CANADIAN NUCLEAR SOCIETY

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• National Research Universal (NRU) • Medical Isotopes
• Cameco Vision 2010 • Climate Change

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Is Our Regulator In Focus?

During a scheduled maintenance outage of the National Research Universal (NRU) reactor inspectors discovered that an emergency backup system, needed to keep the reactor cooling pumps operating following a rare but serious earthquake was not operational. In fact, it had not been operational since it was installed, which is a violation of the NRU Operating Licence renewed by the Canadian Nuclear Safety Commission (CNSC) in 2005. AECL has full control over all aspects of NRU operation, and as such, AECL is not inculpable.

However, blame is not the issue. The issue is focus.

When a power reactor that supplies 4% of the demand for electricity is shut down, the operating organisation loses revenue. It's only money. When the NRU that supplies 70% of the world demand for medical isotopes is shut down, it's not just money. About 160,000 patients per month need medical treatment that requires medical isotopes. In particular, molybdenum-99 has a half-life of only 66 hours and needs to be produced and distributed daily. It's not a drug that can be stockpiled. If the NRU is down for more than a week, people suffer.

The CNSC is focussing on a safety issue. The issue is the potential damage to the reactor caused by a serious earthquake that could release some radioactive gases. The likelihood of such a damaging earthquake at the NRU site is one in a thousand years.

A good definition of safety is the absence of risk. There is, of course, no such ideal. People accept a reasonable risk in exchange for a benefit. We move about, we drive cars, we travel in airplanes, we dine in exotic restaurants, we use electricity and we take pharmaceuticals when needed. All of these activities carry some risk but also provide some benefit. We consider these activities to be "safe" because we view the risk to be acceptable.

For 48 years the NRU reactor operated safely without a seismic backup cooling system. Now, 50 years later, the reactor is shut down while the safety upgrade is completed. This focus on a rare earthquake, having a likelihood of one tenth of one percent, has blinded rationality and created human suffering around the world with a likelihood of 100%!

This is outrageous!

The safety upgrade is important but it is not urgent. Furthermore, as I write this editorial, the parts needed are not available and are on order. There was no need to extend the outage; another one could have been planned that would not upset world health. Instead, we have put many lives at risk, indeed unacceptable risk, all around the world.

The US Nuclear Regulatory Commission has been moving positively toward "risk informed" regulation. The CNSC flatly rejects this principle and medical isotope production with the NRU is no exception.

Is this focussing on safety?

In This Issue

Once again I am grateful for Fred Boyd's continued guidance and contributions to this December edition of the CNS Bulletin. I would also like to thank Fred as well as Jeremy Whitlock, Dave Torgerson and Rosemary Todd of AECL for their kind assistance in obtaining the photos and articles about the NRU.

This edition focuses on **Nuclear Medicine** while commemorating the 50th anniversary of the **National Research Universal (NRU)** reactor. There are two historical reviews, one by Rosemary Todd of AECL and the other by Fred Boyd on the occasion of AECL's invitation to the NRU pioneers who were involved when NRU went critical in 1957. We also have a technical review by **Steve West,** President and CEO of **MDS Nordion.**

Two technical papers are included in this edition. One is **Cameco's "Vision 2010",** and the other is a commentary on **climate change** and Canada's National Round Table on the Environment and the Economy.

We also have Fred's compilation of **General News** as well as **CNS News** and Dan Meneley's review of the book **"Smelling Land".** The CNS President, **Eric Williams,** is keeping us up to date with his regular "corner".

And last but not least, we have Jeremy Whitlock's **Endpoint,** a poetic ode to a great Lady.

Your comments and letters are invited.

This is just the second issue under our new editor, Ric Fluke, and things are going well from that aspect. For various reasons there has been no action on setting up a "Publications Committee". That is still on the books so if you wish to contribute yours thoughts on the future of the *Bulletin* or on the possibility of other publications the Society might pursue, please contact me.

Given that situation I would like to use the opportunity of this space to pass on comments arising from some of the activities in which I have been involved over the pass few months.

The American scene

First on that list is my reaction to the plenary presentations at the Winter 2007 meeting of the American Nuclear Society, held in Washington D.C. in early November. The actions of the US government to support the "renaissance" of nuclear power in that country are impressive, especially compared to the non-action or negative steps by our energy policy and regulatory organizations.

As one example, the US Nuclear Regulatory Commission has, over the past few years, stream-lined its process and modified its regulations to enable it to conduct reviews of designs independent of, and well prior to, a specific licence application. Compare that to the position of our Canadian Nuclear Safety Commission, which cancelled an earlier agreement to do a preliminary review of Atomic Energy of Canada Limited's ACR design. USNRC will also do an early site review. (Admittedly, the CNSC and the Canadian Environmental Assessment Agency did eventually agree to environmental assessments of potential new nuclear power plants based on a "generic" design reflecting the features of several different designs from various vendors.) Finally, USNRC now issues combined Construction and Operating Licences (COL), so that applicants need go through the licensing process only once.

In addition to the positive action of the USNRC, the US Department of Energy is working to promote the expansion of nuclear power in the country. As well as supporting research into advanced reactors, DoE is offering risk insurance for new plants.

Under the Energy Policy Act, the DOE is authorized to enter contracts to provide risk insurance with the first six sponsors to begin construction of new nuclear facilities that meet all other contractual conditions. Coverage would be for regulatory delays and delays from hearings or litigation and would be up to $500 million for the first two plants that begin construction and up to $250 million for the next four. An initial Conditional Agreement is available to any sponsor of an advanced nuclear facility once its application for a Construction and Operating Licence (COL) is docketed by the Nuclear Regulatory Commission (NRC).

Despite this positive governmental support, and the announcement from a few utilities that they proposed to apply for COLs there was a very muted atmosphere at the ANS meeting. Three speakers, one from GE Hitachi, one from GE corporate and one from the Nuclear Energy Institute, the industry association, all stated that the problem is public policy. In fact, Richard Myers from NEI stated that public / private cooperation was needed as the program could not depend on the free market. That from an industry spokesperson in the capital of the most free-market country in the world !

Canada's science policy

The CNS is one of the 25 member organizations of the Partnership Group for Science and Engineering, acronym PAGSE, whose objective is to try to encourage the federal government to support research. I represent the Society at its periodic meetings in Ottawa.

Earlier this year we reviewed the most recent statement of the federal government's science policy recorded in a publication titled *Mobilizing Science and Technology to Canada's Advantage*.

It was prepared by the Ministries of Finance and of Industry. None of the ministries with significant science components, such as Natural Resources, Health, Agriculture, Environment, had any involvement.

The document focuses on three "science and technology advantages": entrepreneurial; knowledge; people. It proposes a number of policies for each.

While stating that it will maintain leadership in public R & D it is silent on the fact that Canada has the lowest private R & D of any G-8 country. One specific proposal under "knowledge" is to transfer "non-regulatory" federal laboratories to universities or the private sector. Under "people" it proposes increasing support for research internships and scholarships and states that the government will "foster a culture that values and rewards ingenuity and entrepreneurship".

Copies of the report can be obtained through website: www.publications.gc.ca.

CNS 2008 Conference

As a final item, please note that the deadline for submitting abstracts of papers to be presented at the 29th Annual Conference of the Canadian Nuclear Society or the 32nd Annual CNS/CNA Student Conference has been extended until January 11, 2008.

The joint conference will be held June 1 – 4, 2008, at the Marriott Eaton Centre hotel in Toronto.

See you there.

Fred Boyd

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~ Cover Photo ~

Foundation group for the National Research Universal (1957).

– Photograph courtesy of AECL.

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Cornerstone of Canadian Nuclear Industry Turns 50

NRU, AECL's crown jewel, keeps shining

Ed. Note: *Rosemary Todd originally published the article below in the AECL magazine "Currents". It is reproduced here courtesy of AECL.*

At 6:10 a.m. on November 3, 1957, the National Research Universal (NRU) reactor reached criticality for the first time. With that landmark achievement, Canadian science and technology stepped up onto the world stage.

At 200 million watts of power, it was a quantum leap forward from its predecessor, the National Research Experimental (NRX), and once again showcased Canada's Chalk River Laboratories as a world leader.

"NRU is a unique and powerful world class science facility in Canada," said Brian McGee, Chief Nuclear Officer. "This reactor stands as a shining example of a true Canadian success story. It is a pioneer in nuclear medicine and the foundation in the development of the nuclear industry in this country."

A research tool, NRU provides knowledge that helps AECL build safer and more efficient nuclear power plants. It has also been the birthplace of many scientific achievements.

NRU has the honour of being the workplace of Canadian physicist Bertram Brockhouse, who won the Nobel Prize in Physics for his influential work at NRX, then later NRU, using neutron scattering to explore materials.

NRU produces neutrons used by the National Research Council's Canadian Neutron Beam Centre to investigate and non-destructively study all types of industrial and biological materials.

Each year more than 200 professors, students and industrial researchers come to the Centre to make use of this national resource. Because neutrons can probe any kind of material, they can be applied to research in metals, alloys, polymers, biomaterials, glass, ceramics, thin films, cement and minerals. This work is leading to advances in medical, industrial and scientific fields to the benefit of all Canadians.

As one of the world's most versatile research reactors, NRU also produced the fundamental knowledge required to develop, maintain and evolve Canada's fleet of CANDU power stations. While NRU doesn't produce electricity, it is Canada's only major materials and fuel testing reactor used to support and advance the CANDU design.

The National Research Universal

The National Research Council commissioned Canada s first neutron reflectometer on June 15, 2007. This instrument is the newest addition to the suite of tools in the Canadian Neutron Beam Centre housed in NRU.

Foundation group for the National Research Universal (1957).

NRU contains testing equipment that allows scientists and engineers to replicate a power reactor's working conditions. This allows them to apply that knowledge to building safer and more efficient CANDU technology for use in Canada and abroad.

Life-saving Technology

A pioneer in nuclear medicine, NRU continues to produce the majority of the world's medical isotopes used in both the diagnosis and treatment of life-threatening diseases. Isotopes from NRU benefit more than 76,000 people each day, more than 20 million people internationally each year – an amazing contribution to world health.

"The NRU reactor's most important contribution to health is without a doubt the cobalt 60 it produces," said Alastair McIvor, Strategic Planning and Marketing, National Research Council. "NRU produces a range of radioisotopes that are used to cure disease or produce images of millions of patients every year. Cobalt 60 accounts for 16 million cancer therapy treatments."

Cobalt 60 was the original innovation of the NRX reactor through which Canada launched the modern field of nuclear medicine. The first cancer treatments using cobalt 60 were delivered at hospitals in Ontario and Saskatchewan in 1951. Today, cobalt 60 from NRU treats cancer patients in 80 countries every year.

The NRU reactor continues to be a workhorse for the medical community. It routinely produces more than 50 per cent of the worldwide molybdenum-99 requirements, and is capable of safely ramping up production to address short-term shortfalls in the world supply.

Brian said, "With credit to the original design and the many dedicated staff who have been a part of NRU's daily operation over time, this reactor's history is something for which we are all proud. There is still a lot of life left in NRU, and I am certain that it will continue to benefit all Canadians well into the future."

At 50 years young, NRU continues its mandate of research and development and remains one of Canada's most versatile science facilities.

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NRU turns 50!

World's best research reactor still going strong after a half century

by Fred Boyd

The "classic" photograph of the start-up of NRU at 6:10 a.m., November 3, 1957 showing John Inglis at the controls and a large group gathered to observe the historic occasion.

On November 3, 2007 the NRU research reactor at the Chalk River Laboratories of Atomic Energy of Canada Limited marked the 50th anniversary of its start-up on the morning of November 3, 1957.

Two modest events were held to mark the anniversary: a tour for local dignitaries and other invited guests (including media) on November 2 and a similar one for NRU pioneers on November 3. Each was hosted by Brian McGee, chief nuclear officer at AECL-CRL.

After a half century of operation NRU continues to produce more than half of the radioisotopes used in nuclear medicine diagnosis and treatment and provides the source of neutrons for advanced research and testing. It has been the birthplace of many scientific achievements, including that of Bertram Brockhouse who shared the 1994 Nobel Prize in physics for his pioneering contributions to the development of neutron scattering techniques for studies of condensed matter.

