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Editorial

I'm All Right, Jack

The "nuclear debate" in Canada (and elsewhere, to judge by monitoring off-shore publications) is all too often portrayed as a struggle between the Institution (be it commercial, scientific or governmental) and the Individual ("concerned citizens from all walks of life" to quote a recent Energy Probe pamphlet). The Institution has been in the past responsible for encouraging energy profligacy (and resultant environmental and social degradation) and aims to see that this wasteful and destructive path continues to be followed so that the Institution can perpetuate itself. The opposition to the institution comes from those "concerned citizens" who, banded together argue for conservation, simplicity, "soft technology" and decentralization.

A carping observer might note that all the representatives of "concerned citizens" seem to be relatively affluent middle-class people for whom "conservation" of what they've already got leaves them very nicely off, thank you. Be that as it may, the superficially attractive (though usually undefined) concept of the "conserver society" tends to grab the moral high ground. Response by nuclear proponents tends to be in the form of economic arguments specific to a country or province. However impeccable these arguments may be they simply do not have the instant appeal of the Utopian vision described by such authors as Amory Lovins.

But nuclear energy does not simply exist as, for example, a rational and prudent energy option for the province of Ontario. It has global significance. This has been clearly and forcefully articulated by, for example, Samuel Glasstone in the opening chapter of *Nuclear Reactor Engineering*. And closer to home, Dr. W. Bennett Lewis has eloquently argued the case for CANDU-based nuclear energy systems playing a major role in raising and maintaining standards of living throughout the world for the forseeable future.

The global argument in support of nuclear energy could be summarized as follows:

- The fuel used by nuclear reactors is only useful for (a) making bombs, (b) making ballast weights for large commercial aircraft, (c) colouring glass, (d) putting in nuclear reactors to generate energy. Fossil fuels not only are at the moment irreplaceable in certain transportation sectors, but also form vital chemical feedstocks.
- The development of nuclear energy systems needs a fairly sophisticated industrial infrastructure which the underdeveloped countries (in most urgent need of increased energy supplies) do not have.

  It is surely not only rational, but *morally required*, that those societies with the capability to do so proceed with all deliberate speed to put nuclear energy systems in place, thus easing the demand pressure on conventional fossil resources so that the underdeveloped and developing countries would have better access to these, and could take the first step towards bringing their standards of living to a level remotely comparable to that of the more fortunate nations.

It's very easy for a comfortably-off North American to argue "conservation" and abandonment of the nuclear option. But in the context of an energy-hungry world it's the classic example of "blow you, Jack — *I'm* all right".

Contents

Letters

Unsubstantiated Accusations?

In the front-page editorial of the January-February *CNS Bulletin* you say that "examples of deliberate misrepresentation by the media in covering nuclear related stories are difficult to find, as are examples of blatantly partisan reporting."

Come off it, Mr. Editor. Even the media do not claim such standards of objectivity, accuracy and excellence for themselves. Whether the misrepresentation is "deliberate" or otherwise, there are endless examples of misrepresentation in media coverage of nuclear matters. If there weren't, it seems strange that Bernard Cohen and the Media Institute should write books about the subject, that Illinois Power should do a videotape response to "60 Minutes," that AECL should use a legitimate medium like advertising to respond to distortions which would be hard to answer otherwise, and that the chairman of Ontario Hydro should write so many letters-to-the-editor to set the record straight.

P.S. It would be hard to ascribe accuracy and objectivity to the attached montage of (newspaper) headlines (concerning Ontario Hydro) and these are only the tip of the mound of examples of perverse comment in the print media alone, far less the electronic media.

John A. Macpherson
Manager, Public Affairs
AECL CANDU Operations

Editor's comment: Unfortunately, you did not indicate the newspapers from which the headlines you sent were drawn. Nor did you attach the stories. And reporters write the stories, not the headlines.

Perspective

CANDU 300: The Latest Concept in the CANDU Family

The following update on the new CANDU 300MWe design is contributed by G.A. Pon, R.S. Hart and D. Tregunno of Atomic Energy of Canada Ltd.

In both developing and industrialized countries there is evidence of a re-emerging interest in small power reactors. The expectation is that small nuclear reactors will better match the lowered demand growth and therefore be more efficient in terms of overall system economies, and that the relatively smaller capital investments required for such plants will bring them within the financial means of more countries and utilities. This renewed interest accounts for the fact that there are now a number of small reactor design concepts which appear to be ready for both technical and economic assessment.

One of these small reactor design concepts is the CANDU 300 — the latest version of the CANDU Pressurized Heavy Water Reactor system. The CANDU 300 concept is the result of an Atomic Energy of Canada Ltd. design study which was undertaken over the past two years. One of the study's primary objectives was to assess the feasibility of designing a nominal 300MWe CANDU power reactor which would meet acceptable cost and schedule targets while, at the same time, utilizing proven CANDU systems, concepts, and components.

A CANDU reactor in the 300MWe size was adopted for the design study because: 300MWe is recognized as being the appropriate size range for the majority of potential small reactor customers; and since 300MWe is approximately 50% of the net output of the CANDU 600, and 30% of the CANDU 950 output, selection of this size allows for maximum use of equipment such as pumps and steam generators, which has been proven in the operation of the CANDU 600 and in the design and development of the CANDU 950.

Design Requirements

The primary design requirement established at the start of the CANDU 300 study was for the CANDU 300's capital cost per kilowatt to approach that of the current CANDU 600. Based on a review of potential cost reductions and recognizing that a short construction schedule also greatly enhances the project's integrity from a financing viewpoint, a second principal design requirement for a 48 month construction schedule was established (from start of construction to full power). In order to facilitate the early commitment of a CANDU 300, and to assure traditionally high CANDU capacity factors and performance, a third principal design requirement was established: that of utilizing proven CANDU concepts, systems and components. This theme of using proven concepts and systems was extended to allow advantage to be taken of well demonstrated equipment and concepts from other areas such as the communications and aerospace sectors.

