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Editorial

Under the Hot Lights

Since the August 1 failure of a pressure tube at the Pickering Nuclear Generating Station last year, the Canadian nuclear power industry has been the focus of media attention unparalleled since the Three Mile Island accident in 1979. Sweating under the spotlight is not altogether a pleasant way of spending time but it is inevitable.

Equally inevitable is the fact that most (if not all) media coverage of nuclear related matters will contain "inaccuracies" from the point of view of the nuclear industry. The nature of the news business is such that there simply isn't the time or space for the degree of precision and qualification that characterizes discourse within any specialist group. While it may be frustrating and galling to encounter news coverage which oversimplifies to the point of seemingly gross distortion, it's something we're going to have to live with.

It's quite tempting, having noted the above, to take the next step, and dismiss the news media from serious consideration — they simply cannot be trusted to handle the information — they wilfully distort the information — they sensationalize the trivial — the list goes on and on. Perhaps this thinking was behind the placing of a full-page advertisement in the Toronto *Globe & Mail* newspaper on February 6. Atomic Energy of Canada Ltd. took a whole page of "Canada's national newspaper" to place on public record "authoritative information on which Canadians can judge for themselves the importance of the industry today and in the long-term future." That sounds reasonable enough — for something over $20,000 (the going rate for a full page in the *Globe*) you reach a wide and important audience. But the ad started with the following statement: "Many Canadians have questions about the costs and benefits of Canada's nuclear industry as a result of inaccurate reports in some of the national media."

That may sound like good tough stuff to those of us in the business smarting under what we feel to be inaccurate reporting, and it may be true that the cost of a full page in the *Globe* is a worthwhile price to pay in order to boost the morale of the nuclear industry. But for those outside the industry, does it sound like a reasonable statement to make? Is it politic? Is it even accurate to imply that people's questions about Canada's nuclear industry are principally the result of inaccurate media reports?

Not unnaturally, there was some media response to this ad. One reporter asked AECL to give some examples of "inaccurate reports" and was told that there was "really nothing in particular." Looked at from an external perspective, it could appear that AECL was simply making an unsubstantiated assertion — a kind of activity more often indulged in (one hopes) by nuclear power opponents.

In our experience, examples of deliberate misinterpretation by the media in covering nuclear related stories are difficult to find, as are examples of blatantly partisan reporting. Examples of errors are more frequent and are to be expected given the constraints under which most reporters must work. It's also worth noting that a reporter who's attention is called to a specific error will make considerable efforts to correct that error in future stories — they are professionals too.

Surely it is more rational to expend considerable efforts to help the news media learn more about our fascinating industry than to scatter vague and unsubstantiated accusations of inaccuracy about the place?

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Perspective

The CSNI Meeting on Containment Safety

Atomic Energy of Canada Ltd. hosted a Specialist Meeting on Water Reactor Containment Safety in Toronto, October 17-21, 1983, sponsored by the Committee on the Safety of Nuclear Installations (CSNI) of the Organization for Economic Co-operation and Development NEA. The meeting included 37 presentations, 16 of which were provided by Canadian representatives. Proceedings of the Specialist Meeting were not published in the open literature, however, some topics will be presented again and published at the forthcoming CNS International Conference on Containment Design in Toronto, June 17-20, 1984. The official OECD-CSNI representative at the meeting, Dr. H. Karwat has produced the following "summary record" which we received permission to print. Dr. Karwat is with the Institute for Reactor Safety and Reactor Dynamics at the Technical University of Munich in Germany.

J.E. Dick,
AECL Containment Analysis Branch

This meeting was attended by approximately 50 international participants from 11 countries, the Commission of the European Communities and approximately 30 Canadian observers. Dr. Pendergast (AECL) chaired the meeting, assisted by a Program Group made up of Dr. A.R. Edwards (United Kingdom), Dr. E. Stubbe (Belgium), Dr. M. Reocreux (France) and Prof. Dr. H. Karwat (F.R. Germany). An account of the sessions follows.

Aspects of Risk and Long Term Containment Behaviour

The presentations of this session started with an assessment of the importance of the containment and its associated systems to limit risk. Particular attention was devoted to the possible benefit of a filtered venting

system (FVS) in reducing risks resulting from seismic events. The FVS may yield an overall reduction in the risk factor from 2-40, which however is considered still to be well within the uncertainty band of the methods of probabilistic risk assessment.

CANDU reactor specific studies on the proper timing of the filtered discharge after a severe accident show that an optimal timing of the discharge may depend on the expected leak rate of the containment to be identified by the operator during an accident and on the type of fission products released into the containment. The findings were based on a simplified analytical model to correlate leakage and containment internal fission product behaviour (decay, plateout and deposition) with the expected collective dose to the environment.

Two papers addressed the long term analysis of the containment behaviour during severe accident situations. The French JERICHO computer code is based on a concept similar to the MARCH code. It simulates the containment by a single volume with separated phases in thermal nonequilibrium. Options may be used to calculate component distribution between both phases. Within the vapor or liquid phase however, homogenous distribution is assumed. The discussion showed the need for an improved treatment of basic phenomena (heat transfer mechanisms, interaction corium-concrete and corium-steel). It is also planned to allow multicompartment description within the future versions of this code. Principally the same observations were made during the presentation and discussion of a paper describing the Canadian PRESCON-2 code, although this code is based on the multinode parameter approach.

