinoptilolite which is inserted in the groundwater path, to filter the contaminant.

On Nov 9, **Dr. William Hogan** from Lawrence Livermore National Laboratory gave a talk on inertial confinement fusion. Dr. Hogan began with the principal of ICF. He then discussed the building the National Ignition Facility at LLNL, which, when completed, will become the highest intensity ICF machine with the most laser beams in the world. The ICF will be used mainly on material research.

On Dec 1, the SP Branch held its annual meeting with **Mr. Allen Kilpatrick,** President & CEO of AECL. as invited speaker Mr. Kilpatrick highlighted the current status of AECL projects abroad and discussed the opportunities for sales of CANDU reactors in Asian-Pacific countries and Eastern Europe. He also touched upon other opportunities like the possible sales of research reactors to Australia and China and the possible sales of MACSTOR (dry storage systems) to former Soviet countries finishing with a projection of the future for AECL.

Write-ups on nuclear-related materials have been prepared. Together with a collection of slides, the write-ups will form the education resource kit which the SPB plans to put on the Internet for public access, and as resource materials for members who need to do school presentations.

A tour to the Pickering Nuclear Generating Station is currently being planned for some of the students and teachers who participated in the '98 Peel Region Science Fair. The original plan to arrange a tour to Darlington NGS last May was cancelled due to a shortage of Ontario Hydro staffs at the nuclear stations to provide the tour.

The new executive consists of: Chair - Parviz Gulshani; Vice-Chair - Ted Wessman; Past Chair - Kwok Tsang; plus eight other members whose specific duties will be determined in January.

TORONTO Branch (Chair: Vacant)

Dr. Stanley R. Hatcher, a former President of AECL, and Past President of the American Nuclear Society gave a talk titled *"2050: Nuclear Power in the Next Century"* at the University of Toronto on December 9. This public seminar has been organized by the Department of Chemical Engineering and Applied Chemistry. In order to broaden the attendance, the University agreed to accept co-sponsorship by the Toronto Branch of the CNS (even though that Branch is currently inactive).

Following the seminar, there was a "wake" for the SLOWPOKE reactor at the U of T. *(See separate article.)*

The CNS Toronto Branch is also co-sponsoring a talk by **Dr. Margaret Maxey** of the University of Texas, on January 13 at the U of T, on *"Rad-Chem Risks: Visions in Collision"* and, in February, one by Dr. Allen Brown of Ontario Hydro on *"Safe Operating Envelope"*.

The Central Canada Branch of the Institute of Mechanical Engineers would like to have CNS support in advertising a lecture by **Gord Brooks** on *"The evolution of CANDU design and technology"*, as part of the program during Engineering Week 1999. The lecture will be held at the University of Toronto on March 2nd, running from 6:30 to 10:00 PM. The CNS Toronto Branch will certainly support this function, and perhaps it should arrange to become a co-sponsor.

CNS Past-President, Ben Rouben, and vice-president, Ken Smith have been active in attempting to resurrect the Toronto Branch.

News of Members

Dr. Daniel Meneley was elected to a two-year term as chairman of the **International Nuclear Energy Academy** (INEA) at a meeting held in Nice, France, October 27, 1998, during the ENC '98 Conference.

The INEA is an honour society of the international nuclear scientific and engineering community dedicated to fostering the development and utilization of the peaceful application of nuclear energy in a safe and economic manner throughout the world. It conducts studies, discussions, and develops recommendations for the international nuclear community on generic issues relevant to nuclear energy matters. Membership is limited to 100. Canada can have up to eight members, the same number as the U.S., the U.K., Russia, Japan, Germany and France. Other Canadian members of in INEA are Ken Hare, Stan Hatcher and Jon Jennekens.