It should be stressed that the CANDU 300 design has resulted from a fundamentally new approach to layout and construction. The CANDU 300 cannot correctly be described as one-half of the CANDU 600, nor can it be described as a down-rated CANDU 600. Designs based on these two approaches were evaluated; however, a fundamentally new approach to the design was deemed necessary if both cost and schedule targets are to be met. A summary design description follows:

CANDU 300 Summary Design Description

As a member of the CANDU family, the basic reactor design of the CANDU 300 closely follows that of the larger CANDU 600 and CANDU 950 reactors. The core design incorporates the standardized geometrical arrangement of horizontal fuel channels in a square lattice. The neutronic characteristics of the CANDU 300 and CANDU 600 reactors are similar. Control and shutdown devices and in-core instrumentation are located in tubes perpendicular to the fuel channels and function in the low pressure moderator part of the core, as in other CANDU reactors.

The CANDU 300 utilizes the standard CANDU fuel channels. Fuel and coolant are enclosed in CANDU 600 zirconium-niobium pressure tubes, which in turn are surrounded by zircaloy calandria tubes. Heavy water is contained in the calandria vessel at low pressure and serves as the moderator. Pressurized heavy water is used as the reactor coolant. There are 12 fuel bundles in each of 208 fuel channels. Standard 37 element CANDU natural uranium bundles are used in the CANDU 300.

Major equipment in the CANDU 300 Heat Transport System includes two CANDU 600 steam generators, two CANDU 600 heat transport pumps, one inlet header, and one outlet header. The CANDU 600/950 heat transport conditions with an outlet header pressure of 10mpa (a) were adopted for the CANDU 300.

The power distribution in the CANDU 300 is radially and axially flattened. Power flattening is achieved through the use of regional differential fuel burnup in combination with a set of absorber devices. Long-term control of the power distribution is achieved through continuous on-load fuelling.

It has long been recognized that the need for adopting a rational and easily understood approach to station organization and safety is of fundamental importance, as is a similarity of approach between the various standard CANDU designs. Therefore, the basic CANDU 950 'Two-Group' approach to station and system layout, which was developed through extensive study and review, was adopted for the CANDU 300. In the 'Two-Group' approach all plant systems are divided into two groups. The systems of each Group are capable of shutting down the reactor and maintaining cooling of the fuel in the event that the other Group of systems is unavailable. Group 1 systems are those primarily dedicated to normal plant power production. The Group 2 systems primarily serve safety, or safety support functions, and are all seismically and environmentally qualified. To guard against cross-linked and common mode events, and to facilitate comprehensive seismic and environmental qualifications of the Group 2 systems, Group 1 and Group 2 systems, to the greatest extent possible, are located in separate places and display diverse principles of operation.

Particular attention has been paid in the CANDU 300 station layout to increased safety and ease of construction and operation. Specifically, the CANDU 300 station layout reduces the construction schedule by: simplifying, minimizing and localizing interfaces; accommodating several construction contractors without interference; eliminating

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La SNC procure aux Canadiens intéressés à l'énergie nucléaire un forum où ils peuvent participer à des discussions de nature technique. Pour tous renseignements concernant les inscriptions, veuillez bien entrer en contact avec le bureau de la SNC, les membres du Conseil ou les responsables locaux. La cotisation annuelle est de $30.00 ($5.00 pour les étudiants).

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construction congestion and providing access to all areas; providing flexible equipment installation sequences; and by eliminating special material handling requirements. The layout also facilitates station operation and maintenance, and accommodates client, contractual and licensing requirements without significant design modifications.

The CANDU 300 reactor building, turbine hall, Group 1 Service Building, Group 2 Service Building, and the Administration and Maintenance Building are physically separate, and arranged to maximize accessibility during both construction and operation. Tunnels connect the auxiliary buildings to steel bulkheads at the reactor building perimeter wall, and accommodate all wiring and piping. The Main Control Room is located below grade, adjacent to the reactor building perimeter wall and the tunnels which lead to the turbine hall and Group 1 Service Building. The Secondary Control Room is located in the Group 2 Service Building, and is above grade. An enclosed passageway around the reactor building, located above the connecting tunnels, provides access around the Reactor Building, and connects to the Turbine Hall, Administration and Maintenance Building, and to Service Buildings.

Consistent with CANDU design philosophy, the safety approach applied to the design of the CANDU 300 is directed at: (a) preventing the occurrence of accident conditions as the result of failure of a normally operating system; and (b) providing systems capable of mitigating the effects of an accident condition if it does occur. This approach provides two basic levels of defence, and maintains an adequate degree of independence between these levels. Each level must be able to achieve the general safety requirements of: (a) shutting down the reactor and maintaining it in a safe shutdown condition; (b) removing residual heat from the core after reactor shutdown; and (c) reducing the potential for the release of radioactive materials and ensuring that releases are within regulatory criteria. The effectiveness will be different for each level, since the first deals with normal operation of the plant, and the second with operation during accident conditions.

As in other CANDU designs, the CANDU 300 incorporates two diverse reactor shutdown systems which are independent of each other and from the reactor regulating system. Both systems can shut the reactor down during conditions occurring during normal reactor operation or accident conditions. The first Shutdown System (SDS1) consists of solid shutoff absorber rods which drop into the core when a trip signal de-energizes clutches which hold them out of the core. The second Shutdown System (SDS2) uses injection of liquid poison into the low pressure moderator to quickly render the core subcritical.

CANDU 300 Target Power Generation Costs

A primary design requirement established at the outset of the CANDU 300 design was for the capital cost of the CANDU 300 to approach that of a CANDU 600 unit on a per kW basis. The results of a system-by-system review of the reference design indicate that the CANDU 300 could be constructed for a per kW investment cost of not more than 120% of the current CANDU 600 design.