The summary discussion stressed in particular the importance of a correct treatment of the heat exchange between the containment atmosphere and structures to simulate buoyancy-influenced processes (hydrogen and fission product distribution). These are of great importance when long term predictions of typical severe accident phenomena are required. However, it was recognized that full code verification is presently not at hand, but partial verification by separable effects tests is possible. To compensate for the limited predictive capabilities of the codes more instrumentation is considered necessary to monitor the state of a nuclear power plant during possible accidents. Furthermore, biasing of code calculations should be avoided wherever the results are used for risk assessment, or for the analysis of real accident situations, to avoid misleading conclusions. Finally, scaling implications on the extrapolation of experimental results due to the limited empirical understanding of some important phenomena require utmost care in planning and designing of experimental test rigs.

Integral Code Verification

Two presentations showed that available containment codes may adequately predict Battelle containment test facility pressure loading and the formation of intercompartmental pressure differences. More recent tests in the large-scale HDR containment experiment however showed some anomalies, most likely related to scaling problems and/or the operational and constructive particularities of the few confirmatory HDR experiments. A considerable sensitivity of the code calculations to the choice of empirical constants necessary in lieu of a more fundamental description of involved processes has been noted. The development of better models to describe flow resistance, heat exchange with structures, water entrainment and thermal stratification has been suggested, but the sparse knowledge on these fundamental processes in the parameter range of interest for the containment was recognized as a possible limitation for future code development. More separate effects tests may be necessary in the future to improve this situation.

Energy and Mass Exchange Between Structures and Containment Atmosphere

Heat transfer processes between the containment atmosphere and structures and between the gas phase and spray droplets have been extensively studied. The results were reported in several presentations. One contribution demonstrated the interaction of locally discharged hot emergency core coolant on buoyancy effects and on local heat-up of the containment atmosphere, which is of particular interest for long term hydrogen and fission product distribution analysis.

A theoretical comparison between the efficiency of outside containment cooling versus internal containment spray cooling showed the superiority of the internal spray system with respect to the achievable thermal efficiency. The outside containment cooling revealed better iodine scrubbing efficiency, supposed to be due to reduced desorption of the iodine from the water phase when the internal water recirculation is minimized.

The summary discussion of this session again addressed the limited attempts to elaborate possible implications caused by the scaling of experiments which were used to derive empirical correlations. While calculations utilizing these correlations are representative for average conditions the experimental data for heat transfer are locally measured, making the comparison analyses-experiment difficult. This holds in particular for the capability to predict temperature stratification within the containment and to predict local temperature differences of structures. Similar observations were made for phase separation phenomena (water entrainment) which are difficult to measure.

Separate Effects Code Verification

Three papers in this session were devoted to experiments and the analysis of single or two-phase flow within specific test facilities (separate effects tests). A French contribution showed first test results obtained from small dimensioned orifices to study basic phenomena of transient two-phase two component flow through orifices of variable lengths. These tests were obviously performed with choked flow conditions at the entrance to the orifice section and the experimental results reported so far may be difficult to extrapolate to larger dimensions and other irregularly shaped flow ducts. Another paper addressed the simulation of a T-junction in a flow network typical to the Canadian shared containment concept. Basic experiments were performed to be compared with the results of analytical models. Of general interest was the limited quantitative agreement between analysis and experiment shown so far for this rather simple modelling task.

The second part of this session included: a contribution describing methods and results of commissioning tests performed for the Canadian multi-unit vacuum containment building of the Bruce nuclear power station. The installed dousing system was successfully tested and demonstrated to keep pressures low in case a steam discharge should take place.

A Swedish paper dealt with pool dynamic studies performed for a typical ASEA pressure suppression system containment involving 86 downcomer tubes entering a 200 m^3 water pool. A report was made on the status of the Swedish FILTRA project for the dual unit nuclear power station at Barsebeck, located in Southern Sweden close to the Danish border. The FILTRA system is said to be designed for the mitigation of the radiological consequences of two preselected accident scenarios, the early failure

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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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of the pressure suppression system and a sequence causing a slow late overpressurization of the containment system.
The summary discussion mainly addressed the ability to scale separate effects tests in such a way that they may serve code verification without unduly biasing the involved codes. Empirical correlations are applied within the codes in lieu of more fundamental constitutive relationships and cannot be easily replaced without considerable experimental effort. However, the allowable degree of empiricism has to be judged in view of the envisaged broad range of application of these codes and in view of their required overall accuracy.

Containment Leakage with Severe Loading

The mechanical effects of pipe whip were addressed by a Canadian paper which described analytical methods to estimate structural damage to concrete. A lack of experimental data from larger scale tests was noted specifically for deformable missiles. Another unspecified parameter for practical application of the study was the initial kinetic energy of a missile or a whipping pipe before it impacts a target and causes the damage.
The US NRC containment integrity research program was described in detail. Main items are the determination of ultimate load capacities of diverse containment structures and the behaviour of containment penetrations under severe accident conditions. Some small scaled (1/30) pneumatic steel shell model tests have already been performed up to complete destruction and visual observations have been communicated. Easy methods for extrapolating this type of experiment are not readily available, a fact which raised several questions about the relevance of the obtained research results for prototype reactor containment behaviour.
A Canadian experimental test to failure was performed on a 1/14-scaled model of a prestressed concrete pressure vessel which was pressurized to structural failure. A film illustrated the presentation and demonstrated the response of the concrete structure to increasing internal pressure. The test showed that structural integrity was maintained at pressures well in excess of the "design" pressure.
The summary discussion of this session again revealed unresolved scaling questions in particular with respect to atypical welding procedures for very thin steel shell models, to the volumetric ratio of steel rebars and concrete components for downscaled models, to the volumetric ratio of steel rebars and concrete components for downscaled models of concrete pressure vessels and with respect to the possibly distorted interactions between steel (or concrete) containment vessels and their penetrations.