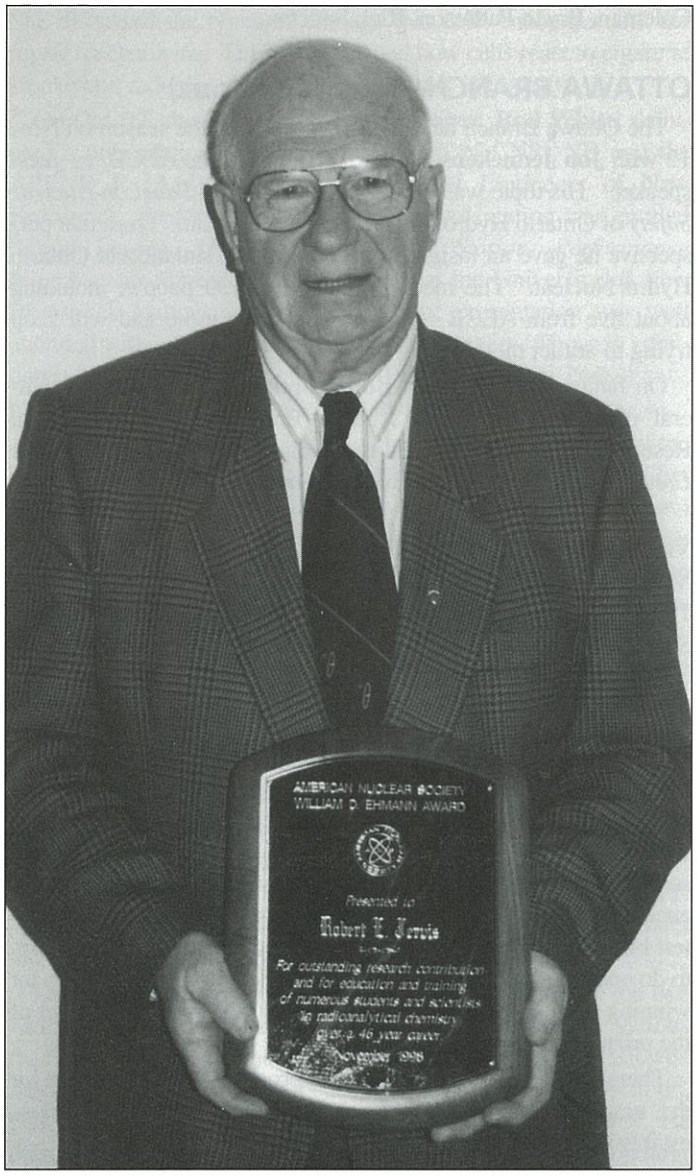
Officers and officers of the Academy are elected by a majority of the membership.

Meneley has worked in the nuclear industry for almost four decades, in the UK, US, Korea, China, and Canada, in many areas, including: reactor physics, safety, plant design, licensing, and education. He was Chief Engineer at Atomic Energy of Canada Limited from 1991 until recently and is presently located in China working with Marketing and Sales on the development of technology transfer to China.

At the same meeting the INEA decided to enter into a formal agreement of cooperation with the International Nuclear Societies Council, of which the Canadian Nuclear Society is a member.

Dr. Robert E. (Bob) Jervis was presented with the William D. Ehmann Award at the Winter Meeting of the American Nuclear Society in Washington, D.C., November 17, 1998. The citation read: *for outstanding research contribution and for education and training of numerous students and scientists over a 46 year career.*

Dr. Jervis is professor emeritus of Nuclear Science and Engineering at the University of Toronto and a former chairman of the Advisory Committee on Nuclear Safety of the Atomic Energy Control Board.



Dr. R.E. (Bob) Jervis poses with the William Ehmann Award which he was presented at the Winter Meeting of the ANS, Washington, D.C., November 1998.

Dr. Reza Moridi has been named Vice-President, Science and Technology for the Canadian Institute for Radiation Safety (CAIRS). Dr. Moridi joined CAIRS in 1990 and has been responsible for the CAIRS National Laboratories in Saskatoon since they was opened three years ago. He led the team that won formal certification from the AECB in March 1998 for the CAIRS Personal Alpha Dosimetry Service.

Dr. Moridi is originally from Iran where he was chairman and professor of physics at Farah Pahlavi University in Tehran. He obtained his Ph.D. in solid state physics from Brunel University in the U.K. and is a Fellow of the Institute of Physics (U.K.).

1998 CNS Awards

Each year the Canadian Nuclear Society recognizes the contribution of its members and others in the Canadian nuclear community for their special contributions. In 1998 this was done at a special luncheon during the 19th CNS Annual Conference in Toronto, October 22.

CNS Fellows

Three members were honoured with the designation ***Fellow of the Canadian Nuclear Society.***

The criteria for this honour include:

- major and sustained contribution to the sciences and/or professions that relate to the advancement of nuclear technology in Canada
- demonstrated maturity of judgement and breadth of experience
- outstanding technical capability
- service to the Canadian Nuclear Society

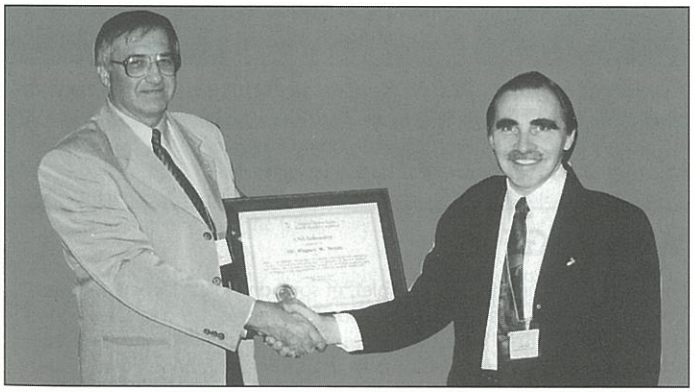
The three recipients of this honour were:

Dr. Richard Bolton, former Director General, Centre Canadien de Fusion Magnétique; for:

> "his exceptional contributions in the foundation, promotion, construction and management of the Tokamak de Varennes; his extensive involvement with the Canadian Nuclear Society, especially in the establishment of the Quebec Branch and with the program committees for several conferences."