The NRU reactor design was started in 1949 when CRL was the Atomic Energy Project of the National Research Council. Construction was already underway when Atomic Energy of Canada Limited was created in 1952.

Some of the invited visitors for the November 2, 2007 tour of NRU pose in the control room in a fashion to simulate the start-up of 1957. In the centre is Cheryl Gallant, M.P for Renfrew-Nippissing-Pembroke.

The acronym NRU stands for "National Research Universal" reactor. It was, and still is, a *national* facility, used by scientists

An aerial view of part of the Chalk River Laboratories showing the NRU building in the upper centre.

across Canada. It was, and still is, a world-class research facility. As well as providing a source of neutrons for research, it was the home for much research required to develop the CANDU reactor design for nuclear power stations. And NRU is universal in nature. As a multipurpose reactor, NRU has enabled decades of research and development from a number of quite diverse scientific communities. At the same time it is the largest medical isotope production facility in the world, improving the health of millions of people internationally, each year.

Back in 1958, speaking at the Second United Nations International Conference on the Peaceful Uses of Atomic Energy, in Geneva, Dr. George Laurence, head of reactor research at CRL and later first president of the Atomic Energy Control Board, said:

> *"We wanted a reactor which would provide intense beams of neutrons for research; a reactor in which we could irradiate materials for radiochemical research; one which could produce cobalt-60 and other radioactive nuclides for treatment of diseases and for many applications in industry and in research; a reactor that would produce uranium-233 and plutonium for research directed toward nuclear power including the improvement of processes for the extraction of uranium-233 and plutonium. Not least important was our need for a reactor in which we could test fuel rods of experimental fuel at least two or three metres long in a high neutron flux and test the behaviour of liquids and gases that might be used for the transfer of heat in future power reactors. In short, we wanted a versatile reactor."*

In June 2007 a further research facility was added to NRU, a neutron reflectometer. The neutron reflectometer has now joined the other neutron spectrometers operated by scientists associated with the Canadian Neutron Beam Centre of the National Research Council. Scientists from university, industry or government labs can apply for time on the instrument for projects on thin films, surfaces and nanolayered materials.

NRU is the source of a variety of radioisotopes that are processed by MDS Nordion and shipped to medical facilities around the world. The primary isotopes produced are:

- Molybdenum-99 (daughter product Technicium 99m): Used for medical diagnosis (imaging) of the brain, thyroid, heart, lungs, liver, kidney, spleen and bone marrow
- Iodine-131: An isotope used in therapy, imaging and diagnosis (primarily for thyroid cancer)
- Iodine-125: Used in in-vitro diagnostic kits (radio immunoassays), bone densitometry devices, protein iodination and therapeutic seed (implants often used in prostate cancer treatment)
- Xenon-133: A medical diagnosis tool, especially for scanning lungs
- High Specific Activity (SA) Co-60: Nickel plated Cobalt-59 pellets are irradiated in NRU for two to four years, becoming High SA Co-60. The High SA Co-60 produced in NRU is primarily used in cancer treatment machines
- Carbon-14: Supplied in sealed aluminium containers and irradiated in NRU for five to seven years. Used as a radiotracer in a variety of biological compounds
- Iridium-192: Used as intense source of radiation for industrial imaging, including radiography and weld-inspection. Also used in portable units for cancer therapy and radiography

AECL has applied to the Canadian Nuclear Safety Commission for a life extension of NRU. It is expected that it will continue as a base for neutron-based research and production of radioisotopes for years to come.

Collaborative Partnerships

Ushering in a new era of personalized medicine

by Steve West, President, MDS Nordion

In the summer of 1920, renowned Canadian surgeon, Dr. Frederick Banting, traveled to the University of Toronto to meet with physiology professor John J.R. Macleod to discuss a potential treatment for "sugar sickness," a widespread condition that, at the time, could only be treated by placing patients on a near-starvation diet.

Two additional researchers joined Dr. Banting and Professor Macleod – a well-known biochemist named J.B. Collip, and Charles Best, a graduate student. Over the next two years, the four-person team worked collaboratively in the successful discovery, development and testing of a new extract that they believed would offer hope to millions of sugar sickness sufferers.

This extract, based on a purified pancreatic hormone the team initially called "isletin," became the lifesaving drug we today know as insulin.

In 1923, in recognition of their outstanding work, Dr. Banting and Professor Macleod were awarded the Nobel Prize in physiology and medicine, an honor they insisted on sharing with their fellow researchers. This breakthrough, often cited as one of the 10 most important medical discoveries of the 20th century, would not have been possible without the cooperative effort of all involved.

Collaboration for Innovation

Despite notable successes, such as the discovery of insulin, collaboration is often the exception – rather than the rule – when it comes to the discovery and development of new therapies and drugs.

Yet collaboration – creative, productive alliances between diverse constituencies in the pursuit of a shared goal – is often the genesis for medical innovation, providing the fuel that enables common people to achieve uncommon results.

Beyond unmistakable benefits, such as accelerated development cycles and decreased discovery and testing costs, tighter interdisciplinary collaboration provides an efficient way to identify and fast-track new ideas and concepts. In addition, it allows researchers to cast a wider net for potential compounds and speed them through the commercialization process, bringing much-needed new drugs to the patients whose lives depend on their delivery.

It is this increased emphasis on creative collaboration between key players, such as academia, industry and public institutions, which is helping to speed the drive toward personalized medicine.

As the foundation for personalized medicine, molecular imaging holds promise as the way to make preemptive strikes against disease and is providing breakthroughs in the area of genomics (the study, reading and interpretation of gene sequences) and proteomics (the study of the composition, structure, function and interactions of the proteins directing the activities in individual living cells).

With the united efforts of researchers from across the globe, and the careful application of advanced molecular imaging technologies, the identification and analysis of new biomarkers is accelerating. The result is medicine that is truly personalized to individual patients, allowing for earlier diagnosis, customized treatment plans, and the delivery of the most effective drugs to battle disease before it becomes a chronic condition.

One example of successful collaboration is the recent announcement of the Molecular Imaging Centre of Excellence. A joint endeavor between the University of Ottawa Heart Institute (UOHI) and MDS Nordion, a business unit of global life sciences company, MDS Inc., the Centre provides the opportunity for the two organizations to work together on groundbreaking cardiology research, using the latest and most innovative molecular imaging technologies.

This cooperative alliance between the two groups will provide a more robust research infrastructure and enable the team to share knowledge, equipment and training in the fight against heart disease, the No.1 killer in both the United States and Canada. Eventually, the team will open its partnership to pharmaceutical manufacturers to help bring promising new drugs to market faster and with less cost.

Such partnerships are crucial to the success of personalized medicine. The practice of personalizing medical treatment for individual patients requires us to solve the mystery of how each patient's body will react to available drugs and therapies.

The Rise of Personalized Medicine

Working collaboratively, researchers will be able to speed the introduction of new medical isotopes, as well as find new applications for existing medical isotopes, simplifying and hastening the process of biomarker identification and measurement.

This precise identification and analysis of new biomarkers will help pharmaceutical manufacturers better target treatments for specific conditions, and allow physicians to create treatment plans that are optimized for the distinct biological needs of each patient.

The promise of personalized medicine is not limited only to the discovery of traditional drugs – it also offers benefits for the application of radio-therapeutics.

Personalized medicine highlights the synergy between the diagnostic and radiotherapy worlds; by analyzing biomarker reactions to a given therapy, physicians can then determine whether the treatment is appropriate and effective for that patient. It also enables treatment dosages to be tailored to meet the individual's needs and can help provide more targeted delivery of radio-therapeutics, thereby boosting the treatment's efficacy.

Personalized medicine, unlike traditional methodologies, is centered on post-diagnostic treatments and focuses on the pre-disease state along with the individual's response to therapeutic treatment at the molecular or genetic level.

The ability to identify a patient's predisposition to a specific disease and then prescribe the most beneficial course of treatment tailored to that individual's unique situation will enhance drug effectiveness, reduce side effects, improve healthcare efficiency, and provide physicians with an edge in the fight against disease before it ever takes root.

But, what does this advance toward the era of personalized medicine mean for radiological professionals?

The rise of molecular imaging and personalized medicine represents a paradigm shift toward genomic medicine, and with their emergence comes vast new potential for the radiological community. Unlike their traditional roles as practical, hands-on medical practitioners, radiological specialists may see their duties expand and transform as the convergence of technology and pharmacology continues.

With the continued refinement of recent molecular imaging technologies and modalities, such as PET/CT, SPECT/CT and MR-PET, radiology as a discipline is ready to move beyond practical image generation and analysis to a more integrated, collaborative role.

Radiologists and radiologic technologists may increasingly be called upon to provide crucial clinical data or diagnostic counsel, giving them an active role in new disciplines, such as cardiology or pathology, which is often beyond the functional responsibilities typically performed.

In this new collaborative position, radiology professionals have the opportunity to make a positive impact on the quality of healthcare.

Celebrated industrialist and philanthropist Andrew Carnegie understood the power and value of collaboration, saying: "Strength is derived from unity. The range of our collective vision is far greater when individual insights become one." Truer words have never been spoken, for the road to great innovation is paved with the collective effort of many minds.

With support and collaboration between key players, there is no limit to what we can achieve. Personalized medicine will revolutionize the way we think about and treat disease – and that revolution begins with the combined teamwork and dedication of all involved.

Steve West is president of MDS Nordion (www.mdsnordion.com) in Ottawa. Questions and comments can be directed to editorial@rt-image.com.

Nuclear Imaging Drug Development Tools

By Lynn Buchanan, Ph.D., Paul Jurek, Ph.D., Russ Redshaw

Edited by Ric Fluke

Ed. Note: The following article was submitted by Grant Malkoske, MDS Nordion. It has been edited for a more general readership.

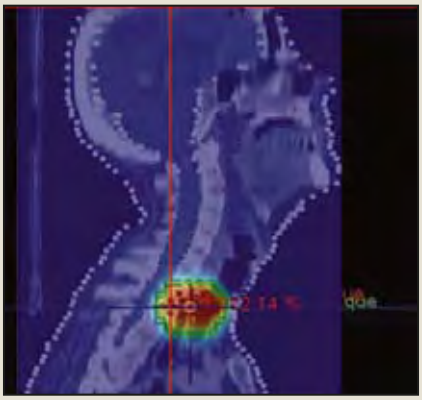
Drug discovery and development is recognized as a long, costly, and risky process. The Pharmaceutical industry is currently facing serious challenges characterized by rising R&D costs and declining productivity in new drug approvals. It now takes about 10–15 years and almost $1B to bring a new drug to market. Much of this expense is the result of costly late-stage failures. By 2010 the projected cost of successfully developing a new drug could reach $2B unless the efficiency and effectiveness of the drug development process are improved.

Molecular imaging is maturing into an important enabling technology with expanding applications from validating that a drug reaches the intended target through to market launch of a new drug. Molecular imaging encompasses a variety of different processes that can be categorized as follows:

- Anatomical image structural morphology of organs or tissues, including computerized tomography (CT), magnetic resonance imaging (MRI), and ultrasound;
- Functional visual biological processes within organs or tissues at the cell and molecular level, including single photon emission tomography (SPECT), positron emission tomography (PET), and optical imaging (bioluminescence, fluorescence); and
- Combining structural and functional imaging capabilities enabling accurate localization of biological or pathophysiological processes in tissues or organs, including PET/CT, SPECT/CT, and MRI/PET.

Nuclear imaging techniques are currently the most advanced and widely used. Recent introduction of complementary pre-clinical

imaging equipment has resulted in PET and SPECT becoming pivotal enabling technologies for translational research and medicine particularly in oncology, neurology, and cardiovascular diseases. Translation of pre-clinical results to clinical trials represents one of the most challenging stages in drug development, where failure rates from lack of safety or efficacy can reach 50%. PET and SPECT effectively bridge this transition to provide in vivo information on drug effects early in the development process. This not only enhances the quality of lead candidate selection but also reduces late-stage failures by shifting attrition to earlier, less expensive stages of the development pathway. In the learn-and-confirm drug development paradigm, clinical data from Phase 0 micro-dosing or Phase I imaging studies can also be "back-translated" to optimize pre-clinical development.