Maintenance of Leak Tightness

A variety of approaches to successful periodic testing of the local and integral leak tightness of containments were presented in several papers. Periodic leak rate testing is normally performed at overpressures well below the design pressures for which the requested leak tightness of a containment has been specified. The quantitative assessment of pressure and temperature measurements in terms of the integral leak rate at design conditions must take into account specific phenomena such as temporary air soakage of concrete structures at elevated pressures during the testing period, external meteorological conditions, internal temperature gradients of components and structures during testing and careful control of humidity. Specific test procedures and extrapolation methods have been reported by Canadian, Italian and Dutch contributions which allow a quantitative assessment of the leak tightness at design conditions.
While the integral leak testing methods were regarded as satisfactory, concern has been expressed that in most cases tests had to be repeated after closing open penetrations or performing some repair work. The "unavailability of leak tightness" has been studied for several years but seems to be only partially resolved. Reference was made to the Incident Reporting System (IRS) of the NEA where observed failures to close penetrations are reported. The relative merit of expensive and time consuming precise integral leak rate measurements in comparison to a more rigorous continuous monitoring of the status of penetrations was addressed during the discussions.

Equipment Response and Instrumentation-Hydrogen Control

A French paper dealt with improvements made in the surveillance of containment by radiation monitoring. This activity has been enhanced after the TMI accident and has led to an increase of the number of radioactivity measurements available within the containment. In this connection filtered venting to prevent the late overpressurisation of containment is also under discussion, but no decisions with respect to its application in nuclear power reactors have been made so far.
More recent developments in the USA concerning hydrogen control within containments of power reactors were presented. The present US Nuclear Regulatory Commission position on mitigation of possible consequences of hydrogen releases during various accident scenarios was briefly described. Three main classes of accidents were distinguished: design basis accidents (DBA), degraded core accidents (DCA) and core melt accidents (CMA). For the range of accidents falling within the DBA concept, burning of hydrogen is not admitted as part of the mitigating procedures. For the DCA and CMA scenarios the main goal of mitigating procedures is the prevention of a hydrogen detonation which could endanger the structural integrity of the containment system. A consequence of this policy Mark I and Mark II pressure suppression system containments have to be inerted by the addition of nitrogen.
Ice condenser containments of PWRs and Mark III containments of BWRs may be allowed to use deliberate ignition systems as a mitigating measure to prevent the formation of detonable mixtures by burning released hydrogen. Based on the assumption of 75% oxidation of the available zircaloy inventory during a degraded core accident sequence, 70 thermal igniters distributed throughout the entire ice condenser containment are considered to achieve this goal. For Mark III containments a system with 90 igniters is presently under assessment.
The discussion on the use of distributed igniter systems addressed several questions concerning the adopted sequence of events (difference between DCA and CMA), dependence on hydrogen formation rates, "diffusion burning" above the Mark III pool surface and hydrogen distribution at the moment of ignition. A hydrogen production rate of 0.4 lb/s may be considered as a limiting definition separating between DCA and CMA in the future.
Many reactors use containment pressure, humidity and/or temperature signals for an automatic detection of an abnormal release of steam or coolant water into the containment. Initiation of these signals depends on whether or not the relevant quantities reach preselected set points. The final contributions to this section addressed this problem. Again, best estimate treatment of the heat transfer to the containment structures is of key importance for an adequate assessment of adopted procedures and chosen set points. The timing of corrective or protective actions partially depends on the proper description of the initial state of the containment (relative humidity being of special importance for some containment concepts) and on a suitable positioning of monitors (humidity, temperatures).
Specific considerations concerning the behavior of subatmospheric containments were addressed in a Canadian paper. Predictive analysis requires careful decisions with respect to the nodalization of the simulated system to describe the interaction of the discharged coolant with the containment structures, the ventilation system and other potential heat sources or heat sinks. Heterogenity in local temperature and humidity is of essential importance here. This was also backed-up by a more fundamental presentation from Britain.
The summary discussion of this session stressed the importance of a case by case treatment of equipment response and the possible interrelations with envisaged safety measures. This in particular holds for the behaviour of hydrogen within the variety of containment concepts and the early mitigating schemes to cope with the consequences of small leaks. Dominating sequences of events cannot be defined in a generalized manner. The predictive analysis of equipment response has to take into account the specific design typicalities of the containment if it is to serve planning purposes with the best possible benefit.

At a concluding session the sessions' chairmen summarized their main findings. Discussions from the floor reiterated the request to improve existing codes to better cope with certain phenomena and facilitate the interpretation and extrapolation of experimental evidence gained from downscaled test rigs.

The meeting concluded with a visit to the Pickering Nuclear Generating Station.

Dr. H. Karwat

Tailings Management: A Long Term Problem?

The following update on ecological methods of uranium mine tailings management is contributed by Margarete Kalin, a Research Associate with the Institute for Environmental Studies at the University of Toronto.

The study of uranium mill tailings in Northern Saskatchewan, Central Ontario and the Northwest Territories has resulted in a broad understanding of these wastes in the environment after deposition of tailings ceases. The sites abandoned or inactive for one or two decades can be expected to reveal recovery processes which occur in this time span on managed and unmanaged tailings sites.