Dr. Hugues W. Bonin, professor, Royal Military College; for:

> "his exemplary contributions over much of his life in nuclear engineering and his devotion to teaching and research; his extensive involvement in scientific societies, particularly the Canadian Nuclear Society; his leadership in the organization and running of the Student Conferences, co-sponsored by the Canadian Nuclear Society and the Canadian Nuclear Association."



Conference Chairman (and past-president) Ben Rouben presents Hugues Bonin with the certificate naming him a "Fellow" of the Society, during the CNS Annual Conference, Toronto, October 1998.

Dr. Daniel Meneley, former Chief Engineer, Atomic Energy of Canada Limited for:

> "his leadership in developing the CANDU safety philosophy; his dedication to teaching and research; his numerous contributions to CNS conferences, seminars, courses and branch activities."

Dan Meneley holds the certificate naming him a "Fellow" of the Canadian Nuclear Society after the presentation at the CNS Annual Conference in Toronto, October 1998.

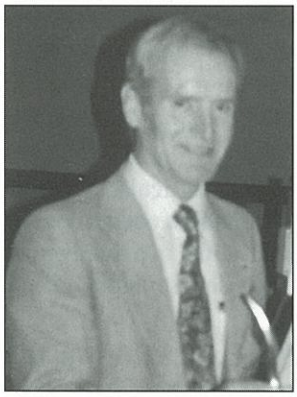
CNS Innovative Achievement Award

The *CNS Innovative Achievement Award* is granted for "significant innovative achievement, implementation of new concepts, or outstanding contribution in the nuclear field in Canada".

The 1998 Innovative Achievement Award was presented to **Dr. Ray Metcalfe,** Technical Director and Principal Research Engineer of Fluid Sealing and Technology Unit, Atomic Energy of Canada Limited.

The citation read:

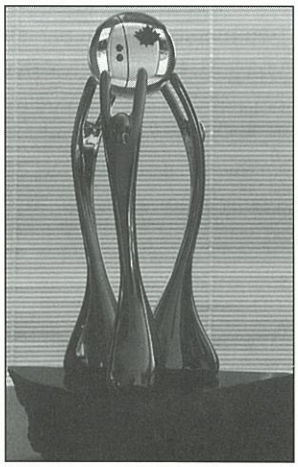
> "for the innovative application of fluid-sealing concepts to improve functional performance, safety and maintainability of static and dynamic seals for CANDU reactor systems".



Ray Metcalfe

John S. Hewitt Team Achievement Award

The *John S. Hewitt Team Achievement Award* is named after Dr. John Hewitt, one of the founders of the Canadian Nuclear Society and its third president, who died, prematurely, a few years ago. It is intended to recognize outstanding achievement by a



The CNS Innovative Achievement Award trophy.

Conference chairman Ben Rouben (2nd from left) poses with the 1998 winners of the John S. Hewitt Team Achievement Award at the CNS Annual Conference, Toronto, October 1998. L to R: John Skears, Tung Tong, Charles Chang.

team in the introduction or implemetation of new concepts, or the attainment of difficult goals, in the nuclear field in Canada.

The winners of the 1998 John s. Hewitt Team Achievement Award are: **Dr. Charles Y. F. Chang, John Skears and Tung Tong,** of Ontario Hydro.

The citation read:

> "for outstanding contribution to thermal hydraulic process design and safety analyses for CANDU reactors, particularly with the development of the SOPHT computer code; successfully contributing to the identification, in a timely manner, of the figure of eight, two-phase, oscillation phenomenon using SOPHT".

CNS Education and Communication Award

The CNS Education and Communication Award was established in 1997 to recognize significant achievements by CNS members in improving the understanding of nuclear science and technology among educators, students and the public.

Two members were presented with this award in 1998.

Morgan J. Brown, of the Whiteshell Laboratory of Atomic Energy of Canada Limited (and chair of the Manitoba Branch of the CNS) was recognized:

> "for his dedication to education in science; communicating to students the science and applications of nuclear energy, especially by giving talks to high-school students and developing technical information packages".

Dr. Ronald G. V. Hancock, Director of the Slowpoke Nuclear Reactor at the University of Toronto, was recognized:

> "for his dedication to education in science, communicating the science and applications of nuclear energy to students, especially for conducting innumerable visits of the University of Toronto SLOWPOKE 2 facility".