Summary

In summary, the CANDU 300 satisfies attractive cost and schedule targets. However, in order to better understand and appreciate customer needs, AECL is actively participating in a current International Atomic Energy Agency (IAEA) study on Small and Medium Sized Power Reactors. Results of this and other similar studies will provide valuable input into the CANDU 300 design.

FYI

Planned Approach to Retubing (Staff)

The objective of Ontario Hydro's program for starting large scale fuel channel replacement work now is to ensure that the two Pickering reactors return to safe economic service as soon as possible without compromising the ALARA (radiation exposures to be kept As Low As Reasonably Achievable) principle. Work will proceed in the following stages:

- Decontamination: This involves circulating a mildly acidic solution through the reactor's piping to dissolve and remove radioactive deposits, and hence reduce the radiation fields in the vicinity of the reactor face. This procedure has been completed once for Unit 2 and has reduced fields by about half. It will be repeated until the fields have been reduced as far as is practically achievable, for both reactors.
- Defuelling: All the radioactive fuel (4680 bundles) will be removed from the reactor using the existing (remotely controlled) fuel handling equipment.
- Remove heavy water: The radioactive heavy water will be drained from both the main cooling system and the moderator system. Both sets of plumbing will then be flushed through with ordinary (clean) water to remove any traces of tritium (a radioactive form of hydrogen) from the reactor.
- Install shielding cabinets: Large, thick-walled metal cabinets will be placed on the fuelling machine bridges at both (east and west) reactor faces. The purpose of these cabinets is to allow staff to work in close proximity to the reactor face while receiving protection from the radiation. Since these cabinets are placed on the fuelling machine bridge, they can move up and down, hence access any portion of the reactor face.
- Preparation: With the shielding cabinets in position, work towards tube removal can commence. This work, involving for example, cutting bellows, disconnection of feeder pipes and cutting and removal of west end fittings, would be scheduled so that as remote handling equipment became available it would be phased in and tube removal and replacement could proceed.

NPD Returns to Service (Staff)

The NPD reactor at Rolphton Ontario was returned to service at 09:28, Saturday, 84/03/31. The reactor was shut down 84/02/02 to remove two pressure tubes (one Zircaloy-2 and one Zr 2.5wt%Nb) for testing for deuterium content and garter spring condition in support of ongoing pressure tube investigations at the Pickering Nuclear Generating Station. Preliminary results of these tests indicate that both the pressure tubes and garter springs were in sound condition. Levels of deuterium in the Zircaloy-2 tube (resident in the reactor since start-up in 1962) were close to predictions, but there were no signs of the surface phenomena associated with the formation of solid zirconium hydride patches. The zirconium-niobium tube (resident since 1967) had very low levels of deuterium. In the case of both fuel channels, the Inconel garter springs were in sound condition, as was demonstrated during tube removal when the springs withstood considerable abuse.

Further tube investigations at Pickering started late March. Unit 3 was shut down March 20 for six weeks, for scheduled annual maintenance and up to six pressure tubes will be inspected, and one removed; to check deuterium levels.

Offshore CANDU 600s In-service (Staff)

The Embalse CANDU 600MW nuclear power station in Argentina was officially declared in-service on January 20. The Wolsung CANDU in Korea followed January 26, with the signing of the official certificate of completion.

A cobalt 60 cancer therapy unit, a Theratron 780, was donated by the Canadian Government to the Korean National Medical Center in commemoration of the dedication of the nuclear power plant built in Wolsong.

Pickering Unit 6 In-service (Ontario Hydro)

Pickering Unit 6 was declared commercially in-service on February 1 by Ontario Hydro, two months ahead of schedule. The nuclear unit first produced electricity in November 1983 and since then has undergone major testing to establish reliable performance. The unit performed so well during testing it was able to supply reliable power two months ahead of earlier expectations.

Unit 6 is the second reactor at the Pickering B station to be declared in-service. Unit 5 went into commercial operation last May.

First Tender for Point Lepreau 2 Sought (Staff)

Maritime Nuclear has invited contractor bids for the supply of a turbine generator for the proposed Point Lepreau 2 nuclear unit in New Brunswick, although the project has not received definite go-ahead. The turbine generator has the longest manufacturing lead time of all CANDU components. Prospects for construction of the proposed unit, still dependent on negotiations with US utilities, have been improved by the exceptionally reliable performance of Point Lepreau 1.

AECL and Ontario Hydro Sign Cobalt 60 Deal (Canadian Energy News)

Atomic Energy of Canada Ltd. and Ontario Hydro have signed an agreement to produce Cobalt 60 at the utility's Bruce B Nuclear Generating Station. Production is expected to begin later this year.

Hydro currently produces Cobalt 60 for AECL at its Pickering A Nuclear Generating Station. However, world demand for the isotope has increased to the point where additional supplies are needed.

"The new agreement will assure AECL and its customers around the world of an ample and secure supply of high quality, competitively-priced Cobalt 60 over the next 20 years," said James Donnelly, President of AECL.

Through AECL, Canada supplies about 90 per cent of the international market for Cobalt 60.

To produce Cobalt 60, ordinary cobalt is sealed in Zircaloy tubes which hang vertically in the reactor. It is then irradiated during the normal operation of the reactor. The Cobalt 60 is delivered to AECL's Radiochemical Company in Kanata, Ontario for further processing and distribution to customers around the world.

Canadian Reactor Performance High in 1983 (Staff)

Canadian nuclear stations in commercial operation averaged high capacity factors in 1983. Although Pickering 2 went down August 1 due to a pressure tube rupture, the four reactors of Pickering A averaged 76.2%, and Bruce A averaged 90.1%. Douglas Point scored 77.4% and NPD had 79.6%. Nuclear power supplied 34.5% of Ontario Hydro's total generation during the year; Pickering 5 entered commercial production and averaged a 72.4% capacity factor.