The natural rehabilitation and recovery processes, with or without the assistance of man, have to be understood, if the wastes are not to leave permanent scars in the environment.

Considerable scientific efforts are being expended to address the problems associated with long lived radionuclides remaining in the tailings after the extraction of uranium. Environmental pathways of persistent substances, such as heavy metals, are also of concern in relation to base metal tailings. Means of waste confinement which ensure minimal release of harmful substances are sought for all tailings. It is suggested that ecological processes may facilitate effective environmental management during and after closure of the tailings pond operation.

Ecological Abandonment Concepts

Depending on tailings characteristics, a dormant site may in time generate environmental problems. These can include acid generation, bioaccumulation of persistent substances by colonizing species and others. A management program which considers long term biogeochemical changes, in the tailings itself and in the cover material (if present) may not only be effective in preventing environmental degradation, but also cost effective. Working with the ecosystems in providing conditions which allow normal ecological processes to function is relatively easy, and long term recovery should occur with minimum interference by man.

Close Out of a Tailings Area

The effects of the close out (cessation of tailings discharge, preferably concurrent with cessation of treatment systems) will result in changes in the tailings area and the zone which receives effluent waters.

In case of pyritic tailings, an alkaline or neutral environment will change to an acidic environment wherever oxygen is present. It follows, that the tailings should be deposited in such a manner that oxygen transport in the tailings mass is minimised. This may be possible by promoting the growth of biota that are tolerant of the conditions in the active tailings ponds. Layers of organic matter may potentially reduce oxygen transport, both active or passive. As the tailings change from alkaline to neutral and finally to acidic environments, acid tolerant biota can be introduced into the tailings area. Organisms tolerant to acidic conditions would dominate the tailings in the long term.

Close Out Downstream Requirements

By locating the tailings area so that effluents percolate diffusely through large basins, development of acid or alkaline tolerant ecosystems can be facilitated. These would gradually decrease in acid or alkaline tolerance, e.g. from a muskeg, to a cattail wetland and then to a more mixed wetland. The ultimate discharge could resemble relatively natural conditions, and the tailings deposition in the long term may only have resulted in diversification of ecosystem types in the area.

Uranium Tailings: A Case Study

A four-year research program is soon to be completed. Long term ecological behaviour of abandoned and inactive uranium mill tailings was studied in relation to site characteristics — the report "Synoptic Survey Identification of Invading Biota" is available from Environment Canada (EPS-4-ES-83-1). Pioneering plants on the abandoned sites were identified, and the growth of dominant species was studied in detail. To address long term pathways of radionuclides, the initial presence of vegetation cover may be less significant than the growth dynamics and conditions. The report "Growth Patterns of Indigenous Vegetation" is presently in press with Environment Canada.

It was found that the semi-aquatic communities on tailings exhibit growth characteristics similar to non-tailings sites. The wetland comprise mainly cattail stands, and in many cases it was established that decomposition and growth have reached a steady state. On the other hand, the growth of two pioneering trees, white birch and trembling aspen exhibited expected characteristics of growth on poor site conditions, similar to gravel pits and road sides. Although the trees showed persistent yearly growth increases, recruitment of young trees by vegetative grow appeared to be limited. The development of the terrestrial ecosystems on abandoned tailings sites should be studied more extensively to allow formulation of optimal long-term management plans.

Before further ecological studies are warranted, the distribution of the radionuclides and other persistent substances in the communities on the tailings should be determined. At present the environmental compartments are characterized which contain radionuclide concentrations relevant to pathway analysis. For example, most of the radium 226 in cattails was found in the roots, and only small concentrations in the leaves. Thus for some aspects of food chain transport, leaves are less important than roots. Should, however, the litter from the leaves act as an accumulation medium for radium from the dissolved or suspended portion of radium 226 in the water, in the long term, litter in cattail stands could develop into a significant source or sink or radium (depending on the chemical conditions and anticipated changes).

Once the relevant environmental components which may play a role in the long term pathways are identified, the ecological dynamics of the ecosystems on the tailings can be evaluated. Studies of ecological dynamics of uranium mill tailings will highlight relevant pathways and their long term components. These components should be examined in detail. Based on the results of these studies a decommissioning plan for tailings sites can be designed that will minimize environmental degradation and any adverse effects which could be associated with long lived radionuclides. This work on uranium mill tailings was funded by AECB, Environment Canada and EMR Canada.

Summary

Technological and engineered environments can be difficult to control in the long term. The multitude of environmental tolerances, adaptations, repair mechanisms and recovery processes which have evolved naturally can assist in tailings design. Abandonment concepts should be developed to work with rather than against nature. Past experience in environmental management has shown that we have to plan today for tomorrow. Our failure to recognize problems within a technological and industrial world today, threatens not only our own environment but also that of future generations.

Margarete Kalin

FYI

Preparing for Restart? (Staff)

Ontario Hydro is in the process of preparing a proposal to the Atomic Energy Control Board for the restart of Pickering Units 1 and 2. Unit 2 has been shut down since the sudden failure of pressure tube G-16 on August 1, and Unit 1 has been shut down since November 15 for pressure tube inspection.

Of five tubes removed from Unit 1, three showed signs of hydride blistering, the phenomenon regarded as the cause of the G-16 failure. However Ontario Hydro sources suggest that these tubes were not in

immediate danger of failure. There appears to be increasing evidence pointing to out of position spacers (garter springs) as major contributors to the formation of hydride blisters, though Hydro warns that this is not necessarily the sole cause.