Nuclear imaging with PET or SPECT relies on use of radiolabelled tracers to visualize specific biological processes at the cell and molecular level. Radiotracer design and development are therefore key considerations. Generally three different approaches can be taken to develop radiolabelled tracers for use in drug development:

1. Use the radiolabelled drug candidate to assess bio-distribution and other characteristics;
2. Use a radioligand (an atom, molecule, radical or ion that forms a complex around a central atom) for the drug target to assess the properties of the candidate; and,
3. Use a radiolabelled biomarker to assess efficacy of the drug candidate.

Isotopes used for imaging are either gamma emitters for SPECT imaging or positron emitters for PET imaging. A positron is a transitory beta-like nuclear particle that travels a few millimetres from its atomic nucleus source and is captured by an electron at which point the electron and positron are annihilated resulting in the generation of two photons that leave the point of capture in opposite directions. When selecting a radioisotope for nuclear imaging studies, several factors must be taken under consideration:

- The physical half-life of the radioisotope must be sufficiently long to meet the study requirements;
- The biological half-life of the molecule to be radiolabelled;
- The physical and chemical characteristics of the radioisotope such as type of radiation, isotope-specific activity, and trace metal contaminants that may be present with the radioisotope that can interfere with radiolabelling.

Some radioisotopes for molecular imaging are short-lived (e.g., half-life of ^{11}C is 20 minutes and ^{18}F is 2 hours), which necessitates having the study carried out in close proximity to a cyclotron. Radioisotopes with half-lives exceeding 12 hours can be shipped across continents from commercial suppliers to molecular imaging centres. Generator systems employ a longer-lived parent radioisotope that is stably retained in the system, from which a shorter-lived daughter radioisotope can be extracted. Such generator systems can be placed in imaging centres and conveniently provide radioisotopes on demand. Generators are particularly attractive for molecular imaging in areas where a cyclotron is not available. For SPECT imaging the ^{99}Mo/^{99m}Tc generator is well established and for PET the ^{68}Ge/^{68}Ga generator system is emerging.

Irrespective of the study objective it is desirable to engineer a true tracer, one that replicates the drug or biomarker's nature. The radiolabel must not influence the biological or pharmacological activity of the drug candidate or biomarker. In this regard ^{11}C is an ideal radioisotope for imaging as it can be synthesized into a candidate drug for imaging. Unfortunately the short half-life of ^{11}C restricts its use to molecules that can be synthesized relatively quickly and for imaging studies of short duration. Nevertheless ^{11}C is the isotope of choice for small molecules and particularly for PET neurology imaging.

Radiohalogens (for PET imaging ^{18}F, ^{76}Br, or ^{124}I; for SPECT imaging ^{123}I) may be used. The most commonly used radio-halogen biomarker for molecular imaging studies is ^{18}F-fluorodeoxyglucose (FDG) that images hexokinase activity. Frequently Iodogen or Chloramine T reactions are used to radiolabel the halogen onto the molecule, but unfortunately, for large bio-molecules, such as antibodies, in vivo dehalogenation is a major issue. For bio-molecules, such as antibodies, a preferred approach for PET imaging is to use ^{64}Cu or ^{68}Ga where the metal ion is stably held by a bi-functional chelate (BFC). BFCs serve two purposes. One part of the molecule covalently binds to the targeting molecule. The other part of the molecule binds the radioactive metal ion. In selecting the appropriate BFC, consideration must be given to the targeting molecule, the radioisotope, and the effect on the target protein stability that conjugation and radiolabelling require.

The choice of BFC is not trivial because some do indeed work better than others. Loss of radioactive metal ion is one of the main modes of degradation in vivo, which leads to inferior image quality. A review of the scientific literature is required to discern the best chelate for a given metal and targeting agent. With regard to conjugation, most BFCs contain reactive groups. There is a trade-off between reactivity and stability with these compounds. Range-finding experiments must be performed to optimize the conjugation conditions. After purification of the conjugate it must be characterized. Range-finding experiments are then performed to determine the best conditions to radiolabel the conjugate, which include receptor-binding studies. Methods to purify and characterize the radiolabelled drug product must be developed.

Nuclear imaging is proving to be a tool for drug development whose value is recognized by leading pharmaceutical and biotechnology companies and regulatory agencies. Ongoing advances in nuclear imaging are continually expanding the uses of PET and SPECT imaging in drug development.

Lynn Buchanan, Ph.D., R&D at MDS Nordion, Paul Jurek, Ph.D., is quality manager at Macrocyclics (www.macrocyclics.com), and Russ Redshaw is director, business development at MDS Nordion. Web: www.mdsnordion.com. Phone: (613) 592-3400. E-mail: russell.redshaw@mdsinc.com.

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CRPA 2007 by Michael Grey

Ed. Note: *The following article is a summary of the Canadian Radiation Protection Association annual conference prepared by Michael Grey. Michael is a Health Physicist and Occupational Hygienist with Candesco Corporation in Toronto, and a Past President of the Canadian Radiation Protection Association.*

"Navigating the Future: Human Performance and Technology in Radiation Protection" was the theme of the 2007 Conference of the Canadian Radiation Protection Association, which was held in Saint John, New Brunswick on September 17 - 20. The Conference attracted 113 delegates and 26 exhibitors, and it included a total of 57 papers.

Two plenary sessions were devoted to organizational culture and its impact on safety. The opening plenary session was an introduction to Organizational Culture given by Alan Stewart of Human Synergistics Canada. Dr. Stewart discussed different types of corporate culture and how these cultures impact health & safety in the workplace. The second included a presentation on the Columbia Space Shuttle disaster by Colonel Richard Searfoss, formerly of NASA, followed by an overview of the CNSC Organization and Management Assessment program given by Helen McRobbie of the CNSC, and a workshop on "How to Influence the Safety Culture of Your Organization," by Doug Parker of NB Power Nuclear.

Refurbishment was a major topic at the Conference and five sessions were devoted to The Refurbishment Challenge, The People Challenge, ALARA I & II, and Retube OPEX. Representatives of NB Power Nuclear and AECL spoke on various aspects of the Point Lepreau Refurbishment Project at each of these sessions. The final session included presentations by Arif Khan and Jag Mohindra, both now with Nuclear Safety Solutions, who spoke on the lessons learned during the Bruce 1&2 Restart and the Pickering A Retube projects.

A half-day workshop was devoted to Radiation Safety Training. It included five presentations from representatives of four different organizations: OPG (Alan Carmichael), Cameco (Kari Kruecki), University of Toronto (Sandu Sonoc and Tanya Neretljak) and Stuart Hunt & Associates (Trevor Beniston). Leah Shurparski of McMaster University gave a presentation on her co-op work term project preparing video training courses for The Ottawa Hospitals Regional Cancer Centre.

Some of the other papers presented during the Conference included:

- "Update on the IARC Study of the Health of Nuclear Energy Workers" by Richard Osborne (Ramasara Consultants Inc.);
- "Commissioning of the Open Pool Australian Lightwater (OPAL) Research Reactor: A Health Physics Perspective" by Pat Kenny (Australian Nuclear Science and Technology Organization);
- "Advantages and Disadvantages of Three Types of Portal Monitors for the Screening of Contaminated Persons" by Gary Kramer (Health Canada);
- "A Study of the Accuracy of Electronic Personal Dosimeters (EPDs) used for the Measurement of X and Gamma Radiation" by John McCaffery (National Research Council);
- "National Nuclear Emergency Laboratory Network and Interoperability" by Dana Beaton (Health Canada);
- "Radon Exposure to Tour Guides in BC Caves" by Dave Morley (British Columbia Centre for Disease Control)
- "Current International Activities in Radiation Protection" by Chris Clement (CNSC); and
- "Report from the NORM Conference in Spain: The Lessons Learned" by Anar Baweja (Health Canada).

The winner of the CRPA Student Paper Contest, David Cooper of the Radiation Therapy Department, The Ottawa Hospitals Regional Cancer Centre, also presented his paper on "Intrafraction Translation Variation: Comparison amongst TOHRCC Tomotherapy Personnel."

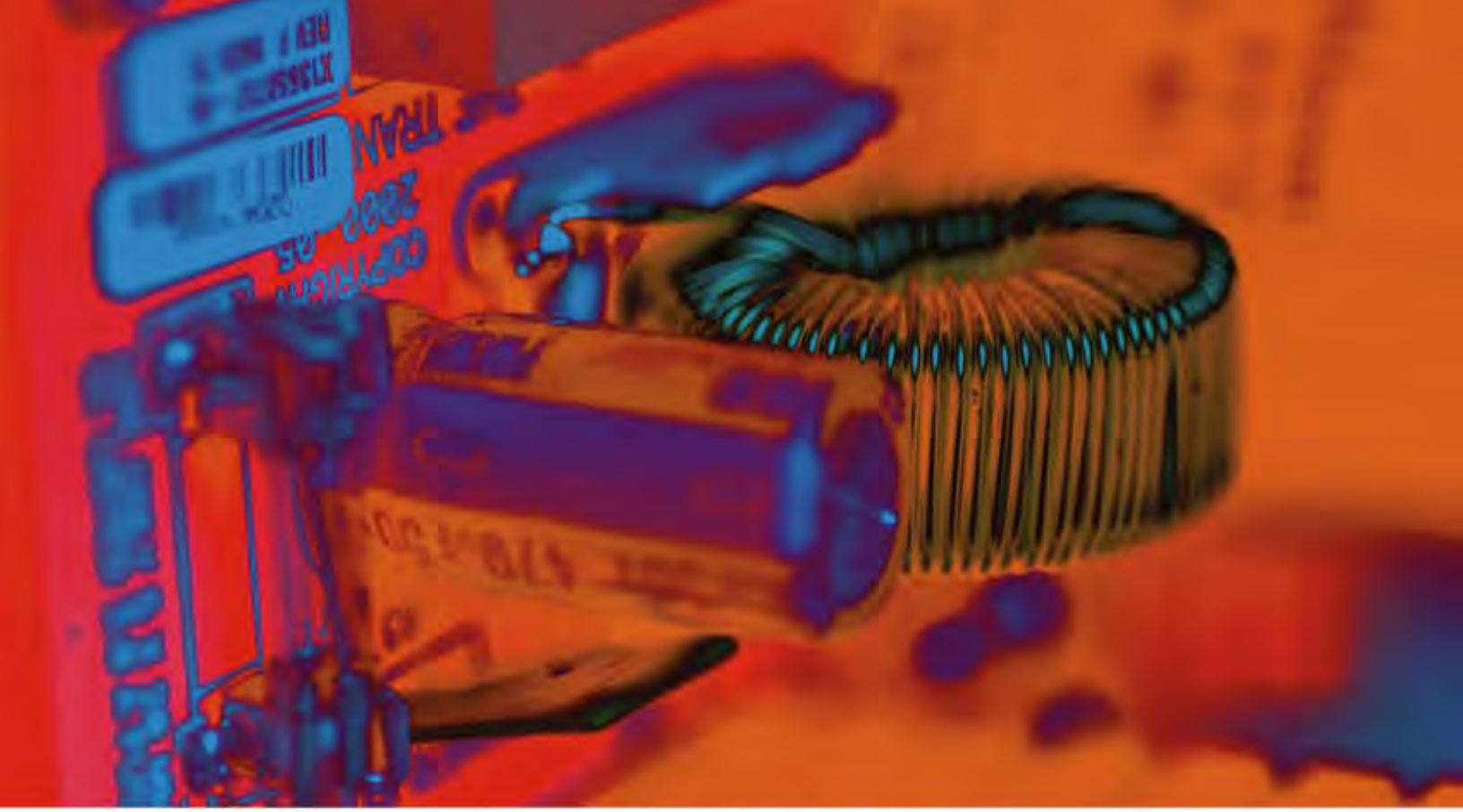
The Conference banquet was held on Tuesday evening during which Col. Richard Searfoss spoke on his experiences as a Space Shuttle Pilot and Commander. Dave Morley, formerly of the British Columbia Centre for Disease Control, was presented with the CRPA Meritorious Service Award, and Stuart Hunt of Stuart Hunt & Associates was presented with the Founder's Award.