Prior to reading out these awards, Hong Huynh, chairman of the CNS Honours and Awards Committee, referred to the **Robert E. Jervis Award,** which is administered jointly by the Canadian Nuclear Society and the University of Toronto. That award is for the best full-time graduate student at a Canadian university who pursues research involving the development and application of radiochemistry and radiation processing, in domains such as human health, chemical engineering, nuclear safety or environmental studies. The 1998 winner was Evon Reynolds of the Department of chemical Engineering and Applied Chemistry at the University of Toronto. The award, which is accompanied with a cheque for $500, was presented earlier in the year.

Conference chairman Ben Rouben presents the CNS Education and Communication Award to Morgan Brown, during the CNS Annual Conference, Toronto, October 1998.

Canadian Nuclear Society

Honours and Awards - Call for 1999 Nominations

DEADLINE FOR ALL NOMINATIONS: 1999 March 15

Fellows of the Canadian Nuclear Society

CNS members who have been designated "Fellows of the Canadian Nuclear Society" belong to a membership category established by the Society in 1993 to denote outstanding merit. The criteria for admission to this membership category include "major and sustained contributions to the sciences and/or professions that relate to the advancement of nuclear technology in Canada." Demonstrated maturity of judgement and breadth of experience, as well as outstanding technical capability, service to the Society, and current CNS membership of at least five years standing, are also requirements for admission.

The newly admitted fellows are presented with special membership certificates on a suitable occasion at the time of the annual conference of the CNS. In the tradition of honorary membership categories of learned societies, CNS Fellows are entitled to add the letters "F.C.N.S." to letters denoting degrees and professional certifications following their names. The maximum number of CNS Fellows at any one time is limited to not more than five per cent of the total membership.

All CNS branches and technical divisions are encouraged to forward confidential nominations statements, signed by three members, to the Chairperson of the CNS Honours and Awards Committee. Alternatively, any three CNS members, not necessarily of the same branch or division, may together forward a nomination. The nomination statement should include a focused rationale for the nomination, supported by information on the candidate's:

(i) formal education or equivalent,
(ii) work history, professional achievements, publications, patents,
(iii) experience, demonstrated maturity of judgement and contribution to nuclear science and technology, and
(iv) past services to the CNS.

The Honours and Awards Committee will consider the above criteria with weights of 20%, 20%, 25% and 35%, respectively.

. . . . . .

CNS Innovative Achievement Award

The Innovative Achievement Award was established by the CNS in 1991. Recipients of the award are specially recognized for

> *"Significant innovative achievement, implementation of new concepts, or outstanding contribution in the nuclear field in Canada."*

The award trophy, on which all recipients' names are inscribed, is in the form of an original sculpture showing three figures supporting the Society's logo. Each recipient retains a miniature replica of one figure from the sculpture, as well as a commemorative certificate presented at the annual conference of the CNS.

Members of the Society are strongly encouraged to nominate individuals who have made key contributions to the Nuclear Science and Technology. Such contributions should have been to the conceptual design, development or implementation phase of the concept, or to a combination of these phases.

Nominations letters should be signed by three persons and accompanied by:

(i) a short biography,
(ii) a description of the particular innovative or outstanding achievement for which the award would be made, and
(iii) a well focused rationale supporting the nomination.

. . . . . .

CNS John S. Hewitt Team Achievement Award

The John S. Hewitt Team Achievement Award was established by the CNS in 1994. This awards aims at recognizing the recipients for

> *"Outstanding team achievements in the introduction or implementation of new concepts or the attainment of difficult goals in the nuclear field in Canada."*

The award is in the form of one or more engraved plaques or certificates presented to the members of the team at the annual conference of the CNS.

Members of the Society are strongly encouraged to nominate teams of generally not more than five persons who have made key contributions to the introduction or the implementation of new concepts or the attainment of difficult goals in the nuclear fields in Canada. Such contributions should have been to the conceptual, design, development or implementation phase leading to the achievement, or to a combination of these phases.

Nomination letters should be signed by three persons and accompanied by:

(i) a short biography of each team member,
(ii) a description of the particular achievement for which an award would be made, and
(iii) a well focused rationale supporting the nomination.

. . . . . .

CNS Education /Communication Award

The Education / Communication Award was established by the CNS in 1997. This awards aims at recognizing the recipients for

> *"Significant achievements in improving the understanding of nuclear science and technologies among educators, students and the public"*

The award is in the form of a certificate, presented to each person being recognized, at the annual conference of the CNS.

All CNS branches and technical divisions are encouraged to forward confidential nominations statements, signed by three members, to the Chairperson of the CNS Honours and Awards Committee. The nomination statement should include a focused rationale for the nomination, supported by information on the candidate's:

(i) biography of the nominee,
(ii) description of the achievement(s) with specific references, examples, etc.