Ontario Hydro's immediate objective is to satisfy itself and the regulatory authority that the two reactors can be restarted and operated safely and reliably until equipment and materials are available for large scale fuel channel replacement. Late last year Hydro announced that development of remote tooling for retubing was being accelerated, with 1986 targeted as the year for which the equipment should be ready. And, more recently, Ontario Hydro placed a $26 million order with Chase Nuclear for 1000 zirconium-2.5wt% niobium pressure tubes, delivery to be completed by 1986.

Investigations into pressure tube behaviour continue, the most recent development being the shut-down of the Nuclear Power Demonstration (NPD) reactor at Rolphton for removal of two pressure tubes. One of the tubes will be an original zircalloy-2 tube, resident in the reactor since its start-up in 1962, while the other will be a zirconium-niobium tube, installed in 1967.

Environment Canada Proposes Costly Radiation Standards (Ottawa Citizen)

Environment Canada has angered the Atomic Energy Control Board and provincial power utilities by proposing for radioactive water pollutants from reactors standards that are as much as 300,000 times more stringent than today's.

The AECB and the provincial utilities say there is no evidence that the existing standards are inadequate. In any case, they point out that most reactors have been operating at no more than one per cent of the present emission limit.

Environment Canada officials say they want to prevent the long-term build-up of radioactive waste in the water. At this point, they are unable to cite any direct evidence that such an accumulation is occurring, although one official said "some information" will be contained in the ministry's report when it is released for public review later this year.

Even if there is evidence that some cumulative increase in low-level radiation is occurring in the water around nuclear power plants, the question still arises: Does it pose any real risk to public health?

Environment Canada admits that it is "difficult to define" the danger this would pose, largely because the long-term effects of low-level radiation are a matter of debate within the scientific community.

Surely Environment Canada must show that current standards are inadequate before requiring power utilities to spend millions of public dollars to eliminate a danger that may not exist.

Perhaps the ministry will be able to do that when its documentation is released for public review. But it is already clear that it has utterly failed to convince the industry and its regulatory body that a problem exists.

Centre for Nuclear Engineering Established in Toronto (University of Toronto)

A Centre for Nuclear Engineering has been established in the Faculty of Applied Science and Engineering at the University of Toronto. The centre will be under the chairmanship of Professor O.J.C. Runnalls, who is also Professor of Energy Studies in the faculty.

The centre's responsibilities will include:

- co-ordination of elements of the undergraduate program in Nuclear Engineering including contributions to the Engineering Science option in Nuclear and Thermal power;
- co-ordination of graduate program offerings in Nuclear Engineering for graduate students registered in various departments;
- facilitation and co-ordination of research in Nuclear Engineering;
- acting as host to industrial, utility, and academic visitors from the international Nuclear Engineering community;
- administration of an Industrial Liaison Program to provide close interaction between representatives of the nuclear industry, utilities, and relevant government agencies, and staff and students associated with the centre. The program may include periodic seminars, group discussions, industrial visits, and other relevant functions.

The centre and its activities are being funded jointly by the Faculty of Applied Science and Engineering and by the nuclear industry.

Point Lepreau: Outstanding Performance in 1983 (NB Power)

In the nine months from April 1 to December 31, 1983, the Point Lepreau Nuclear Generating Station has produced over 4 billion kilowatt hours, representing an average production output of 608,000 kilowatts during every hour of every day during that period, or 89% of maximum possible production.

NB Power has indicated that the operation of the plant has been extremely good and trouble free in its early operating stage, a period when operating bugs are normally expected.

With the near 100% production levels experienced over the last six months, the total production cost of Point Lepreau energy, including all financing costs, operating and maintenance costs, fuel and taxes, is less than just the cost of oil fuel alone for energy produced at efficient oil-fired stations.

Japan Joins TMI (Staff)

For a participation fee of $18 million (US), the Japanese Federation of Electric Power Companies will participate in a five year research and development project at Three Mile Island. Formal execution of the agreement between the Japanese utilities and the US Department of Energy is expected shortly. Meanwhile NRC commissioners have voted in favour of a plan to restart the undamaged unit 1 reactor, possibly as early as June.

Two Canadian Firms Commence Cernavoda Contracts (External Affairs)

Babcock and Wilcox Canada of Cambridge, Ontario and Versatile Vickers of Montreal will begin work on contracts worth a total of $70 million to supply steam generators and heat exchangers for the former and calandrias for the latter to the Cernavoda CANDU nuclear power facility in Romania.

Both firms signed contracts with Romenergo, the Foreign Trade Organization responsible for the Cernavoda project, at the end of 1983 for this equipment. Their contracts became effective in mid-January 1984 when they received downpayments.

Thoria Fuel Labs Built at CRNL (Chalk Talk)

While other AECL groups at Chalk River and Whiteshell study irradiation behavior, reactor physics and reprocessing of thoria fuels, a group in CRNL Fuel Materials Branch is looking at possible manufacturing techniques. Thoria must be handled differently from uranium dioxide because it is more toxic. The small size of the particles that make up thoria powders means that special precautions must be taken to prevent "dust" inhalation.

Recently, four new laboratories were completed in Fuel Materials Branch for thoria examination, where researchers will go back to basics with this ceramic material to try to develop simpler powder and pellet production methods that could eventually be handled safely and remotely.