Both 600MW units also entered into commercial operation during 1983, with Point Lepreau 1 averaging an outstanding 85.7%, and Gentilly-2, which had turbine and operator problems, averaged 36.3%.

Rolphton Training Centre to be Phased Out (Ontario Hydro)

The Rolphton Nuclear Training Centre will be phased out by the end of 1985, Ontario Hydro has announced.

Ontario Hydro's training program will be carried out at its Eastern and Western Nuclear Training Centres at Pickering and the Bruce Nuclear Power Development.

The decision to move out of Rolphton was made because of reductions in training requirements over the next two years due to cutbacks in hiring and the cost effectiveness of the move.

Hydro has proposed to the community the formation of a small group comprised of Ontario Hydro personnel and local representatives to work together in search of other uses for the training centre.

Nuclear Liability Act Under Review (AECB)

The Atomic Energy Control Board advises that a discussion paper entitled "Review of the Nuclear Liability Act", Consultative Document C-79, is issued for public comment.

The document is available for scrutiny at the AECB's office in Ottawa, and may be ordered from the Office of Public Information.

Comments received before June 7, 1984, will be considered in the revision process for this document.

Douglas Point to Close (Staff)

Atomic Energy of Canada Ltd. has notified Ontario Hydro that it does not plan to restart its Douglas Point Nuclear Generating Station following a scheduled shutdown on May 5. Economic factors were cited as instrumental in this decision by AECL's President of CANDU Operations, Donald Lawson. Notifying Ontario Hydro of the AECL decision, Lawson noted that "the decision to suspend operations is in keeping with AECL's corporate strategy of reducing marginal operations in order to make the most efficient use of available resources."

The CANDU commercial prototype, Douglas Point achieved first criticality in November 1966, and started producing electricity the following year. The operation of Douglas Point is the responsibility of Ontario Hydro, who pay AECL for the electricity produced by the station. According to Hydro sources, the cost of energy from the Douglas Point station is equal to that from the utility's Lakeview (coal fired) Generating Station — now the most expensive thermal plant on the Hydro system.

Ontario Hydro's Executive Vice-President of Operations, Arvo Niitenberg, said that the utility is investigating what other arrangements might be made with AECL for electricity production at the plant and what other contributions the plant could make to the Hydro system.

Call for Royal Commission into Nuclear Fuel Cycle Rejected (Staff)

Jean Chretien, Canada's Energy Minister, rejected a call on January 23 for the creation of a Royal Commission of Inquiry into Canada's nuclear fuel cycle. Simon de Jong, NDP MP for Regina East had moved during NDP Opposition Day in the Canadian House of Commons "That a Royal Commission of Inquiry be created to study the nuclear fuel cycle in Canada including the range of economic, social, medical, environmental and safety matters resulting from exploration, mining, production, transportation, storage and use of uranium and its byproducts."

Extensive debate ensued in an almost deserted chamber during which it was noted that when the NDP was in power in Saskatchewan, it decided to go ahead with the development of uranium mines in northern Saskatchewan, and that in Canada, about ten different commissions on the nuclear industry have existed.

In rejecting the call for an inquiry Chretien indicated that the policy of the government is to try to sell CANDU reactors so as to maintain a viable industry and that few people would want to give up its 36,000 jobs. He also said "...I will tell the House at this time that our policy is yes, we want to carry on with the CANDU reactor.

We want to sell some CANDU reactors abroad under conditions which I have previously expressed with respect to exporting electricity from CANDU reactors built in Canada. There are public hearings now before the National Energy Board with respect to Lepreau, New Brunswick. One of the conditions I am committed to is that if the CANDU reactor is being built, it has to be built without subsidy...we are faced with decisions today: should we sell or not sell to Turkey? A commission can give me the answer in two years but it is today that I have to make a decision. Should we sell another one to Korea?

The point I am making is that decisions have to be made today, not have a Royal Commission. I do not think we need a commission; we need the view of the House of Commons...". The debate was the first one since Chretien became minister 17 months earlier.

Resource-led Growth Best for Canada: AECL (Staff)

Canada's economic performance could remain in a steady state of underachievement for the rest of the century unless something "shocks the system," Atomic Energy of Canada Ltd. has warned in its brief to the Macdonald Royal Commission on the Economic Union and Development prospects for Canada.

With the assistance of Informetrica Ltd., AECL examined a number of ways to stimulate the Canadian economy and overcome some of the major problems that have beset most industrialized countries for almost a decade. In its submission, AECL advocated that Canada adopt a strategy of resource-led growth, one which yields broadly based and sustained economic and social progress the earliest.

This strategy calls for the necessary actions to convert Canada's resources into wealth through their competitive and efficient delivery to rapidly expanding world markets and use in Canada.

The AECL resource-led growth path includes a number of specific major projects in western Canada as well as others in the

east. The entire group of megaprojects proposed would sum to around 25 per cent of Canada's total investment activity. Envisaged is complete flexibility in investments and, although resource investments are a principal driving force, they are set within programs for significant modernization of plant and equipment throughout the economic structure.

The major projects in resource development, utilities, and transportation comprise: oil and natural gas developments off the east coast and in the Beaufort Sea, as well as in western Canada; hydroelectric projects in Quebec, Newfoundland, Manitoba, British Columbia and Alberta; coal expansion in the Maritimes, British Columbia and Alberta; nuclear power installations in eastern, central, and western Canada; resource fabrication plants and other energy-intensive manufacturing facilities; transportation investments and construction activity: ports and coastal transport in the north, east, and west; natural gas and oil pipelines, railroads, highways, and electric transmission lines.