Please send your nominations in confidence, before 1999 March 15 to :

The Chair, Honours and Awards Committee
Canadian Nuclear Society
144 Front Street West, Suite 475
Toronto, Ontario M5J 2L7

CNS Fellows and Award Winners

Fellows of the Canadian Nuclear Society

George Howey	1992
John Hewitt	1992
Phil Ross-Ross	1992
John Foster	1993
Terry Rummery	1993
Ken Talbot	1993
Alan Wyatt	1993
Fred Boyd	1994
Stan Hatcher	1994
Daniel Rozon	1994
Michel Ross	1995
Bob Jervis	1995
Dave Torgerson	1995
Bill Midvidy	1996
Terry Rogers	1996
Paul Fehrenbach	1997
Edward Price	1997
Richard Bolton	1998
Hugues Bonin	1998
Dan Meneley	1998

CNS Innovative Achievement Award

Bill Morison	1991
Wing Tao	1991
Andrew Stirling	1992
Dé C. Groeneveld	1993
Tom Holden	1994
Ray Metcalfe	1998

John S. Hewitt Team Achievement Award

Don McLean, Bill Morgan and Mitch Ohta
- for the development and demonstration of dry spent fuel storage
1995

Charles Kittmer, Roger Joynes and Larry Green
- for the development and demonstration of micro-sampling of pressure tubes
1996

Staff of Point Lepreau G.S.
- for excellence in nuclear power plant operation and exceptional sustained plant performance 1996

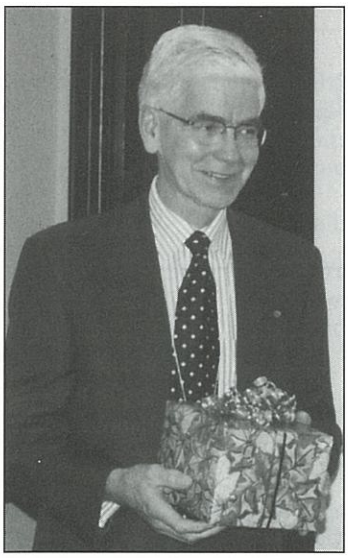
The Members of the Nuclear Fuel Waste Management Team at Atomic Energy of Canada Limited and Ontario Hydro
- for Development of the Concept, and Preparation of the Environmental Impact Statement for Disposal of Canada's Used Nuclear Fuel
1997

Charles Y. F. Chang, John Skears, and Tung Toong
- outstanding contribution to thermal hydraulic process design and safety analyses for CANDU reactors, particularly, the development of the SOPHT computer code
1998

CNS Education / Communication Award

Aslam Lone	1997
Morgan J. Brown	1998
Ronald G. V. Hancock	1998

CNS / CRPA Honour Richard Osborne



A special session was held at the 1998 CNS Annual Conference in October to recognize the four decades of contribution to the field of radiation protection by Dr. Richard V. Osborne, who retired as Director of Health and Environmental Sciences of Atomic Energy of Canada Limited, in the spring of 1998. (Richard's opening paper, in the session, is reprinted in this issue.)

In his introductory remarks, the session chairman, Dr. Colin Allan, General Manager, Systems Development and Engineering at AECL-CRL, reviewed some of Richard's background, noting that he joined AECL in 1963 after obtaining degrees from Cambridge and London Universities and a period at the New York Medical Centre. Much of his early work at AECL was on the behaviour and effects of tritium, a very topical problem associated with the then emerging CANDU program.

In 1981 Dr. Osborne was appointed Manager of the Environmental Research Branch at AECL-CRL and in 1988 took on a year and a half assignment as Executive Assistant to the President of the AECL Research Company. Returning to CRL, he was appointed Director of the Health and Environmental Sciences Division. He also chaired the AECL Health and Environment Working Group and was a member of the company's Safety Review Committee and Environmental panel.

Richard was a founding member of the Canadian Radiation Protection Association and its first president, in 1979. Outside the country he was on the Board of the Health Physics Society (of the USA) from 1976 to 1979 and vice-president of the International Radiation Protection Association from 1992 to 1996.

He has represented Canada on a number of international panels, committees and working groups, such as those of the Nuclear Energy Agency of the OECD, the National Committee on Radiation Protection of the USA, the International Atomic energy Agency. He was the Canadian representative to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) in 1996 and 1997.

Richard has been associated with the International Commission on Radiological Protection (ICRP) since 1980 as a member, now vice-chairman of Committee 4 and is currently chairman of a special working Group looking into the control of individual doses. e.g., dose limits.

Colin Allan concluded by remarking that Richard Osborne is someone:

- fully competent in his filed
- who feels a deep concern for the environment and for the well-being of his fellows, and,
- an individual who is committed to their service.

After Richard gave his paper he was presented with a gift by Paul Thompson, president of the CNS and Michael Haynes, president of CRPA.