Refitting the new labs took two years of planning and 10 months of construction. Fume hoods and air filters were installed and the air in the labs is changed every three to five minutes to minimize "dust" problems. An alpha radiation counter, used by people as they leave the area, is an added precaution.

Two of the four labs are devoted to the powder/pellet process, for the study of the conversion of thorium nitrate-based solutions into thoria powders and examination of their pellet production characteristics. "Solgel" techniques will be used in the third lab to prepare an entirely different kind of fuel form — microspheres, a larger and potentially safer type of thoria particle. The fourth lab will be used to study material at various stages of processing.

The group's first aim is to get a thorough understanding of thoria fuel and to use the information to improve and simplify the

manufacturing processes for future, and possibly present, CANDU fuels. As a bonus the research may also be applied to ceramics outside the nuclear domain.

Concrete Canisters Go Commercial (WNRE Bulletin)

An agreement signed January 13 by AECL and an American west coast holding company licenses Nuclear Packaging of Federal Way, Washington to sell concrete canister technology developed by AECL's Whiteshell Nuclear Research Establishment for dry storage of used fuel from U.S. light water reactors (LWR).

WNRE has for some time been developing the concept of storing used fuel in above-ground concrete canisters as an alternative to storage in water-filled bays. While there is still considerable storage capacity remaining at Canadian reactor sites, U.S. utilities are looking for alternate economical interim on-site storage. Nuclear Packaging (NuPak) sees the market for alternate storage in concrete canisters developing in the near future and wants to be prepared.

The agreement allows for the transfer of technology to the American firm, agrees that any development work on the concept will be offered to WNRE researchers on a first refusal basis and grants AECL a royalty on all revenues related to concrete canister sales by the company. Essentially, NuPak will handle design, marketing, promotion and licensing and WNRE expects to become involved in the R&D work.

There could be future development work because requirements for LWR used fuel storage are different from those for used CANDU fuel. The geometrical requirements are different — the U.S. canisters would have to be taller because of fuel design. As well, the U.S. fuel produces more heat and has different criticality requirements.

WNRE Receives Fuel Test Facility Approval (AECB)

The AECB has approved an amendment to the site licence for AECL's Whiteshell Nuclear Research Establishment at Pinawa, Manitoba, authorizing the operation of a new laboratory called the Immobilized Fuel Test Facility. This facility is designed to provide for a wide range of experimental work to be performed in support of the nuclear fuel waste management program, e.g. predicting the long-term behavior of irradiated fuel under conditions existing in a nuclear fuel storage vault, and determining the behavior of materials proposed for engineered barriers in a nuclear waste vault.

Proposed AECB Regulations for Comment (AECB)

The Atomic Energy Control Board advises that a proposed regulatory guide entitled "Criteria for Concept Assessment: Geological Considerations in Siting a Repository for Underground Disposal of High-Level Radioactive Waste", Consultative Document C-72, is issued for public comment. Comments received before April 24, 1984, will be considered in the revision process for this document, prior to its being used on a trial basis or formally applied in the nuclear regulatory process.

Also released are the proposed regulations entitled "Regulations Respecting Uranium Mining", Document C-59.

Comments for this document received before April 3, 1984, will be considered in the revision process for this document.

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

Corrective Actions at Key Lake Announced (AECB)

The Atomic Energy Control Board has announced results of its preliminary investiation into a Key Lake uranium mine water spill of January 5 in northern Saskatchewan.

On an immediate basis, the AECB has approved measures to restore the reservoir damaged in the incident, to lower the water level in both reservoirs at the plant, and to install water level indicators and alarms.

The licensee, Key Lake Mining Corp., has also been required:

- to submit a plan for appropriate remedial action, to be approved by the AECB
- to reorganize the company's operating and administrative practices to adequately address environmental concerns
- to conduct a comprehensive investigation of the incident and submit a full, formal report on what happened, why, what was done, the remedial program, and corrective actions to prevent recurrence
- to submit analyses on the facility's water management regime for both the coming spring break-up and spill recovery period, and the longer term.

An estimated 87 million litres of mine water was accidentally released from two connected water storage reservoirs.

Ontario Heavy Water Plant to Close (Staff)

Ontario Hydro will be closing one heavy water plant this year, in keeping with lower demand for heavy water. Should inspections confirm the reliability of the B plant, the older A plant will be mothballed. The B plant started up in 1981 but experienced commissioning problems which led to corrosion and has since been rehabilitated.

Layoffs at AECL Radiochemical (Staff)

Atomic Energy of Canada Ltd. Radiochemical Co. has given layoff notices to 240 of its 1000 employees at its facilities in Kanata, Ontario. AECL cited the poor economy and increasing international competition in its field of radiation treatment equipment and radioisotopes as reasons for the layoffs.

CNS News

A Note on the CNS/ANS Agreement of Cooperation

Of particular interest to CNS members in the "Agreement of Cooperation Between the CNS and the ANS" is item 2d., which states: "All members of either society may attend national meetings and national topical meetings or conferences of the other society at regular member fees." Members must pre-register to take advantage of this reduced registration fee. For CNS members this could be significant, for example, at the ANS Winter Annual Meeting last November in San Francisco, registration fees were $175 for members (CNS and ANS) and $350 for non-members.