AECL notes that the resulting balanced sectoral and regional growth will increasingly be powered by electricity — known domestic supplies of uranium combined with CANDU technology will provide an inexhaustible source of economic power and can free up other energy resources for export and for higher value uses in Canada. A nuclear plant can be conveniently located to serve a specific need for electricity without the continuing requirement to move large quantities of depletable resources and nuclear plants are also a hedge against inflation. The high, front-end capital costs means that, for any given installation, the real costs of delivering electricity can decline year after year. Any cost "lumpiness" caused by installing capacity ahead of immediate demand can be leveled by temporary, additional exports of electricity — whether the installation is in Canada or abroad.

In addition to traditional customers, new markets in the Pacific Rim will sustain the resource-led option. AECL cautions that failure on the part of Canada's industrial partners to provide the markets and capital flows needed by the developing economies will foreclose this as well as other Canadian growth paths: failure on Canada's part to respond to world market opportunities could lock the Canadian economy in a steady state of underachievement, to the year 2015 considered by the submission.

Canadian Uranium Estimates Released (EMR Canada)

Estimates of Canada's uranium resources for 1982 remained essentially unchanged from those of 1980, according to a report released in March by Energy, Mines and Resources Canada.

The report says economic conditions facing the industry have changed greatly during the past few years as production costs continued to rise without corresponding increases in uranium prices. As a result, a smaller portion of Canada's uranium resources is of current economic interest.

The report, entitled "Uranium in Canada: 1982 Assessment of Supply and Requirements", indicates that total resources in the measured, indicated and inferred categories amount to 573,000 tonnes of uranium. Just over 10 per cent of this uranium will be required domestically during the next 30 years to fuel the more than 15,000 megawatts of nuclear power capacity now operating or committed for operation in Canada by 1993. In 1982, seven uranium producers in Canada, directly employing some 5,000 people, produced concentrates containing 8,075 tonnes of uranium. Based on currently committed expansion plans, Canada's projected annual production capability could grow to some 12,000 tonnes of uranium by 1986.

Canadian producers shipped 7,643 tonnes of uranium valued at some $838 million in 1982. As of January 1, 1983, outstanding uranium export commitments amounted to 60,000 tonnes or roughly 10 per cent of the total Canadian uranium resources mentioned above. Japan has been Canada's most important single customer in the past decade, receiving about 34 per cent of Canada's total exports since 1972. Most of the remaining exports have gone to the European Economic Community (33 per cent), other countries in Western Europe (18 per cent), and the United States (15 per cent).

Reference is made to the substantial efforts in uranium exploration that have been maintained, especially in northern Saskatchewan, where two-thirds of the $71 million total exploration expenditures of 1982 were incurred. This continued effort has led to the discovery of a number of important deposits over the past few years which could be developed if market conditions improve. It is estimated that total Canadian production capability could reach 15,000 tonnes of uranium annually by the mid-1990s.

Canada is a leading supplier of uranium to the world's uranium markets — its significant potential for additional discoveries, together with the experience of over 40 years of uranium production, ensures that it will remain a reliable long-term supplier well into the next century.

Before It's Too Late: New Cohen Book (Staff)

Dr. Bernard Cohen, the prolific Professor of Physics at the University of Pittsburgh, has authored "Before It's Too Late: A Scientist's Case FOR Nuclear Energy," which promises to be "The Health Hazards of NOT Going Nuclear" book of the 1980s.

For those who have been following Dr. Cohen's papers in *Health Physics*, this book draws together many of his findings and arguments presented there on the subject of risk, radiation and waste management, into a highly readable text solidly in favour of nuclear power. Through objective comparisons, using the methodology established in his classic "Catalogue of Risks" paper, radiation, reactor accidents, radioactive wastes, plutonium and bombs, nuclear costs, the solar dream and scientific attitudes are discussed. The media is soundly criticized as the source of the public's "insane" fear of radiation and nuclear power.

The book, published in 1983, is available for $16.95 (US) from Plenum Press, 233 Spring St., New York, NY 10013.

Exotic Nuclear Decay Discovered (Nature)

H.J. Rose and G.A. Jones of the University of Oxford have shown that radium-223 nuclei occasionally decay with the loss not of an α-particle, but of a carbon-14 fragment. The decay scheme of ^{223}Ra usually involves the successive emission of three α-particles (to give radon-219, polonium-215 and lead-211) followed by an electron, to give bismuth-211. This decay scheme, which begins with uranium-235, predominantly leads to lead-207 by the further emission of two α-particles and an electron. The unstable ^{223}Ra nucleus shortens this process by eliminating a substantial part of the charge and mass that must ultimately be lost in a single package.

Rose and Jones show that the discovery of ^{14}C emission from ^{223}Ra, important though it is, serves chiefly to emphasize that α-particle emission is the chief means by which radioactively unstable nuclei lose mass.

The rarity of these new decay events also explains why this novel form of radioactivity has not previously been found. The observations entailed more than half a year of running time with detectors arranged so as to distinguish between single ^{14}C fragments and more frequent occurrence of groups of three α-particles from the nearly simultaneous decay of separate ^{223}Ra nuclei.

While there is no reason to think that the discovery that ^{223}Ra can decay with the emission of a ^{14}C particle will quickly be followed by similar observations in respect of other nuclei, Rose and Jones are looking at another candidate nucleus.

Important questions arise, not the least of which is why the first exotic fragment to have been found in the decay of a radioactive nucleus should have been the unstable ^{14}C nucleus and not the stable ^{12}C, itself simply a combination of three α-particles.

Superficially, the calculation of the rate of some specified radioactive decay is a simple problem in elementary quantum mechanics, often found in introductory textbooks. An α-particle, for example, can escape from an unstable nucleus only if it can tunnel through the potential barrier against disintegration caused by the nuclear forces that hold even unstable nuclei together. The chance that if such a particle exists within the nucleus it will then escape, or the rate of the corresponding disintegration process, is thus a function of the height of the potential barrier, its width and of the total decrease of the potential energy of the system once the disintegration has taken place.