The Conference concluded with tours of the Point Lepreau Generating Station and the Saint John Regional Hospital and it was followed by 2 training courses; a 3-day overview of internal dosimetry and a one-day course on radiation instrumentation.

Feedback received from Conference delegates was very complimentary, attributed largely to the efforts of the Local Organizing Committee, which was co-chaired by Laurie Comeau and Curt Nason and included Kathleen Duguay, Greg Wright, Cris Nicolau and a host of other volunteers from NB Power and the CRPA Executive, and the generous financial (and other) support provided by the Canadian Nuclear Safety Commission, Canberra, NB Power, AECL, Global Dosimetry, Gamble Technology, Monserco, Nuclear Waste Management Organization and Lou Champagne Systems.

The CRPA's 2008 Conference will be held in Saskatoon, Saskatchewan from June 2 - 5. There will be a pre-Conference mine tour on June 1, and the Conference will include tours of the Canadian Synchrotron Light Source and the radio-analytical laboratories (including the SLOWPOKE II reactor) at the Saskatchewan Research Council. The Local Organizing Committee for the 2008 Conference is being chaired by Steve Webster of SaskLabour and additional information is available on the CRPA website (http://www.crpa-acrp.ca/).

The 2009 Conference will be held in Montreal, Quebec.



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LETTER TO THE EDITOR

The Editor
CNS Bulletin

Tomorrow's albino mastodon

In April, 2006 the Alberta Electric System Operator (AESO) imposed a cap of 900 MW on wind turbine capacity in order ensure overall system reliability in a system of about 12000 Mw total capacity. In October of 2007 the cap was removed by Alberta Energy and AESO was advised to start "working on ways to enable electricity producers to add more wind to Alberta's power supply". The AESO is also to "make sure Alberta's reliable grid operation will be maintained." A recent article in the Lethbridge Herald indicated the AESO is discussing the possibility of 6000 more megawatts of wind generated power in southern Alberta at a series of open houses. I was incredulous.

I went to the next open house in nearby Taber. Sure enough, AESO staff acknowledged they had expressions of interest for about that much new wind turbine capacity. They anticipated the problems associated with actually making use of such a massive installation. They pointed out the unpredictable input to the grid and the need for backup to provide power when the wind dies. They were seeking public input and advice on the potential need for a similarly oversized transmission system to service the turbines.

Handouts at the AESO meeting indicated wind power costs about $2000 per kW of capacity. The cost of 6000 MW of wind power would thus be about $12 billion. Several additional billions would be needed to expand the grid to get the product to market. Still more billions would be needed for backup power. A revealing comparison can be made with the proposal to build 2200 MWe of nuclear power capacity near Peace River. That installation would produce somewhat more reliable base load electricity *(based on capacity factors of 0.3 and 0.9 for wind and nuclear, respectively)* for a mere $6.2 billion. Such a system in southern Alberta could substitute for the proposed wind turbines and avoid the need for so much additional transmission capacity. Indeed, it might be possible to scrap plans for the contentious Altalink, Montana to Alberta Tie Line, and Pincher Creek to Lethbridge power lines.

Existing wind power subsidies are nowhere near enough (approximately $1.5 billion from ecoENERGY for renewable power) to provide all the big business promoters of these wind farms with the incentives they need to go ahead with their proposals. Still, with all the emotion around climate change and "renewable" energy, Albertans need to be vigilant in resisting the creation of this albino mastodon of mammoth proportions which they and their heirs will be expected to pay for.

Yours truly,

Duane Pendergast
Chair,
Alberta Branch, Canadian Nuclear Society

Make the Renaissance Real

By Brent Williams, Vice President, North American Young Generation in Nuclear

If you went to a nuclear power industry conference in 2007, you heard the words "Nuclear Renaissance".

We argued about cost recovery and loan guarantees, design standardization, licensing and fuel reprocessing. We talked about oil sands and hydrogen and refurbishment and new build and repositories and passive safety systems and talking to the public. We thrilled to the level of public support we have, and to the prospect of building and refurbishing reactors. A bunch of us even talked about how to ensure we have enough people to build and operate this next generation of reactors.

The problem is that at the same time that we're kicking off this great initiative, we're replacing a huge percentage of our workforce. We desperately need to hire the right people, keep them, and teach them. The learning curve for the next generation is nasty.

Knowledge capture and transfer is where you come in. You have the information that will impact the success or failure of this renaissance. Your understanding of your company's organizational functionality, technology, and your past experiences are vitally important to the incoming staff.

Make the time to be part of your organization's mentoring program. If your company doesn't have a mentoring program, then start one.

You'll be making a difference to the protégé and the industry, and you'll meet some neat people in the process.

Cameco Vision 2010 by Aldo D'Agostino[1]

Ed. Note: The following paper was presented at the 28th Annual Conference of the Canadian Nuclear Society. It provides a comprehensive plan to address historic wastes and redevelopment of the Port Hope uranium conversion facility in consultation with the local community.

Abstract

Cameco Vision 2010 is a comprehensive redevelopment plan for the Port Hope conversion facility, which is Canada's oldest continually operating nuclear facility. The project involves the removal of old or under-utilized buildings, the removal of contaminated soils, building materials and historic wastes, and the construction of new replacement buildings.

Dealing effectively with the human environment is considered equally important to a project's success as addressing the biophysical environment. The project completed a community consultation process early in 2006 and, subsequently, Cameco significantly enhanced its community outreach program.

This paper presents a summary of Cameco Vision 2010 and community engagement activities.

1. Cameco Corporation, Port Hope, Ontario, Canada

1. Introduction

Cameco Vision 2010 is a comprehensive redevelopment plan for the Port Hope conversion facility, Canada's oldest continually operating nuclear facility, and will require an environmental assessment (EA) of the project. In the context of EAs as well as in the wider realm of corporate social responsibility, dealing effectively with the human environment is now considered equally important to a project's success as addressing the biophysical environment. Furthermore, host community support is one of four key measures of success in Cameco's mission statement.

As such, Cameco undertook a Vision 2010 community consultation late in 2005, well before the Vision 2010 EA process was to commence. Subsequently, Cameco enhanced its community outreach to include regular community forums, newsletters, and a dedicated website as a way of establishing an ongoing dialogue in Port Hope around wider issues such as economic impact and, longer-term health and environment concerns.

2. Goals and objectives of Vision 2010

Vision 2010 is a major cleanup and renewal initiative at Cameco's Port Hope conversion facility (PHCF) that involves the removal of contaminated soils and a number of old or under-utilized buildings, building materials and stored historic wastes, along with the construction of new replacement buildings with necessary landscaping.

The project is being carried out in conjunction with the Port Hope Area Initiative (PHAI) project, a joint federal-municipal government undertaking for the cleanup and long-term management of low-level radioactive and industrial waste in the Municipality of Port Hope, Ontario. Vision 2010 presents a unique and timely opportunity to increase the operational efficiency and environmental performance of the PHCF, while also making the PHCF look more attractive and integrate better with the community's vision for the future.

Vision 2010 is to be realized through development of a preferred master plan using the following key objectives:

- Maintain plant operations at all times while soil remediation, demolition, and new construction is in progress. This will require sequential relocation of personnel, materials and tasks from one area of the site to another.
- Consolidate site operations, in particular for cylinder-handling and storage facilities, so that the analytical laboratory and other operations related to the production of uranium hexafluoride (UF_6) and uranium dioxide (UO_2) are ultimately situated as close as possible to their respective centres of activity, where practical and cost effective.
- Enhance site safety and security by ensuring that the design meets the required level of safety and security with preference given to options that more easily achieve these goals.
- Improve the working environment for Cameco employees, further inspiring employees and contributing to their health and welfare. The site should be a place that Cameco employees can show with pride and that confirms the importance of Cameco to the residents of the Municipality of Port Hope.
- Implement, to the extent possible, the stakeholder planning objectives for Vision 2010 articulated by Port Hope community members and documented in the Vision 2010 Independent Advisory Report (Gartner Lee Limited, 2006) [1].
- Optimize the site's overall operations through the remediation/construction process. Some approaches may be more effective from a construction standpoint but ultimately

may not maximize the lifecycle potential for site operations. Others may present long-term flexibility but may be cost-prohibitive to achieve within the site restrictions. An optimized program that delivers maximum results when considering all technical, operational, commercial, environmental and social objectives is sought.

3. Project location

The Municipality of Port Hope, with a population of 16,500, is located on the north shore of Lake Ontario about 100 km east of Toronto. In 2001, the then Town of Port Hope amalgamated with Hope Township to form the Municipality of Port Hope.

Port Hope is celebrated as having the best preserved 19th century streetscape in Ontario and its downtown is well-known as a shopping destination for antiques and other specialty items. Port Hope is home to various industries including Cameco's PHCF and Zircatec Precision Industries (Zircatec), a Cameco company.

The PHCF occupies an area of approximately 10 hectares on the shore of Lake Ontario. Immediately to the east of the site are the Port Hope harbour, the centre pier (currently leased by Cameco) and the Ganaraska River. To the south is a beach, which is remote from the recreational activities of the inner harbour and is presently used for strolling and fishing. The VIA Rail station building sits just to the northwest of the PHCF. To the north of the PHCF are the CN and CP rail corridors whose tracks cross the Ganaraska River valley on two viaducts supported on masonry piers. Commercial and residential areas are located north of the tracks and east of the river.

4. Cameco Corporation

Cameco is a Canadian company that is involved in the exploration, mining, milling, refining and conversion of uranium containing materials as well as Candu reactor fuel and components manufacturing through its subsidiary Zircatec. Cameco's headquarters are in Saskatoon, Saskatchewan. Cameco's uranium refining and conversion operations are located in Blind River and Port Hope, Ontario, respectively. The fuel and reactor components manufacturing facilities of Zircatec are located in Port Hope and Cobourg, Ontario. Collectively all of these operations are referred to as the "fuel services division" of Cameco. The processed uranium is part of the supply chain used in the manufacture of reactor fuel for electric utilities here in Canada and around the world.

Cameco also produces electricity through its share of the Bruce Power Limited Partnership, which operates four nuclear reactors at a power plant on the south shore of Lake Huron, Ontario. Cameco also holds 53% ownership of Centerra Gold Inc., which was spun off from the company in 2004. Centerra is a growth-oriented Canadian-based gold mining and exploration company engaged in the acquisition, exploration, development and operation of gold properties in Central Asia, the former Soviet Union and other emerging markets.

5. Site history

Port Hope was settled in 1793 by United Empire Loyalists. The Town of Port Hope was incorporated in 1834 as the seventh town in Ontario. Because of its position both on Lake Ontario and at the junction of the Grand Trunk Railroad and the Port Hope-Lindsay Railroad, industry and trading grew in the town. The harbour served as a terminus for agricultural products, coal and industrial output from the 1800s to the early part of the 20th century.

The PHCF was initially established by Eldorado Gold Mines Limited in 1932 to process ore from Port Radium, in the Northwest Territories, into refined radium. The radium refining operation ran until 1939 when operations were suspended for a short period for economic reasons. In 1943 the company was renamed Eldorado Mining and Refining Limited and in 1944 the company became a Crown corporation. The operation was then converted to a uranium processing plant.

The company was renamed Eldorado Nuclear Limited in 1968. In October 1988, Eldorado Nuclear Limited and the Saskatchewan Mining Development Corporation were merged to form a new entity, Cameco, A Canadian Mining and Energy Corporation. This organization was subsequently privatized in the early 1990s and the name was shortened to Cameco Corporation.