On first reflection, item 2d. may appear unjustified since the CNS appears to have much more to gain than the ANS, but this is not necessarily so. Conferences are dependent for their success on submissions from the nuclear community. A good percentage of attendees at conferences present papers. Canadians in the past have contributed very significantly, and through our agreement are encouraged to continue their interests and contributions to ANS events. And vice-versa, the number of ANS members contributing to CNS events is proportionately less. Of importance to the societies and its members are cooperative programs which bring individuals together to exchange ideas and viewpoints and gain personal insights about one's peers. Also, society members are usually the ones contributing to conference organization and operation. The intent of a member and a non-member fee is to penalize those who do not support via membership any learned nuclear society. In this sense, members of CNS and ANS are equals and the fee structure recognizes this.

We look forward to greater participation of ANS members at CNS events and CNS members at ANS events.

P.A. Ross-Ross
Past President,
CNS and CNS International Delegate

La Commission Internationale sur la Sûreté Nucléaire

Par D.A. Meneley, et G.A. Vivian
(Traduction abrégée par H.W. Bonin)

Dans l'avant-dernier numéro du Bulletin, Phil Ross-Ross avait fait rapport des progrès de la nouvelle initiative en matière de sûreté des réacteurs nucléaires. Le but de cet article-ci est de rapporter les plus récents développements, tout en lançant un appel aux lecteurs du Bulletin pour leur aide, leurs commentaires et leurs conseils.

A la conférence générale de l'Agence Internationale de l'Energie Atomique (AIEA), en octobre dernier, le Dr. Hans Blix proposait l'établissement d'une commission internationale afin de réaliser une plus grande consonance entre les philosophies de

la sûreté nucléaire et les critères de sûreté sur lesquels les pays fondent leurs règlements de sûreté. Cette commission devrait jouir d'un grand prestige international, sans toutefois s'ingérer dans les affaires internes des pays. Les membres de la commission seraient proposés par les sociétés scientifiques, afin d'assurer leur grande compétence, tout en permettant à la CISN de jouir d'une indépendance maximum des gouvernements et de l'industrie.

Cette position du Dr. Blix concorde avec celle exprimée dans le rapport du Comité Zangger, disponible en écrivant au Dr. D. Meneley, Ontario Hydro, 700 University Avenue, Toronto, Ont. M5G 1X6.

Opposition

Toute nouvelle idée reçoit rarement immédiatement l'assentiment général, et une certaine opposition a commencé à se dessiner, notamment en provenance de la France. Il semble que les experts français en sûreté nucléaire s'inquiètent de ce qu'une telle commission internationale en vienne à déranger l'équilibre pragmatique qu'ils sont parvenus à établir au sein de leur procédure nationale de règlementation. De plus, le comité de l'Agence de l'Energie Nucléaire sur la Sûreté des Installations Nucléaires a exprimé une forte opposition à l'idée dans un rapport récent à l'OCDE. Les fondements de cette opposition sont semblables à ceux des Français, le rapport spécifiant de plus que les autorités de règlementation existantes sont des organismes appropriés à cette tâche complexe, et qu'elles maîtrisent ce sujet très bien. On croit que les causes profondes de cette opposition proviennent d'un manque de compréhension des objectifs de la commission proposée. La tâche présente consiste à communiquer l'essence même de ce projet aux membres de la SNC, ainsi qu'aux autres.

Objectifs de la CISN

Nous sommes aidés dans cette tâche de communication par une déclaration récente de Milt Levenson, président de l'"American Nuclear Society." Il explique essentiellement que bien que la règlementation de la sûreté des centrales nucléaires soit un sujet extrêmement complexe, et varie d'un pays à l'autre selon la législation locale, on peut distinguer un point commun qui est la protection du public. La commission proposée se doit d'être au-dessus des considérations commerciales, politiques et nationalistes, et ses travaux doivent s'effectuer avec un maximum de qualité scientifique et d'objectivité. L'activité de la commission deura être indépendante de celle des organismes nationaux de sûreté nucléaire. Le rapport du Comité Zangger esquisse plusieurs tâches dont le but est la compréhension de ce sujet en un laps de temps raisonnable. Le Groupe International des Sociétés Nucléaires devrait agir rapidement de concert avec d'autres groupes pour établi cette institution, choisir un groupe d'experts de façon à s'attaquer au plus tôt à certaines de ces tâches. Si le succès couronne ces efforts, la contribution de la CISN sera jugée par la génération suivante avec les mêmes égards avec lesquels nous considérons aujourd'hui la Commission Internationale de Radio-Protection. Un conclusion plus importante est que nous aurions contribué à fournir aux habitants de cette planète une source abondante, sûre et économique d'énergie nucléaire.

Interested in Contributing to the CNS Bulletin?

To submit original articles, letters, FYI items, reviews, calls for papers, etc. contact one of the following:

- D. Mosey, Editor, *CNS Bulletin*, c/o Ontario Hydro, 700 University Ave., H19, Toronto, Ontario, M5G 1X6.
- H. Bonin, Associate Editor, *CNS Bulletin*, c/o R.M.C., Dept. of Chem. & Chem. Eng., Kingston, Ontario, K7L 2W3.
- The *CNS Bulletin*, c/o the CNS office.
- Your local branch representative.

CNS Bulletin Issue:	Editorial Deadline:
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March/April	End of March
May/June	End of May
July/August	End of July
September/October	End of September
November/December	End of November

Interessés à contribuer au Bulletin SNC?

Pour soumettre des articles originaux, de lettres, des nouvelles, des revues, des appels aux communications, etc., veuillez bien entrer en contact avec l'une des personnes suivantes:

- D. Mosey, Rédacteur, *Bulletin SNC*, a/s Ontario Hydro, 700 University Ave., H19, Toronto, Ontario M5G 1X6.
- H.W. Bonin, Rédacteur Associé, *Bulletin SNC*, a/s Royal Military College, Département de Chimie et de Génie Chimique, Kingston, Ontario K7L 2W3.
- Le *Bulletin SNC*, a/s Bureau de la SNC.
- Le représentant de votre section locale.