This calculation, first made in simple form by Gamow, has more recently been much refined and accounts for the "Gamow factors" used by Rose and Jones as part of

their reason for believing that their disintegration products are ^{14}C and not some other isotope of carbon. But even on this simple picture, one huge uncertainty persists — the chance that a particle of the kind that eventually tunnels successfully through the barrier can be held, if only momentarily, to exist. What emerges from what Rose and Jones now say is that the "preformation probability" of ^{12}C would have to be comparable with that of the much simpler α-particle if it were to be produced in a disintegration. That cannot be the case, at least on this simple picture. It is relevant, but sobering, also to recall that the preformation probability of ^{14}C inferred from the results now reported is substantially greater than might have been expected from simple considerations, which is a reminder that the calculation of the absolute rates of even α decay, for example, is still not feasible.

If there should accumulate a handful of examples of exotic kinds of radioactive decay in unstable heavy nuclei, it should at least be possible to glean some empirical information on the chance that various groups of nucleons will assemble into different potential disintegration fragments in neutron-rich heavy isotopes such as ^{223}Ra.

Nuclear Cost Advantage Large in 1990: NEA

(Nucleonics Week)

Nuclear stations will have a cost advantage of 30% to 75% over coal stations commissioned in 1990 in Europe and Japan, according to a new report "The Costs of Generating Electricity in Nuclear and Coal-fired Power Stations," published by the OECD Nuclear Energy Agency. This economic advantage would still hold, the report found, if nuclear capital costs should increase by 50%, fuel-cycle costs double or treble, or the capacity factors of nuclear plants fall below 50%, compared to coal stations operating at a 70% capacity factor.

In the U.S. and Canada, nuclear competition with coal in 1990 depends greatly on region. The NEA report found that nuclear "will have a clear economic advantage" in central and Atlantic Canada and retain a 5-10% advantage in the northeastern and southeastern U.S. "On present assumptions, however,...a coal plant, in close proximity to the major North American coal fields, is likely to be the cheaper route for new plants even when equipped with flue gas desulfurization systems." The report noted that the nuclear advantage would be reduced if coal costs could be stabilized in real terms; conversely, "nuclear prospects will improve" if nuclear plant capital costs can be held steady, made more predictable, and/or reduced, particularly in the U.S. This, the report said, could be accomplished by reducing construction times, using standardized designs and siting several units on single sites which will use common services.

China Offers to Take European Spent Nuclear Fuel

(Nucleonics Week)

China is offering to take permanent title to spent fuel from European utilities against a fee reported to be in the neighborhood of $1,500 (US) a kilogram. A high-level delegation of Chinese officials, led by Wang Shisheng, Deputy Minister of the Ministry of Nuclear Industry and Director of the China Nuclear Energy Industry Corporation (CNEIC), was in West Germany and Switzerland in January for discussions on spent fuel takeover. CNEIC signed a letter of intent with a consortium of three West German companies — Nukem GmbH and Transnuklear GmbH, both of Hanau, and Alfred Hempel GmbH & Co. KG of Dusseldorf — under which the Germans would serve as CNEIC agents for spent fuel business in "all countries of western Europe," according to a Nukem statement.

The German-Chinese letter of intent does not specify what would happen to the spent fuel once it got to China.

Decommissioning Update

(Nuclear Engineering International)

General Electric's Nuclear Energy Operations has been selected by the US Department of Energy to oversee the decommissioning of Shippingport (60MWe LWBR).

The project involves the removal of reactor equipment and radioactive materials to make the site suitable for unrestricted use.

It is expected that new techniques for handling irradiated parts will be employed. For example, portions of the plant's nuclear core will be cut under water to shield against radiation release.

The value of the decommissioning contract is estimated by the DOE to be between $60 and 70 million. Work is expected to take four and a half years. Preparations will begin in the summer of 1984.

Pacific Gas and Electric meanwhile intends to mothball Humboldt Bay (65MWe BWR).

In West Germany, decommissioning activity is also picking up, with work in hand or planned at three units.

Niederaichbach, (100MWe pressure tube GCHWR) is to be one of the world's first commercial units to be returned to a green field. Decommissioning is expected to begin in autumn 1984, and take four to five years.

France Reaches 48% in 1983

(Staff)

Nuclear stations contributed 48% of French electricity production in 1983, setting a new record for France. Electricity consumption has risen in most sectors, however consumption by the Eurodif gaseous diffusion enrichment plant at Tricastin fell. New industrial incentives to increase electricity use begin this year.

CNS News

CNS Annual Conference Preview

The preliminary program of the 5th Annual Conference of the Canadian Nuclear Society is now out. This conference is part of the International Nuclear Conference, to be held in Saskatoon's Centennial Auditorium June 3-6, and marks the first CNS Annual Conference to be held in Western Canada, the first to have sessions in parallel with the CNA's 24th Annual International Conference and also features England's prestigious Uranium Institute as a co-sponsor, with it's own parallel sessions. On the CNS preliminary program, CNS sessions are: Modelling and Analysis (6 papers), Nuclear Technologies (7 papers) and Tailings and Reactor Waste Management (6 papers). CNS attendees will be able to attend presentations in any of three parallel (and competing) sessions, the Uranium Institute sessions offering international and uranium oriented papers and the CNA sessions offering a wide range of reports on Canadian and offshore nuclear progress. Plenary sessions on electricity and nuclear issues begin and end the joint conference, which also features a rodeo and barbecue, as well as tours of the uranium mines and mills at Key Lake and Rabbit Lake in Northern Saskatchewan by special registration.

Staff

1984 Student Conference Report

The 1984 Student Conference on Nuclear Science and Engineering was held March 16-17 at McMaster University in Hamilton. The conference was sponsored by the Canadian Nuclear Association, the Canadian Nuclear Society, Westinghouse Canada and McMaster University. Thirty student speakers from across Canada presented papers on a wide variety of nuclear-related topics. There were 120 conference participants of which 70 were students and 50 were professionals from the Canadian nuclear industry and from various universities.