BOOK REVIEW

Enriching Experiences

Reviewed by Fred Boyd

by Clarence Hardy
Glen Haven Publishing, Peakhurst, NSW, Australia

It is likely that few Canadians, even in the nuclear field, were aware that Australia pursued a significant program of research and development in uranium enrichment form the mid 1960s to the mid 1980s. This slim (175 pages) paperback provides an account of that work by someone who was very much involved.

The R and D at the Australian Atomic Energy Commission focussed on two enrichment techniques – laser and centrifuge. From 1973 to 1978 there was a joint program between Australia and Japan which concluded that a centrifuge plant was feasible. This was followed by The Uranium Enrichment Study Group from 1975 to 1983 which involved considered collaboration with the enrichment firm URENCO.

Following a change of government in 1983 the program was closed down, and, three years later the AAEC was dismantled.

Publications available

Review of Fuel Failures in Water Cooler Reactors Technical Report Series No. 388

International Atomic Energy Agency – 1998
e-mail: sales.publications@iaea.org
560 Austrian schillings

This 167 page report contains detailed descriptions of primary and secondary failure mechanisms which have occurred in PWR, BWR, WWER and CANDU reactors.

Publications available

'The Nuclear Advantage, Saskatchewan Edition,'

Reviewed by Jerry Cuttler

The Nuclear Advantage, Saskatchewan Edition is the most recent publication of a Regina-based firm, Keewatin Publications. Essentially an attractive colour pamphlet, it tells a fascinating story about many aspects of Saskatchewan's nuclear history, from uranium mining to cancer research to the Synchrotron Light Source planned for the University of Saskatchewan. There are plans to have it distributed to schools throughout the province. Keewatin has similar publications underway for audiences in Ontario, Quebec, New Brunswick and British Columbia.

Keewatin is run by John Belhumeur, co-publisher of The Native Journal, a national aboriginal newspaper, and Walter Keyes, a former Saskatchewan Deputy Minister. For the past nine years Walter has been a consultant to the uranium and nuclear industry and other natural resource companies. He is also the chairperson of the CNS Saskatchewan Branch.

Keewatin Publications is taking a positive approach to public communications on nuclear topics.

A unique feature of these publications is their multi-level sponsorship. Most of the publications are supported by a wide variety of sponsors, each contributing a little funding, but no one contributing so much that they end up calling the entire tune or unbalancing the more neutral approach of the writers. This is also a good business practice since in recent years the nuclear industry has not had the resources for individual firms to "go it alone," and the service provided by Keewatin ensures that some constructive materials about nuclear technology are always entering the public domain.

In January 1999, Keewatin will be distributing a pamphlet titled Canada's Nuclear Export Industry, Putting Canadians to Work. This pamphlet addresses a well kept secret in Canada. This is the fact that nuclear exports, in several recent years, have been the second largest technology sector export in Canada, after electronics. This pamphlet will tell the story of how the lives of working Canadians from coast-to-coast have been affected by these overseas projects.

It's good to see such effective communications in the nuclear industry.

These publications are a 'must read' for anyone with an interest in the subject.

Ed Note. Electronic versions of Keewatin pamphlets can be obtained via email at <keewatin@sk.sympatico.ca>

Publications available

"Canadian Report for the Convention on Nuclear Safety"

One of the obligations of the countries adhering to the international Convention on Nuclear Safety, which came into force in October 1996, is the submission of a comprehensive report on their nuclear safety program. The first reports were due within two years of the convention coming into force, to serve as a basis for a review meeting of parties to the Convention to be held within 30 months.

The Report for Canada, which was coordinated by the Atomic Energy Control Board, with input from Atomic Energy of Canada Limited and the three nuclear utilities, was completed in September 1998 and released publicly in November.

This 241 page document describes the nuclear power program in Canada, the regulatory system, and deals with a number of topical areas, as required by agreements associated with the Convention, viz.: financial and human resources (devoted to safety); human factors; quality assurance; verification; radiation protection; emergency preparedness; siting; design; operation. In addition, the Canadian report includes a description of the CANDU reactor and an outline of the Canadian nuclear safety philosophy.

The report is available on the AECB Web site <www.gc.ca/aecb > which can also be reached by a link from the CNS Web page < www.cns-snc.ca >

CALENDAR

1999

January 24 - 27

Health Physics Society Symposium
Albuquerque, New Mexico
contact: J.M. Hylko
Fax: 505-837-6870
e-mail: jhylko@msm.com

February 8 - 9

CNA/CNS Winter Seminar
Ottawa, Ontario
contact: Sylvie Caron
CNA/CNS Office
Toronto, ON
Tel: 416-977-6152 ext. 18
Fax: 416-979-8356
e-mail: carons@cna.ca

March ?