Currently at the PHCF, only the UF6 and UO2 plants continue to operate for large-scale commercial production. The facility receives nuclear-grade UO_3 from its Blind River Refinery, for conversion to UF_6, or UO_2. These products are further processed at other facilities to produce fuels for light and heavy-water reactor programs, respectively. The PHCF also produces depleted UO_2. In addition to these fuels, the PHCF is also licensed to manufacture depleted uranium metal components for use in a variety of industrial applications.

The PHCF has achieved ISO 14001 certification for its environmental management system (EMS).

6. Port Hope Area Initiative

As stated previously, Vision 2010 entails the cleanup and redevelopment of the PHCF site. Presently there are a number of old or under-utilized buildings, contaminated soils, and stored historic wastes on the PHCF site.

The federal government, through the Low Level Radioactive Waste Management Office, is currently conducting an EA to consolidate historic low-level waste that is currently located in a number of locations throughout the municipality. These wastes are the result of past industrial practices, which resulted in contaminated materials being allowed into the community. When the project is completed all historic low-level radioactive wastes will be transferred to a single waste management facility, which will be located adjacent to Highway 401. The name of the local project is the Port Hope Area Initiative (PHAI).

As part of the PHAI project, the corporation of the then Town of Port Hope, the Corporation of the Township of Hope and the Corporation of the Municipality of Clarington entered into a legal agreement with the federal government (represented by the minister of natural resources) to mitigate the effects of historic low-level radioactive waste on the municipalities, as well as the property owners within the municipalities.

The agreement between the federal government and the Municipality of Port Hope specifies that 150,000 m^3 of decommissioning waste at the PHCF is to be accommodated in the long-term waste management facility (LTWMF) which is to be located in the

Municipality of Port Hope. Cameco has a specified window of opportunity, during the time that the LTWMF is receiving wastes, in which to transport its decommissioning waste for placement at the facility.

7. Project works and activities

The project has two phases: a site remediation phase and a construction phase. Several activities within each phase will occur simultaneously as both phases will be undertaken in incremental stages.

7.1 Site remediation phase

A preliminary remedial action plan (RAP) has been prepared for Vision 2010. Remediation for this undertaking is comprised of three major activities: removal of historic waste, building demolition and soil excavation. All of these activities will generate contaminated material that will be shipped to the LTWMF.

7.1.1 Historic wastes

After Eldorado's off-site waste management facilities could no longer receive waste from the PHCF site, Eldorado placed its waste materials into drums. Over the years, outlets were established for many of the materials and the drummed on-site inventory has been reduced. The remaining on-site drums will be relocated to the LTWMF.

7.1.2 Building demolition

Cameco's Vision 2010 team reviewed all available construction drawings and used them to estimate the quantity and type of materials present for demolition. The buildings slated for demolition will be cleaned to remove surface contaminants. Once the buildings have been cleaned, they will be disassembled to the maximum extent possible rather than using traditional demolition methods in order to minimize the release of dust, limit the spread of potential contaminants, maximize the amount of material that can be cleaned and recycled as scrap metal or aggregate, and to reduce impacts on the operation of the facility.

7.1.3 Soil excavation

The contaminated soil to be removed from the site was identified in the report on the Phase II Environmental Site Assessment (ESA) undertaken in 2003 (SENES, 2003). This ESA was augmented in 2006 by a study undertaken to further delineate the sub-surface contamination on the main site (SNC-Lavalin Engineers & Constructors, 2006).

The excavations will be conducted sequentially around the site as dictated by operational and new construction activities. The excavations will be small in area so as to minimize disturbance to operations. The rate of excavation will likely be at a pace that is matched to the receiving schedule of the LTWMF as stipulated by the PHAI.

7.2 Construction phase

7.2.1 Construction of new buildings – master plans

Over 30 buildings are currently on the PHCF site. Of these, almost two-thirds are slated for demolition for various reasons (e.g., they overlie contaminated soils, or they will be replaced by purpose-built facilities). As a result, some new buildings will be required. With some variations, depending upon the master plan option selected, these would include the following:

- a new building near the UO_2 plant to store UO_2 drums and house other functions;
- several small additions to the UF_6 plant, for possible uses such as wastewater treatment, indoor potassium hydroxide (KOH) unloading and scrap metal processing;
- a new laboratory building housing both analytical and research labs;
- a new receiving building possibly combined with non-destructive examination (NDE), and emergency vehicles storage;
- a new visitor's centre; and
- a new building to house the UF_6 cylinders.

7.2.2 Site services

Above-ground services at the PHCF are carried on piperacks, many of which will be replaced during the construction phase. Below-ground services will be re-constructed or re-located as needed to properly service the PHCF as remediation and construction activities continue. Cameco will use the Vision 2010 project to enhance stormwater management on the property through consolidation of and improvements to the existing system.

7.2.3 Master plan options

Cameco developed a number of possible PHCF site layouts after a series of user group meetings and site inspections. The site layouts were further developed into four master plan options, each of which would meet the requirements of the PHCF. Community consultation was sought on these four options. For the purposes of the Vision 2010 Project EA study, a preferred alternative will be developed that integrates various elements of the four master plan options and addresses to the extent possible the stakeholder planning objectives articulated in the Independent Advisory Report (Gartner Lee Limited, 2006) [1]. This preferred alternative will be evaluated in detail.

7.2.4 Green space

The community consultation results indicate that a "circle of green" space is highly desirable around the PHCF and, thus, a land transfer between the municipality and Cameco may be required to maximize green space. Cameco and the municipality entered into discussions with the goal of negotiating a land transfer that could make possible the preference of stakeholders, consistent with the vision of the municipality for the community's waterfront.

8. Federal EA process

The Canadian Nuclear Safety Commission (CNSC) is the federal authority responsible for the regulation of nuclear facilities in Canada. Approval from the CNSC, pursuant to the Nuclear Safety and Control Act (NSCA), is required before Cameco may proceed with Vision 2010.

In September 2006 CNSC determined that the EA for Vision 2010

would be classed as a comprehensive study, and CNSC staff are currently developing EA guidelines for the proposed undertaking. Once these guidelines are received from the CNSC, Cameco will initiate the Vision 2010 Comprehensive Study EA, which includes a substantive public communication and consultation program.

If the EA and licence amendments for the Vision 2010 project were to be completed toward the end of 2008, construction activities could commence in 2009. The work would continue for approximately six years with closeout of this project in approximately 2015.

9. Provincial and/or municipal permits

Cameco's PHCF falls under federal jurisdiction. However, any emissions to the environment from the operations associated with the project require a Certificate of Approval under the *Environmental Protection Act (EPA)* for air emissions and under the *Ontario Water Resources Act (OWRA)* for the direct discharge of water effluents. The PHCF's current Certificate of Approval for air emissions would require modification for new, permanent facilities and new certificates would have to be obtained, as appropriate, for temporary facilities associated with the cleanup.

All building demolition and new building construction will require permits from the Municipality of Port Hope.

10. Local stakeholder consultations

In the fall of 2005, Gartner Lee Limited was engaged by Cameco to design and conduct a consultation and communication program with respect to Vision 2010. Between November 2005 and January 2006, a series of targeted communications and community engagement initiatives were implemented, with the goal of including a wide and representative cross-section of the Port Hope community in open and creative discussions about how the Vision 2010 project should evolve.

During the initial community consultation process for Vision 2010, over 150 stakeholders were directly engaged and 422 responses to a mail-out questionnaire were received.

The Vision 2010 communications and consultation program included:

- a dedicated website – www.camecovision2010.info;
- a Vision 2010 1-800 information line – 1-866-383-0307;
- consultation announcements in both local print media, and on local television and radio stations;
- seven community roundtables;
- two Cameco employee roundtables;
- separate meetings with the Municipality of Port Hope Council and senior staff;
- two meetings with local environmental community groups;
- a mail-out questionnaire to every household;
- a project display at the Port Hope Public Library; and
- establishment of the Vision 2010 stakeholder liaison committee.

Specific recommendations, consistent both with Cameco's mission statement, and with the comments and suggestions heard from stakeholders, were developed during the Vision 2010 consultation process. As reported in *Cameco Vision 2010: Connecting with Port Hope's Future Independent Advisory Report* (Gartner Lee Limited 2006), the key recommendations were [1]:

- The Project should be guided by the statement: "Vision 2010 should be an award-winning, attractive, world-class project" This means being innovative and setting high standards for architectural design, facility construction, site remediation and landscaping.
- Continue the community dialogue around detailed designs and implementation of Vision 2010 through continuation of the Vision 2010 stakeholder liaison committee or working group, and related transparent and continuous community communication.
- Establish a process and structure to enable Cameco and the community to liaise on creative community development initiatives and on continual improvement in the areas of environment, health, and social and economic performance.
- Develop a preferred concept plan for Vision 2010 that addresses the specific renewal, cleanup and modernization planning objectives put forward by community members.
- Determine the best options to include public education components in Vision 2010.

Several specific stakeholder planning objectives for the Vision 2010 project were articulated by Port Hope community members during this communications and consultation program. In summary, these planning objectives were aimed at:

- maximizing green space;
- providing for indoor cylinder and drum storage;
- maximizing public access to the waterfront;
- maximizing naturalization opportunities and environmental design features;
- integrating the PHCF site with community character and waterfront plans;
- including educational, research and development components;
- enhancing Cameco's contribution to the local and regional economies;
- minimizing site emissions and environmental effects;
- attending to health issues; and
- enhancing Cameco's corporate social responsibility initiatives.

11. Cameco's enhanced community engagement

During the Vision 2010 consultation process, a number of participants felt that there were concerns outside the renewal of the conversion facility that needed to be addressed. It was these key findings along with the analysis of Cameco's operating licence mid-term record of proceeding that have helped to structure Cameco's new community outreach program geared specifically toward dealing with a wide range of community concerns and issues.

Prior to the public release of the Vision 2010 report in March 2006 Cameco began planning the new process it would use to engage the community on an ongoing basis. That process, established in May

2006, is anchored around an ongoing and broadly-based series of community liaison forums – open meetings where detailed plain-language briefings are accompanied by a variety of feedback mechanisms – workshops, questionnaires, Q&A sessions, etc.

11.1 Community liaison forum

Cameco decided to follow an open community forum model versus a committee model aimed specifically at special interest groups because it recognizes Cameco's relationship with Port Hope residents affects virtually everyone in the community and in many differing ways [2].

An open, flexible, broadly-based forum model enables the company to improve its outreach program with all its relationships as well as bringing a common information base to all interested parties, both active special interest groups and passive community members. As a result target audiences for this initiative include: near neighbours and residents of Port Hope, municipal council members, local businesses and business organizations, special interest groups, nongovernmental organizations, local and regional media, community service organizations, and all other interested parties.

The forum process is intended to improve Cameco's outreach in the four key areas highlighted in the company's sustainability report of 2005 and correspond to the findings of the Vision 2010 community consultation and record of proceeding in the CNSC's mid-term review. They are: health, safety and security, the environment, social responsibility, and the economy.

Reporting on these forums is undertaken via newsletters mailed to every mailing address in the Municipality of Port Hope. This newsletter includes a review of the forum itself as well as other items of interest to the community identified during the forum discussions. This plain-language newsletter is aimed at broadening the outreach of the forums. The newsletter reaches the encompassing target audience as well as participants.

To accompany the community liaison forum process, Cameco launched a new website (www.camecoporthope.com) to provide local residents and other interested parties with specific, detailed, plain-language information about its Port Hope operations. This is the first community-focused website in the history of Cameco. The website is being promoted extensively as a resource for Port Hope residents to learn more about Cameco's approach to health, safety and security, its environmental performance, including a plain-language environmental scorecard, its activities in the community and the economic impact of its Port Hope operations.

A recent addition to the website and the forum newsletter, supported by an advertising campaign, is a content-rich, plain-language question and answer component. This method is particularly effective in clarifying information, dispelling rumour, providing succinct information on key issues, as well as making information, both technical and general, broadly available to the entire target audience.

Also incorporated into these outreach vehicles is reporting on ongoing developments that relate to Vision 2010.