The conference was comprised of three session periods, a plenary session (with Dr. Dan Meneley speaking on "The Pickering Pressure Tube Failure"), a reception and banquet, a luncheon, and tours of the McMaster Nuclear Reactor and McMaster Tandem Accelerator.

The conference attracted participants from Montreal to Regina and offered a unique opportunity for young researchers to present papers to an audience of peers and academic/industrial professionals. Of equal importance were the new acquaintances made, the old friendships renewed and the discussions at the various social functions during the conference. Students learned about the work being done by their peers and about current interests at other universities and in industry.

The McMaster Nuclear Reactor Twenty-fifth Anniversary Symposium was held on the morning of March 16. Attendees of the Student Conference were invited to attend the symposium which traced the history of the research and researchers at the McMaster Nuclear Reactor over the past 25 years.

The sponsors of the Student Conference are to be congratulated by all Canadians for they have demonstrated their commitment to the

advancement of nuclear science and engineering, reinforcing their belief in the potential of our young people and thereby aiding in the assurance that the advancements of the past five decades will indeed provide a solid base from which the Canadian nuclear industry will continue to grow and prosper in the future. Proceedings of the conference will be published.

Eva B. Hampton
John V. Marczak
McMaster University
(CNS Toronto Branch)

CNS Annual Conference Proceedings Published

Proceedings of the Fourth Annual Conference of the Canadian Nuclear Society, held June 1983, are now available. The full text of fifty-two technical papers dealing with CANDU reactors and the Canadian nuclear fuel cycle are included, covering such topics as SLOWPOKE-3, CANDECON, fuel channel replacement and new compounds to extract metals from water.

The two volume proceedings are edited by Jan-G. Charuk, Conference Chairman, and are available for $40.00 to CNA/CNS members, $50.00 to non-members, from the Canadian Nuclear Society; 111 Elizabeth St., 11th Floor; Toronto, Ontario; M5G 1P7.

Interested in CNS Membership?

Membership in the Canadian Nuclear Society offers:

- Activities at local branch levels
- Activities within areas of your technical interest
- The *CNS Bulletin* bimonthly
- And more.

Contact the CNS office for a membership application form or further information.

Intéressés à devenir membres de la SNC?

La Société Nucléaire Canadienne vous offre:

- Des activités au niveau des sections locales
- Des activités dans les domaines techniques qui vous intéressent
- Le *Bulletin SNC* bimestriel
- Et bien plus.

Ecrivez ou téléphonez au bureau de la SNC pour obtenir un formulaire de demande d'admission ou de plus amples informations.

Conferences & Meetings

Short Course — Thermalhydraulics for Nuclear Reactors

Sponsored by McMaster Institute for Energy Studies, in cooperation with AECL, Ontario Hydro and CNS, to be held **May 14-17, 1984** at McMaster University. For information contact: **Dr. Jack Kirkaldy, GS 201, McMaster University, 1280 Main St. W., Hamilton, Ontario, L8S 4K1; Tel. (416) 525-9140 x4527.**

Symposium on Current Issues and Research in Thermalhydraulics

Sponsored by McMaster Institute for Energy Studies, in cooperation with AECL, Ontario Hydro and CNS, to be held **May 18, 1984** at McMaster University. For information contact: **Dr. Jack Kirkaldy, GS 201, McMaster University, 1280 Main St. W., Hamilton, Ontario, L8S 4K1; Tel. (416) 525-9140 x4527.**

CNS 5th Annual Conference

The Fifth Annual Conference of the Canadian Nuclear Society will be held in Saskatoon, Saskatchewan, at the International Nuclear Conference, in parallel with the Canadian Nuclear Association's 24th Annual International Conference, **June 3-6, 1984**: co-sponsored by the Uranium Institute. For information contact: **Dr. I.J. Itzkovitch, Chairman, CNS 1984 Annual Conference, c/o Eldorado Resources Ltd., 400-255 Albert Street, Ottawa, Canada, K1P 6A9. Tel. (613) 238-5222.**

International Conference on Containment Design

Sponsored by the Canadian Nuclear Society, to be held **June 17-20, 1984** in the Toronto Westin Hotel. For information contact: **N. Yousef, Technical Program Chairperson, 1984 Containment Design Conference, c/o Ontario Hydro, H10-A13, 700 University Avenue, Toronto, M5G 1X6, Tel. (416) 592-5983.**

International Symposium on Nuclear Power Plant Outage Experience

Sponsored by IAEA, to be held **June 18-22, 1984** in Karlsruhe, West Germany. For information contact: **Conference Service Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.**

Topical Meeting on Fission Product Behaviour and Source Term Research

Sponsored by ANS, CNS et al., to be held **July 15-19, 1984** in Snowbird, Utah. For information contact: **Dr. A.J. Muzumdar, Ontario Hydro, 700 University Ave., Toronto, Ontario, M5G 1X6.**

Joint ANS/ASME Conference on Design, Construction and Operation of Nuclear Power Plants

Sponsored by ANS and ASME, to be held **August 5-8, 1984** in Portland, Oregon. For information contact: **J. Lentsch, Portland General Electric, 121 S.W. Salmon St., Portland, Oregon 97204.**

Symposium on Thermodynamics of Nuclear Materials

Sponsored by the International Union of Pure and Applied Chemistry (IUPAC), to be held **August 13-17, 1984** in Hamilton, Ontario. For information contact: **Dr. H.E. Flotow, Chemistry Division, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60439.**

International Topical Meeting on Fuel Reprocessing and Waste Management

Sponsored by Canadian Nuclear Society and American Nuclear Society et al., to be held **August 26-29, 1984** in Jackson Hole, Wyoming. For information contact: **Eva Rosinger, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, R0E 1L0.**