CANDU Reactor Safety Course
Toronto, Ontario
contact: Dr. G. Harvel
AECL Mississauga
Tel: 905-823-9060 ext. 4543
e-mail: harvelg@aecl.ca

March 26 - 27

CNS / CNA Student Conference
Trent University
Peterborough, Ontario
contact: Dr. Jim Jury
Trent University

March 27 - 29

Conjoint Scientific Meetings of Nuclear Medicine and Prairie Provinces Chapter of Society of Nuclear Medicine
Banff, Alberta
contact: Cdn. Society of Nuclear Medicine
774 Echo Drive
Ottawa, ON K1S 5N8
Tel: 613-730-6278
e-mail: csnm@rcpsc.edu

May 10 - 14

International Symposium on Environmental Protection at Facilities
contact: R. Maloney
AECB, Ottawa
Tel: 613-995-5116
e-mail: maloney.r@atomcon.go.ca

May 30 - June 2

CNA/CNS Annual Conference
Montreal, Quebec
contact: Sylvie Caron
CNA/CNS Office
Toronto, ON
Tel: 416-977-6152 ext. 18
Fax: 416-979-8356
e-mail: carons@cna.ca

May 31 - June 3

Annual Conference Canadian Radiation Protection Assoc.
Saskatoon, Saskatchewan
contact: Steve Webster
Univ. of Saskatchewan
Saskatoon, Sask.
Fax: 306-933-7775
e-mail:
steve.webster.lab@govmail.gov.sk.ca

June 6 - 10

ANS Summer Meeting
Boston, MA
contact: ANS Office
La Grange Park, Illinois
Tel: 708-579-8258
Special Session at ANS
- Industrial Applications of Neutron Scattering

contact: Aslam Lone
AECL Chalk River
Tel: 613-584-8811 ext. 5287
Fax: 613-584-8047
e-mail: lonea@aecl.ca

June 15 - 10

Effects of Low and Very Low Doses of Ionizing Radiation on Human Health
Toronto, Ontario
contact: World Council of Nuclear Workers
49, rue Lauriston
75116 Paris, France
e-mail: wonuc@wanadoo.fr

Sept. 12 - 16

Decomissioning, Decontamination and Reutilization
Knoxville, Tenn.
contact: John E. Gunning
e-mail: jegunnin@bechtel.com

Sept. 25 - 28

ICENES 2000: 10th International Conference on Emerging Nuclear Energy Systems
Petten, The Netherlands
contact: Dr. Harm Gruppelaar
Petten, The Netherlands
e-mail: gruppelaar@ecn.nl
website: www.ecn.nl

Sept. 26 - 29

6th International CANDU Fuel Conference
TBD
contact: Mukesh Tayal
AECL - SP
Tel: 905-823-9040 ext. 4652
e-mail: tayalm@aecl.ca

Aug. 1 - 5

Symposium on Flow - Induced Vibration - 1999
Boston, Mass.
contact: Michael Pettigrew
AECL - CRL
Chalk River, ON
Tel: 613-584-8811 ext. 3792

Aug. 29 - Sept. 3

Global '99 - International Conference on Future Nuclear Systems
Jackson Hole, Wyoming
contact: Dr. Todd Allen
Argonne National Laboratory
P.O. Box 2528
Idaho Falls, Idaho
83403-2528
e-mail: todd.allen@anlw.anl.gov

Sept. 6 - 10

3rd International Conference on Isotopes
Vancouver
contact: Dr. Nigel Stevenson
TRIUMF
4004 Westbrook Mall
Vancouver, BC V6T 2A3
e-mail: nigel@triumf.ca

Sept. 12 - 17

International Conference on Inertial Fusion Sciences and Applications
University Bordeaux, France
contact: IFSA '99
162, Avenue Dr. Schweitzer
33608 Pessac Cedex
France
e-mail: voirin@ixl.u-bordeaux.fr

October 3 - 8

NURETH-9 - 9th International Meeting on Nuclear Reactor Thermalhydraulics
San Francisco, California, USA
contact: Dr. S. Levy
Levy & Associates
3880 South Beacon Avenue
Suite 112
San Jose, California
USA 95124

Oct. 15 - 19

12th Pacific Basin Nuclear Conference
Seoul, Korea
contact: Mr. Kyo-Sun Lee
KAIF
Seoul, Korea
Fax: +82-2-785-3975
e-mail: kaif@borna.dacoin.cc.kr

Nov. ?