11.1.1 Forum 1 – prioritizing future forums

The first forum, held in May 2006, asked the 80 participants to set priorities for future forums in Cameco's four key areas for sustainability. The forum agenda included an introductory briefing about Cameco in Port Hope and the company's commitment to this new process over the long term. The attendees were then broken up into eight smaller groups with professional facilitators helping the groups to prioritize future forums. These breakout groups also acted as focus groups for Cameco's ongoing outreach effort [2].

Attendees for the first forum came from the list of participants of the Vision 2010 consultation process. Subsequent forums have included both invitees as well as other interested parties. All forums have been open to the public and extensively advertised to ensure that all interested parties know that a forum is upcoming.

11.1.2 Forum 2 – introduction to Port Hope health studies

The second forum, held in June 2006, responded to the recommendations of the first and had health as its focus, particularly a review of health studies done in the past on Port Hope. An expert epidemiologist from the University of Toronto was retained to conduct that review and to advise Cameco on community health issues. The breakout groups provided all attendees with the opportunity to be heard and to have their views communicated back to Cameco.

11.1.3 Forum 3 – economic impact of Cameco and Zircatec in Port Hope

The third forum, a luncheon, took place in August 2006 in conjunction with the local Rotary club. During that luncheon the findings of an economic and financial impact analysis of Cameco and Zircatec in Port Hope and Northumberland County were presented [3]. The format for this event was altered to reflect the target audience, namely the business community in Port Hope and surrounding area, although members of the public were also invited to attend.

The findings from the company's most recent public opinion research were also released – the first-time such research has been made available to the public. Interest in this event was very high with a standing-room only audience and very positive media coverage resulted.

11.1.4 Forum 4 – the regulatory process

This forum was also held in August 2006, with the CNSC staff presenting to the community about its roles and responsibilities as well as reviewing the regulatory process. The first forum identified an interest from the community to understand the regulatory process. Although not identified as one of the highest priorities by the community, Cameco recognized that due to the timing of its licence renewal application, the community would be well served to get this briefing earlier. Presenting to and receiving questions from an audience of approximately 70, CNSC staff explained to the community how to get involved in the licensing process and the role of the CNSC as a regulator of the nuclear industry.

11.1.5 Forum 5 – health panel

A daylong health forum that included a panel discussion with varying views on community health issues was held in October 2006. This forum and others that will be based on health and

environment issues are aimed at ensuring the public has a full understanding of the effects on people's health of both emissions and legacy issues. To support this effort, Cameco is actively seeking permission to post all relevant health studies on Port Hope, including author summaries, on its Cameco Port Hope website. To date, approvals from the organizations, which conducted the studies, have been very slow. Copies of all studies listed as references on the web site are available at the Port Hope library.

11.1.6 Forum 6 – environment

At a daylong forum on the environment in February 2007, Cameco sought public input to develop an emissions reduction plan for the conversion facility. Presentations were provided on the ISO 14001 certification process, background on new emission standards planned by the Ontario Ministry of the Environment, as well as information about Cameco's environmental management plan and on the conversion facility's current emissions performance. Participants were asked to identify their individual top three priorities for the plan based on information they were provided about the significant environmental aspects that pertain to emissions from the conversion facility and Cameco's current environmental performance. Approximately 95 people attended the forum.

11.1.7 Future forums

Cameco is committed to its community engagement program. Future forums will be held approximately quarterly to continue to address community issues.

11.2 Other community outreach initiatives

11.2.1 Port Hope fall fair

In an effort to reach out to members of the community about Cameco's operations and to help the community celebrate 175 years of Port Hope's Fall Fair (September 2006), Cameco placed a 40' x 60' tent on the fairgrounds and filled it with over a dozen educational displays, including two videos and two scale models of the Vision 2010 project. Every visitor was given a "passport to information", which not only provided information about the conversion facility and Zircatec, but also contained a fun series of questions that allowed visitors to find the answers by reading the displays. Over 4,500 residents toured the Cameco tent and approximately 50 employees from Cameco and Zircatec were on hand over the course of the weekend to answer visitors' questions.

11.2.2 Community walk

In October 2006, Cameco undertook its first community walk program. Employees of the facility and Zircatec volunteered to travel the streets of Port Hope for four evenings and a Saturday afternoon to provide residents with information and answer their questions about Cameco, and to invite them to the community forum on health. The objective was to follow 31 routes and reach over 1,400 households. The volunteers included members of employees' families and each visited up to 50 homes. Cameco sent follow-up letters to local residents who posed questions that the walkers were unable to answer themselves.

11.2.3 Public opinion research

Cameco has been conducting public opinion research for several years, including polling and regular media monitoring and analysis. The results show that the majority of Port Hope residents strongly support Cameco and public trust in the company is high. A survey done in June 2006 by Fast Consulting found that 80% of Port Hope residents support continuation of uranium conversion, up from 70% in June of 2005. A majority (53%) indicated that they are strongly supportive, up from 34% one year ago. The majority (82%) agree that Cameco does everything possible to ensure public safety and 74% agree that the regulatory process adequately ensures the safety and security of Port Hope residents. Vision 2010 also enjoys widespread support at 92%.

11.2.4 Ongoing activities

The above program events were in addition to Cameco's other ongoing community outreach activities. The following are some examples: quarterly updates to Municipal Council, school outreach programs, open houses, facility tours, participation in local home and trade shows, special guest speakers, etc.

In addition Cameco provides financial and other forms of support to approximately 60 local organizations, institutions and events, including the Northumberland Hills Hospital, the Port Hope Public Library, the United Way, Port Hope Soccer Club, the Capitol Theatre, the All-Canadian Jazz Festival, Cameco Women Build, Dragon Boat Races, scholarships to graduating students, etc.

12. Conclusion

Cameco's mission statement identifies supportive communities as one of four key measures of success for the company. In the context of Port Hope where local interest in the nuclear industry in general and PHCF activities in particular is perennially high, the company has a responsibility to engage the community meaningfully and substantively. Ensuring strong relationships, understanding, and mutual co-operation underpins Cameco's new approach to community outreach as it enters what promises to be a very busy 2007 with the Vision 2010 comprehensive environmental assessment.

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Commentary on NRTEE's

"Advice on a Long-Term Strategy on Energy and Climate Change"

A.I. Miller and R.B. Duffey, Atomic Energy of Canada Limited

Ed. Note: The following paper was presented at the 28th Annual Conference of the Canadian Nuclear Society. It provides a review and commentary on Canada's National Round Table on the Environment and the Economy.

Abstract

Globally, a decrease of at least 25% of 1990 emissions of Greenhouse Gases (GHGs) is needed to stabilize atmospheric GHG levels. In a World with today's population and with equitable distribution of energy usage per capita, countries such as Canada and the USA need to reduce CO_2 emissions by approaching 90%. Canada's National Round Table on the Environment and the Economy (NRTEE) has prepared a detailed review of how Canada's projected GHG Emissions could be reduced by 2050. The Study has ambitious targets for renewable energy sources, conservation, fuel efficiency and CO_2 sequestration but includes only a very small expansion of nuclear power. Although the stated aim is a 60% reduction in GHG emissions, the base year is 2003 and the Study identifies ways to achieve only a 50% reduction. Since 2003 emissions were 30.2% higher than those in the Kyoto base year (1990), the NRTEE target is substantially deficient if Canada is to achieve a fair contribution to GHG stabilization. The NRTEE Study serves to confirm the increasingly held view that "nuclear power is essential to attaining the goal of reducing emission of greenhouse gases while at the same time maintaining access to electricity" [1].

This paper reviews the NRTEE assessment and focuses on the impact of a much larger nuclear contribution than envisaged by the NRTEE Study. While the Study proposes only 9.2 GW of nuclear expansion, we show how an additional 55 GW of nuclear would result in Canada achieving a 75% reduction in GHG emissions. The rate of deployment to achieve this is within a factor of two of the actual deployment of nuclear reactors in the 1970s and 1980s.

Global Background to CO_2 Accumulation and Climate Change

Almost all climatologists and most governments now accept the link between accumulation of GHGs and rising temperatures on our planet. Modelling of details of the function by which the two are linked is exceedingly complex and so the details are very imprecise but a consensus of sorts has emerged that 550 ppm CO_2 should the upper bound beyond which there would be an unacceptably high risk of a runaway greenhouse effect – in which rising temperatures releases CO_2 from natural stores or impairs CO_2 removal mechanisms. This is partly a rationalization of suggesting a target that is technically attainable: 450 ppm would be safer but, at less than 70 ppm above the current level, is virtually unattainable. Thus, 550 ppm is the level proposed as a target by the "Stern Review [2]", a recent report prepared for the Government of the United Kingdom.

Stern further notes that attaining this stabilization will require a one-quarter reduction in CO_2 emissions by 2050 and a halving by 2100.

We stress that these are reductions in worldwide emissions and much deeper reductions by developed countries are essential to offset the rapidly rising energy demands [3] of developing economies. Table 1 illustrates the situation as it existed in 2005 and as it would exist in a world where the CO_2 footprint of all nations was at 50% of the average of European countries[i] in 1990.

Table 1: Energy consumption in Mtoe[ii] 2001 for selected regions and countries

	Oil (Mt)	Natural Gas(Mtoe)	Coal (Mtoe)	Nuclear Power (Mtoe)	Hydroelectric(Mtoe)	Total (Mtoe)	Population (millions)	toe/person	Consumption at 50% European rates	Consumption at 75% Of 1990rates	Cut needed (or increaseallowed)
USA	945	570	575	188	61	2337	300	7.8	533	370	84%
Canada	100	82	33	21	82	318	32	9.9	57	40	88%
Europei	775	536	377	251	127	2063	570	3.6	1014	704	66%
Europei (1990)	761	412	535	201	110	2020	568	3.6	1010	701	65%
Asia/Pacific	1117	366	1648	125	167	3424	2734	1.3	4862	3376	1%
China	327	42	1082	12	91	1554	1300	1.2	2312	1605	(3%)
India	116	33	213	4	22	387	1100	0.4	1956	1358	(251%)
Thailand	46	27	26	0	2	85	65	1.3	116	80	6%
World	3837	2475	2930	627	669	10537	6400	1.4	11380	7903	25%

i Excluding Russia and Belarus as well as central Asian states listed by BP under Europe.

ii Mtoe = million tonnes of oil equivalent

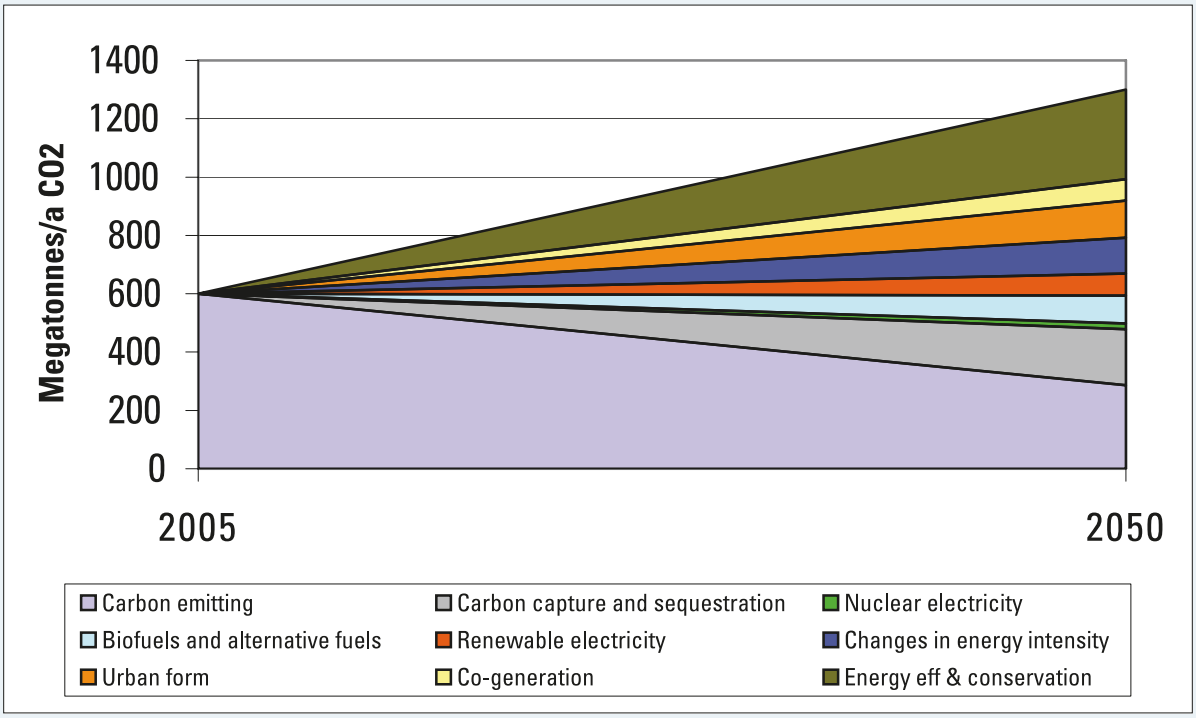

Figure 1: Projections for CO_2 Emissions by 2050 according to the NRTEE Study

The column third from the right of Table 1 shows what would happen if the CO_2 footprints of all countries were reduced to half the European level in 2001 – representative of either conversation measures on an almost imaginable scale or economic collapse. Even without allowance for future population increases, the emissions of an equitable world operating with this footprint results in a 19% increase in total emissions. With World populations expected to reach at least 9 billion by 2050, one can readily appreciate why projections of energy use virtually all expect total demand to at least double. For the world as a whole to achieve a 25% reduction in CO_2 emissions, a massive decarbonization of energy supplies is obviously an essential element.