9th International Symposium on Uranium Supply and Demand and Related Technical and Policy Issues

Sponsored by Uranium Institute, to be held **September 5-7, 1984** in London, UK. **For information contact: Terence Price, Secretary-General, Uranium Institute, 8th Floor, New Zealand House, Haymarket, London, SW1Y 4TE, UK.**

5th International Meeting on Thermal Nuclear Reactor Safety

To be held **September 9-13, 1984**, in Karlsruhe, West Germany, sponsored by the European Nuclear Society, the American Nuclear Society, the Canadian Nuclear Society and the Japan Atomic Energy Society. For information contact: **H. Rininsland, Kernforschungszentrum Karlsruhe, Postfach 36-40, D-7500 Karlsruhe 1, FRG;** or **Bill Penn** or **Dan Meneley, Ontario Hydro, 700 University Ave., Toronto, Ontario, M5G 1X6.**

Executive Conference on the Decontamination of Power Plant Reactors: Costs, Benefits and Consequences

Sponsored by American Nuclear Society, to be held **September 16-19, 1984** in Springfield, Massachusetts. For information contact: **J.E. LeSurf, London Nuclear Ltd., P.O. Box 1025, Niagara Falls, Ontario, L2E 6V9.**

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CNS 1984 Annual Conference Chairman / *Président de la conférence annuelle de la SNC (1984)*
Irwin Itzkovitch (613) 238-5222

Conference on Robotics and Remote Handling in the Nuclear Industry

Sponsored by Canadian Nuclear Society, co-sponsored by: Canadian Society for Mechanical Engineering and the American Nuclear Society. To be held at the King Edward Hotel, Toronto, Ontario, **September 23-27, 1984.** For information contact: **H.S. Irvine, Ontario Hydro, 700 University Avenue, Toronto, Ontario, Canada, M5G 1X6.**

26th Annual Radiation Protection Course

To be held at Chalk River Nuclear Laboratories, **October 1-5, 1984,** this course aims to provide the basic principles of radiation protection to professional personnel concerned with radiation safety in all areas of the workplace. For information contact: **Mrs. C.L. Nagy, Course Coordinator, Health Sciences Division, Atomic Energy of Canada Ltd., Chalk River Nuclear Laboratories, Chalk River, Ontario, K0J 1J0; Tel. (613) 584-3311, local 2689.**

Seminar on Remote Handling Equipment for Nuclear Fuel Cycle Facilities

Sponsored by IAEA and OECD NEA, to be held **October 2-5, 1984** in Harwell, UK. For information contact: **International Atomic Energy Agency, P.O. Box 100, A-1400 Vienna, Austria.**

International Conference on Occupational Radiation Safety in Mining

Sponsored jointly by CNA, EMR Canada and AECB; co-sponsored by CNS et al. To be held **October 14-18, 1984** in Toronto, Ontario. For information contact: **R.D. Gillespie, Program Chairman, Radiation in Mining Conference, c/o MacLaren Engineers Inc., 33 Yonge Street, Toronto, Ontario, Canada, M5E 1E7.**

International Workshop on Irradiated Fuel Storage — Operating Experience and Development Programs

Sponsored by Ontario Hydro with U.S. liaison through EPRI, to be held **October 17-18, 1984** in Toronto, Ontario. For information contact: **Dr. Ron Oberth, Ontario Hydro, 700 University Ave., Toronto, Ontario, M5G 1X6; Tel. (416) 592-2856.**

International Symposium on the Implementation of IAEA Codes of Practice and Safety Guides for Nuclear Power Plants

Sponsored by IAEA, to be held **October 29-November 2, 1984** in Vienna, Austria. For information contact: **Conference Service Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.**

Joint Meeting of ANS, AIF and ENS

To be held **November 11-16, 1984** in Washington, DC. For information contact: **G. Cunningham, Nuclear Studies, Mitre Corp., 1820 Dolley Madison Blvd., McLean, VA 22102.**

The Unfashionable Side

Solar Stock Available

A brokerage report commenting on a prospectus for a new stock issue by the high profile energy company Gecko Solar Laboratories Inc. of California has recently been received. Excerpts of this report of interest to CNS members follow.

"Gecko Solar Laboratories has generated worldwide interest in its anomalous semiconductor technology and several licensing agreements are rapidly approaching the realm of possibility. Anomalous technology, as realized by Solomonic Solar Cells, promises cheap solar cells for all in a multi-billion dollar market. Although technical details of the product aren't known, Gecko has revealed that it is in the atomic structure itself that its novel energy conversion capability lies: for unlike amorphous silicon, with its random structure, anomalous silicon has a structure which is *deliberately anomalous.*

"Although the efficiency of these cells have yet to approach initial expectations (a recent test mistakenly indicated an overall 20% efficiency, in fact, subsequent tests by the S.E.C. revealed efficiency to be around 1%) the 1 kilowatt test (mistakenly reported to be a 1 megawatt test) dramatically illustrated grid-scale capabilities. Anomalous materials have other applications as well, such as in the slicing of bread.

"Other products of Gecko Solar are ripe with promise: Their amorphous photovoltaic powered flashlight product has found applications in the Far North and Dr. Solomon Breeder, President of Gecko and ASLEEP Head is reported to be investigating the potential of building solar-powered DeLorean sports cars in Bermuda.

"Diversification continues, with the company, on behalf of ASLEEP (the Association of Solar Laboratories for Ephemeral Energy Production) having signed a licensing agreement with a Canadian Crown Corporation to build disposable nuclear reactors, this licensing fee now being the main source of Gecko Solar's income. Their aerosol product "Neut-Away" (formerly known as "Solar Beach Spray") has also found applications in the nuclear field.

"It is for these reasons, with the truly awesome potential of the high technology endeavours of this company, that we feel the company's current price-earnings ratio of 500 is entirely justified and that this new stock issue *should not be missed.*"

Chuck Wood