CNS Simulation Symposium
Ottawa, ON
contact: Dr. G. Harvel
AECL-SP
Mississauga, ON
Tel: 905-823-9060 ext. 4543
e-mail: harvelg@aecl.ca

Nov. 14 - 18

ANS Winter Meeting
Long Beach, California
contact: ANS Office
La Grange Park, Illinois
Tel: 708-579-8258

Nov. 16 - 18

International Topical Meeting on Nuclear Plant Instrumentation, Control and Human-Machine Interface Technologies
(embedded in ANS Winter Meeting)
contact: Dr. R. M. Edwards
Unitersity Park, Penn., USA
Tel: 814-865-0037
Fax: 814-865-8499
e-mail: rmenu@engr.psu.edu

2000

June ?

CNA / CNS Annual Conference
Saskatoon, Sask.
contact: Sylvie Caron
CNA/CNS office
144 Front St. W., Ste 475
Toronto, ON
e-mail: carons@cna.ca

Sept. 25 - 28

ICENES 2000: 10th International Conference on Emerging Nuclear Energy Systems
Petten, The Netherlands
contact: Dr. Harm Gruppelaar
Petten, The Netherlands
e-mail: gruppelaar@ecn.nl
website: www.ecn.nl

Oct. 15 - 19

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e-mail: kaif@borna.dacoin.cc.kr

CNS Council • Conseil de la SNC

1998-1999

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	e-mail:	pthompson@nbpower.com
1st Vice-President / *1ier Vice-Président*	Krish Krishnan	(905) 823-9040
	e-mail:	krishnanv@aecl.ca
2nd Vice-President / *2ième Vice-Président*	Ken Smith	(905) 828-8216
	e-mail:	unecan@echo-on.net
Secretary / *Secrétaire*	Ian Wilson	(905) 469-1179
	e-mail:	ian.wilson@ilap.com
Treasurer / *Trésorier*	Andrew Lee	(416) 592-6843
	e-mail:	sya.lee@hydro.on.ca
Past President / *Président sortant*	Ben Rouben	(905) 823-9040
	e-mail:	roubenb@aecl.ca

Members-at-Large / *Membres sans portefeuille*

Parviz Gulshani	(905) 823-9040
Glenn Harvel	(905) 823-9040
Hong Huynh	(514) 392-5614
Peter Laughton	(613) 584-3311
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Raymond Leung	(416) 592-8624
Kris Mohan	(905) 823-9040
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Ed Price	(905) 823-9040
Duke Segel	(416) 322-8363
Harold Smith	(905) 823-9040
Judy Tamm	(905) 823-9040

Committees / *Comités*

Branch Affairs / *Affaires des sections locales*
Ken Smith . . . . . (905) 828-8216
e-mail: unecan@echo-on.net

Education & Communication / *Éducation et communication*
Jeremy Whitlock . . . . . (613) 584-3311
e-mail: whitlockj@aecl.ca

Finance / *Finance*
Andrew Lee . . . . . (416) 592-6843
e-mail: sya.lee@hydro.on.ca

Honours and Awards / *Honneurs et prix*
Hong Huynh. . . . . (514) 392-5614
e-mail: hhuynh@cng2.hydro.qc.ca

International Liaison / *Relations internationales*
Fred Boyd. . . . . (613) 592-2256
e-mail: fboyd96@aol.com

Inter-Society / Inter-sociétés
Parviz Gulshani . . . . . (905) 823-9040
e-mail: gulshanip@aecl.ca

Internet
Peter Laughton . . . . . (613) 584-3311
e-mail: laughtonp@aecl.ca

Membership / *Adhésion*
Raymond Leung. . . . . (416) 592-8624

Program / *Programme*
Krish Krishnan . . . . . (905) 823-9040
e-mail: krishnanv@aecl.ca

Universities / *Universités*
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e-mail: garlandw@mcmaster.ca

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e-mail: popovicj@aecl.ca

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  Judy Tamm . . . . . (905) 823-9040

CNA Liaison / *Agent de liaison d'ANC*

Murray Stewart . . . . . (416) 977-6152

CNS Office / *Bureau d'ANC*

Sylvie Caron. . . . . (416) 977-7620
e-mail: carons@cna.ca

CNS Bulletin Editor / *Rédacteur du Bulletin SNC*

Fred Boyd . . . . . (613) 592-2256
e-mail: fboyd96@aol.com
Richard Fluke. . . . . (416) 592-4110

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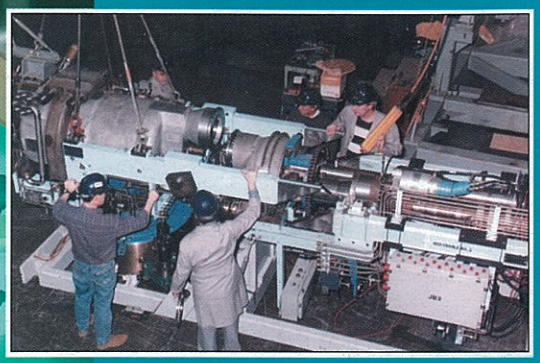

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