The column second from the right shows the levels of equitable per capita emissions required to meet Stern's 25% reduction target. Note that the under-average contribution of the developing economies will not for long offset the above-average contribution of the developed economies: China's 1.2 billion population has already virtually reached the target recommended by Stern (having increased energy use by 55% in the four years to 2005); Thailand – a typical Asian emerging economy – already exceeds the target.

For developed countries such as Canada, a reduction of CO_2 emissions of 80 to 90% will be required. This will be hugely challenging and need for a cut of this magnitude does not yet seem to be widely appreciated in Canada. Canada's Clean Air Act has the stated aim of achieving by 2050 a 45 to 65% reduction of the 2003 levels. However, the 2003 level of energy use in Canada was 30.2% above that of 1990. So the Clean Air Act target is really aiming for a reduction of only 15 to 28% by 2050 when compared to the 1990 reference year.

The NRTEE has produced a draft review[4] with the stated aim of achieving a 60% reduction (based on 2003 levels) of Canadian CO_2 emissions by 2050 reduction. The review examines a very broad range of approaches to curbing CO_2 emissions but actually identifies means to accomplish only a 50% reduction. The Study's detailed analysis of what could be achieved by deployment of renewable energy sources, by conservation and efficiency increases, by reducing energy intensity, and by sequestration of CO_2 appear fairly optimistic. However, even if all of the contributing technologies deliver their assigned contributions, the Study's detailed assessment of these sources shows clearly that they are collectively incapable of delivering CO_2-emission reduction on anywhere close to the extent required for Canada to contribute an equitable footprint of GHG emissions.

The Findings of the NRTEE Study[5]

The NRTEE review is a valuable overview of possible routes to meeting Canada's energy demand in a way that is environmentally sustainable. Though the format of energy wedges, first suggested by Socolow[6], is rather simplistic, its adaptation to Canadian projections conveys important messages. As a basis for its economy, Canada is conspicuously dependent on supplying other countries with raw materials. The effect of this is particularly evident in the impact of oil sands development on Canada's CO_2 emissions and is clearly reflected in the Study's projection of an *increase* in energy demand *after allowance for the contribution of energy efficiency and conservation* of about one-third by 2050. We agree with the Study's inference that dealing with GHG emissions is far more likely to achieve political traction if living standards are not undermined. Consequently, the focus on ways to reduce CO_2 per unit of energy consumed is appropriate. To achieve this, the Study places emphasis on deployment

of low-CO_2-emitting technologies for our energy supply.

Another important point made by the Study is the importance of a clear statement on long-term CO_2 emissions policy so that our economy can make the appropriate adjustments. Industry and individuals need to know now what CO_2 emissions will cost them in the future if they are to start making appropriate choices.

However, beyond the inadequate nature of its reduction target and its failure to place Canadian action in a global context, we note two other major weaknesses in the NRTEE Study. First, it does not compare the economics of the various routes to reduced CO_2 emissions. Second, it does not convey a sufficient sense of urgency: the emphasis on 2050 as the target date for reductions is far too leisurely. This distant focus and the linear nature of the projections do not encourage vigorous near-term action.

As they have generally been used, Socolow's wedges look forward around 50 years and are linear in time. We are concerned that Socolow's approach does not encourage action in the nearer future. With that caveat, Socolow wedges are well-suited to revision by expanding, contracting and even adding wedges and so we use them here. Figure 1 reproduces the projections of the NRTEE Study as Socolow wedges.

Comments on the NRTEE Study's Individual Technology Wedges

➢ The Study places heavy reliance on "Clean Coal" technology with Carbon Capture and Storage (CCS).

While potentially important, CCS is not fully developed, has unknown economics, and its deployment and operation will produce substantial uncaptured collateral CO_2 emissions. The use of CCS to enhance oil and gas production is likely the best form of CCS but CCS's ability to retain CO_2 in geological formations for long periods is, while promising, still far from being sufficiently proven.

➢ After CCS, the Study places heavy reliance on renewables, particularly wind.

The serious limitations caused by wind's intermittency and seasonal variability are now widely appreciated. (See, for example, the studies by E.ON[7] and the Irish National Power Grid[8].) While a few percentage points of total electricity supply can be supplied by wind and other unreliable and intermittent energy sources, the experience in Germany[6] and Denmark[9] suggests the large-scale use of wind power for large industrialized economies like Canada's will be very difficult to manage. The E.ON study shows very clearly that there would be large collateral costs associated with introducing wind. These must be incurred to maintain back-up generating capacity and to strengthen transmission grids. The paper on the Danish experience highlights their total reliance on massive sources of hydro-electric power from Norway and Sweden to balance the variations in output of their wind turbines. Elsewhere, we have examined one possible way to circumvent the variability and intermittency of wind with our NuWind concept[10] in which nuclear and wind capacities are combined to supply a mixture of electricity and hydrogen by electrolysis with wind's variability absorbed by variation in the electrolysis rate.

➢ The Study's treatment of transport issues is questionable and has serious omissions.

Taking transport off petroleum is not considered: vehicles relying on both deeply pluggable hybrids and fuel cells look probable (e.g. Japan is forecasting two million hydrogen fuel cell vehicles by 2020). While this could be considered a part of improvements to vehicle efficiency, either deep hybrids or hydrogen-powered transport will entail expansions to electricity supply. For transportation, fuel cells are strangely underemphasised. They are mentioned only once in the Study as stationary power producers with the hydrogen produced from natural gas: this is not an effective way of abating CO_2 emissions. We see huge scope for transport switching either to electrolytically-produced hydrogen in fuel cells or to electricity from storage batteries. Both have particular strengths in niches within the sector: batteries for local transport; fuel cells for air, rail and sea transport.

Aircraft emissions are ignored though this is the fastest growing transport segment. For this segment, liquid hydrogen offers substantial potential as a replacement of kerosene.

The Study's reliance on biofuels is dubious. Unless based on wastes, CO_2 avoidance by deployment of biofuels is often small or non-existent; the land areas required to produce significant amounts of biofuels are huge. And this at a time when climate change will likely be placing pressure on land for food production as well as for setting aside for carbon capture.

➢ The Study's expectations for improved energy efficiency seem ambitious but may collectively be attainable.

Thus, we are comfortable with the Study's assumptions for production of cement and for iron and steel and for improvements. Expectations for improvements in the efficiency of buildings are close to those of Socolow and seem somewhat unambitious even though constrained by the long life of housing stock. Much greater use of heat pumps seems possible and likely. For lighting, we expect LEDs will oust incandescents and fluorescents within a few years.

The Study's expectation about a two-thirds improvement in the fuel efficiency of light vehicles (to 3 L/100 km) and for light and medium trucks seems attainable – especially if pluggable hybrids are widely deployed. The Study's expectation of a 50% improvement for heavy trucks seems more dubious.

➢ The Study is dependent on a large increase in natural gas use.

This is a questionable assumption since no source of increased gas supplies is identified and no attention given to the effects of natural gas leakage in the course of production and transmission. Because methane is a much more potent greenhouse gas than CO_2 (a factor of 21, per unit of volume, is usually used), leakage of a few percent can offset the lower CO_2 emissions of methane per unit of energy produced.

➢ Improvements in energy efficiency do not necessarily result in reductions in greenhouse gas emissions.

The efficiency improvement data for Canada unfortunately show a positive correlation: a10% *increase* in energy use efficiency has been accompanied by a10 % *increase* in related GHG emissions, and by *no* reduction in total or specific energy use.

➢ The Study notes approvingly how Canada's industrial sector produced 24% more in 2003 than in 1990 while using only 11.7% more energy and emitting only 1.3% more CO_2. We wonder whether the projected improvements in energy efficiency in the industrial sector are fully allowing for the improvements already made.

While an energy intensity decline of 0.1%/a for the cement industry may not be too difficult to achieve and of a cumulative 20%/tonne for iron and steel by 2050, an expected reduction of 10%/tonne.a for pulp and paper and 2.5%/a for chemicals implies a surprising degree of existing inefficiency. We believe that the implied 2/3rd reduction of the chemical industry's energy use by 2050 is unlikely for an industry that is already efficient we question the real benefit of declines in manufacturing of energy-intensive goods since this amounts to export of an energy demand.

➢ The Study assumes real benefit from declines in manufacturing of energy-intensive goods.

This amounts to export of energy demand and has no value for the Global environment and may even increase emissions through added energy for transportation.

➢ The Study says that Canada must "deploy … *all* of the potential GHG-reduction technologies at unprecedented levels of implementation". It then almost ignores nuclear power though this is already a substantial contributor to CO_2 reduction in Canada, a proven technology with undisputed low CO_2 impact, and widely included in projections of future energy supplies (e.g. all of the main scenarios presented in the Third Assessment Report of the Intergovernmental Panel on Climate Change plus the International Energy Agency study, 2006).

The NRTEE Study expects all generating capacity in Canada to increase by 2 GW/a (about 1%/a) between 2005 and 2050 – a total of 90 GW. We view this as reasonable since electricity will be a major pathway to overall reduction of GHG emissions *provided it is produced with little or no CO_2 emissions.*

While we agree with the Study's emphasis on the need to transform the electricity generation and oil and gas industries, we do not agree that CCS is the only way to tackle this. Nor do we agree that development of Canada's fossil fuel resources should be transformed solely through CCS. Nuclear power can be a major source of energy for petroleum production and is already being actively assessed for this role in the Alberta oil sands. Because nuclear power's potential for emissions reduction is underestimated by this report, we conclude this paper with a new estimate of what nuclear could reasonably contribute and its effect on CO_2 emissions.

One very modest wedge included by NRTEE is for 9.2 GW of new nuclear capacity – envisaged as being deployed entirely in Ontario. Fortunately, a much larger role for nuclear power - which we see as a major omission from the Study – can provide large leverage to the Study's recommendations and could quite easily produce an outcome with a 75% reduction in CO_2 emissions by 2050 rather than the 50% reduction identified in the NRTEE Study. While even a 75% reduction is not going to win Canada high praise from the international community, it is a reasonable target for an economy supplying rapidly expanding quantities of primary resources to the global economy.

Nuclear Power's Existing and Future Roles

In 2005, Canada's nuclear power plants produced 86 TW.h of electricity avoiding about 73 million tonnes of CO_2 emissions, avoiding what would otherwise have been a 46% increase in coal-fired generation. Nuclear also avoided emissions of 284 thousand tonnes of NOx, 327 thousand tonnes of SO_2, and 103 thousand tonnes of particulates[11]. If nuclear electricity had been produced instead from coal-fired plants, an additional 23 million tonnes of coal would have had to be burned, raising Canada's coal consumption by 71%.