Numéro du *Bulletin SNC*	Date limite pour l'éditorial
janvier/février	Fin de janvier
mars/avril	Fin de mars
mai/juin	Fin de mai
juillet/août	Fin de juillet
septembre/octobre	Fin de septembre
novembre/décembre	Fin de novembre

4th Pacific Basin Nuclear Conference Proceedings Published

The latest, comprehensive reference work on nuclear progress is now available as the Proceedings of the Fourth Pacific Basin Nuclear Conference, published by the Canadian Nuclear Association, which hosted the event (co-sponsored by CNS and others) last September in Vancouver. This conference attracted some 250 delegates to hear 48 papers appearing in the proceedings, representing the nuclear energy outlook of 12 Pacific Basin countries. It contains general sessions dealing with the high energy growth in Pacific Basin countries, their active nuclear programs, uranium supply and issues affecting nuclear goals. Canadian papers included the topics: Canada's nuclear program, role as a uranium supplier, future trends in heavy water production, thorium fuel cycle research and isotope production by AECL Radiochemical Co. Technical papers deal with uranium enrichment, fuel reprocessing, waste management, seismicity and applications of radionuclides.

The proceedings also feature papers on international cooperation by IAEA Director General Hans Blix and on the state of China's nuclear program by Wang Ganchang, President of the Chinese Nuclear Society. The 374 page volume edited by E.W. Vogt and G.A. Ludgate of TRIUMF is available for $75.00 from the CNA.

Conferences & Meetings

Student Conference 1984

Sponsored by CNS, CNA and McMaster University, to be held **March 16-17, 1984** at McMaster University. For information contact: **Douglas R. Wyman, Department of Engineering Physics, McMaster University, Hamilton, Ontario, L8S 4M1.**

Topical Meeting on Financial and Economic Bases for Nuclear Power

Sponsored by ANS and CNS, to be held **April 8-11, 1984** in Washington, D.C. For information contact: **V.R. Sligl, Ontario Hydro, 700 University Ave., Toronto, Ontario, M5G 1X6.**

CNS Simulation Symposium on Reactor Dynamics and Plant Control

Sponsored by CNS, to be held **April 9-10, 1984** in Saint John, New Brunswick. For information contact: **N.G. Craik, c/o Maritime Nuclear, P.O. Box 7000, Station A, Fredericton, NB, E3B 5G4; Tel. (506) 453-3027.**

5th Annual Conference of the Canadian Radiation Protection Association

To be held **April 30 - May 3, 1984** in Banff, Alberta. For information contact: **S. Hunt, Local Arrangements Chairman, C-7 Civil Electrical Engineering Building, University of Alberta, Edmonton, Alberta, T6G 2G7.**

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Irwin Itzkovitch (613) 238-5222

CNS 5th Annual Conference

The Fifth Annual Conference of the Canadian Nuclear Society will be held in Saskatoon, Saskatchewan, at the Joint 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.**

Annual Meeting of the American Nuclear Society

To be held **June 3-7, 1984** in New Orleans, Louisiana. For information contact: **ANS, 555 N. Kensington Ave., La Grange Park, IL 60525.**

International Conference on Containment Design

Sponsored by the Canadian Nuclear Society, to be held on **June 17 to 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 International Atomic Energy Agency, to be held **June 18-22, 1984** in Karlsruhe, West Germany. For information contact: **Robert Najar, 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.**

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 to 29, 1984** in Jackson Hole, Wyoming. For information contact: **Eva Rosinger, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, R0E 1L0.**

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.**

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 to 27, 1984.** For information contact: **H.S. Irvine, Ontario Hydro, 700 University Avenue, Toronto, Ontario, Canada, M5G 1X6.**

The Unfashionable Side

The Disposable Residential Reactor: Detailed Design

Efforts have proceeded to design, build and license a disposable domestic heavy water nuclear reactor by a Crown Corporation. As originally conceived by a committee of the Association of Solar Laboratories for Ephemeral Energy Production (which claims to have a working prototype of the reactor in the pool room of the chairman's household in California) the reactor would cost $99.59 (Canadian) and would be pool-type, utilizing heavy water and a single fuel channel and natural uranium, facilitating a simple core configuration. Power output would be one millionth the standard 600MW unit, i.e. 600 watts (the equivalent of six 100 watt lightbulbs) and the reactor would be distributed in kit form at local Canadian Tire stores. Commissioning would take about five minutes. Fuel and D_2 would be returned to the store in special deposit bottles. Natural convection would be the main safety mode. Calandria material would be transparent, reinforced silica and reactor control would be mediated by aquatic organisms wearing borated jackets, each with a reactivity worth of ± 0.0001 delta k/k. These control units could also be trained for power ramping and setback routines to allow load following.

A special highly reflective aerosol known as "Neut-Away" has also been developed by ASLEEP which repels neutrons and gamma rays, to keep radiation exposure to the family unit and pets within reason and to allow a small core. Hoses would allow attachment of reactor to swimming pools, dishwashers, greenhouses, and hot water piping. The small size of the reactor would also facilitate decommissioning.

The detailed design of the reactor has been submitted to the Control Board for scrutiny and preliminary licensing.

Chuck Wood