Canada's current coal-fired electricity generation is around 85 TW.h/a[12]. This is very close to current nuclear generation but the coal-fired fleet is larger since it is mostly operated to meet peak demand and is utilized on average for 54% of capacity. Simply to replace all existing coal-fired electricity-generating capacity in Canada would require 18 GW of new nuclear plants and, by operating with their expected 90% capacity factor, these would also produce 57 TW.h/a of additional, off-peak electricity. This would be sufficient to fuel 4 to 5 million light vehicles switched to using fuel cells or storage batteries or about one-quarter of the 18 million cars in the registered Canadian fleet. To raise the penetration of nuclear electricity to fuelling 80% of this fleet would require the full capacity of a further 24 GW.

Canada's oil sands are expected to add 2 million barrels per day of new capacity by 2015, most of it depending on Steam-Assisted Gravity Drainage (SAGD) technology. Assuming that 1 million barrels per day of SAGD can be supplied by nuclear heat using steam injection equal to two barrels of condensate per barrel of bitumen, another 3 GW of nuclear capacity would be required (with modest co-production of electricity since steam for SAGD is mostly not required at the full pressure available from a nuclear reactor). Extending the nuclear application to produce the hydrogen required to upgrade oil sands bitumen (assume 4 kg/bbl) by electrolysis would require a further 9 GW of nuclear capacity.

With the above scenario, these three major applications of energy could be supplied by about 50 reactors of the size of the ACR-1000. This corresponds to 55 GW of generation, a reasonable figure in the context of NRTEE's projected

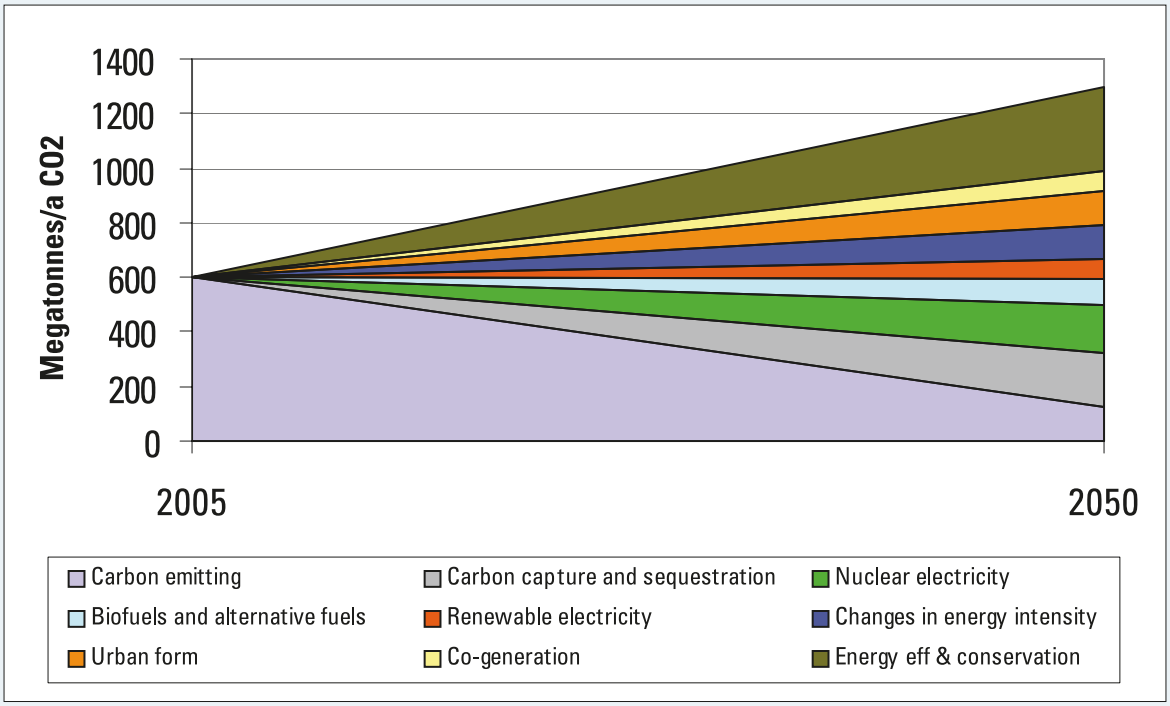

Figure 2: Projections for CO_2 emissions by 2050 according to the NRTEE Study with an enhanced nuclear role.

total increase of 90 GW, especially since we envisage deeper deployment of electrical energy in transportation. At that scale of nuclear deployment, the reduction in Canada's CO_2 emissions would go from the 50% detailed in the NRTEE Study to 75%. This would represent CO_2 emissions below one-third of the 1990 level and would allow Canada to reclaim some leadership in GHG abatement although it would remain desirable to do considerably more. This outcome is summarized as Socolow wedges in Figure 2.

We stress that this modified NRTEE scenario is illustrative only and does not include electricity-based fuel for other forms of transportation although road freight, rail and marine transport could all be fuelled by hydrogen. Fuel consumption by transportation other than cars is approximately equal to that for cars. Some penetration of the non-car transport sector could easily offset situations where other substitutions are already factored in in the NRTEE Study and leave scope for even larger nuclear deployment.

The Practicality of Nuclear Deployment

In the 17 years between 1971 and 1987, Canada brought 18 nuclear reactors into service. A new nuclear program bringing reactors on-stream in between 2015 and 2050 would require under three reactors every two years. This would not be a difficult rate to achieve, especially since, unlike the 1970s and '80s, today's reactors utilize modular construction extensively.

As a "wedge", nuclear energy would avoid emission of about 130 Mt of CO_2 – compared to advanced coal-fired technology with an assumed 60% conversion efficiency. Detailed analysis of the nuclear opportunity can be found in a number of our papers[13,14,15]. Nuclear is the one established technology with the capacity to sharply curtail global CO_2 emissions Canada, with its indigenous reactor technology, is well placed to lead globally, and the NRTEE study is seriously remiss in its neglect of the nuclear option.

The biggest single attribute of nuclear power is its extreme density: uranium or thorium contains one million times the energy content of hydrocarbon fuels. So it is affordable and easy to make provision for the confinement of all waste products – as is currently practised. The world's uranium and thorium resources (of which Canada is a major repository) are enormous and capable of sustaining world energy demand for hundreds to thousands of years. In contrast, although renewable energies are permanent sources, their energy densities are a further million times less than hydrocarbon fuels and the impact on the environment of harvesting them is enormous compared to nuclear.

The economics of nuclear power are well established – Canada having sold reactors profitably to a number of foreign countries – and compare favourably with power from renewables and compete with energy from hydrocarbons when the cost of CO_2 is included.

We believe that the NRTEE study's seriously underestimates the scope for the nuclear wedge by at least factor of five (5), by only anticipating a 9.2 GW addition to the Ontario reactor fleet.

In Conclusion

As energy vectors, we are envisaging a strong move away from hydrocarbons and toward electricity. The electricity obviously must be produced with minimal release of CO_2. As envisaged

by the NRTEE Study, some of this could come from fossil fuels adapted to use CCS but, as already noted, this technology is still under development and its effectiveness and economics are still quite uncertain. A fairly small proportion could come from renewable sources though the costs remain high and reliability and variability detract from most of them. Substantial additional deployment of nuclear energy is now widely envisaged in almost all major studies of future energy supply. For Canada, it provides a clean, safe, proven, indigenous option. Partly through existing technology and partly through evolution of new reactor types, nuclear energy's use can be extended to significant new roles where it is applied to provide heat to, for example, the oil sands as well as to unfamiliar new requirements for energy such as water desalination.

The recent Australian assessment states the nuclear case very unambiguously and we quote here two paragraphs from the report's Executive Summary[16]: "In the context of rapidly growing energy demand, particularly from developing nations, nuclear power represents the only means of limiting increased emissions while meeting the world's voracious appetite for energy. While the Committee recognises that there is a role for renewables, and certainly for greater use of efficiency measures, renewables are limited in their application by being intermittent, diffuse and pose significant energy storage problems. Renewables also require substantial backup generation, which needs to be provided by conventional baseload power sources. Promised baseload contributions from geothermal, which will be welcome, are yet to be developed on any scale.

"The Committee believes that the 'nuclear versus renewables' dichotomy, which was explicit in some submissions, is a false debate and misses the point: while renewables have a contribution to make, other than hydro and (potentially) geothermal, they are simply not capable of providing baseload power on a large scale. The relevant comparison, if one needs to be made, is between baseload alternatives. On this issue the evidence is clear—nuclear power is the only proven technology for baseload power supply which does not release substantial amounts of CO_2."

We would take issue only with the Australian report's suggestion that nuclear deployment is essential mainly for developing nations. Our analysis indicates that it is also essential for developed nations such as Canada.

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Enhanced Security in the Nuclear Industry

by Gerry Frappier, Director-General of Security and Safeguards, Canadian Nuclear Safety Commission

With the recent convergence of debate on the potential for growth in Canada 's nuclear industry, and renewed terrorist threats directed at this country, it is timely to review the security situation for Canada 's nuclear facilities and materials. After 9/11, Canada 's nuclear regulator- the Canadian Nuclear Safety Commission (CNSC)- determined that the entire industry (including its own organization) faced a need for significant enhancements in their approach to security.

With concern over the release of radioactivity due to the increased potential for sabotage or theft in this new era, a robust and comprehensive security posture was needed. The CNSC quickly implemented emergency security measures after 9/11. Six years later, the vulnerability of nuclear facilities against acts of terrorism has been drastically reduced. Security at Canadian nuclear facilities now meets or exceeds international recommendations and best practices, but the job of monitoring and improving nuclear security continues.

Canada is a world leader in uranium mining, with downstream facilities for refining, conversion and fuel fabrication. Canadian companies and institutions are also involved in nuclear research, energy production, and medical and industrial applications, and are world-leaders in radioisotope production. The *Nuclear Safety and Control Act of 1997* established the CNSC as the federal regulator for the use of nuclear energy and materials to protect health, safety, security and the environment. The CNSC also oversees Canada 's international commitments on the peaceful use of nuclear energy. The agency fulfills this mandate through a stringent licensing process, and through the development of regulations. Although licensees are responsible for implementing security measures, the CNSC develops the requirements and monitors their implementation.

Following 9/11, the CNSC undertook an emergency review of nuclear security. Within weeks, an order was issued detailing enhanced security requirements for all major facilities, such as power reactors and nuclear research and test establishments. Shortly thereafter, enhanced security requirements were ordered for a second group of installations having a lower-risk profile, including uranium refineries and fuel fabricators. A subsequent review was completed of all nuclear licensees.

At the same time, the CNSC began a thorough evaluation of the existing *Nuclear Security Regulations* based on emerging threats and their own security studies. As an issue of international concern, a great deal of work had been done in documenting international best practices by the **International Atomic Energy Agency** (IAEA). This worldwide expertise was critical in the development of new Canadian security standards. The CNSC consulted with licensees, law enforcement and intelligence agencies, other federal departments, and other levels of government. This broad review led to the **amendments** to the *Nuclear Security Regulations* in the fall of 2006. The amendments gave permanent codification to the requirements of the two emergency orders of 2001, along with additional security requirements for licensees.

Each of these measures represents a significant undertaking. For example, the construction of physical protections and vehicle barriers has taken years and a large investment to implement. Access control has been improved through state of the art dual verification systems, such as card access and biometrics. In addition, x-ray imaging and explosive and metal detection devices provide enhanced levels of screening for weapons.

In terms of the human element, nuclear power facilities previously relied mainly on unarmed guards. Off-site response forces were to be called in for serious threats, with on-site security focusing on delay. Today, each major facility is protected by well-equipped, highly trained tactical operations units. While the police would always be called in for an emergency, the on-site forces have been trained and equipped to handle anticipated threats and will intervene immediately until the police response arrives.

The design basis threat analysis is the foundation for all other measures, as has been stressed in IAEA documentation. This means investigating the characteristics of threats that facilities must be prepared to counter. It also provides the standard of protection for which the CNSC holds licensees accountable. Updated design basis threat studies were undertaken with the cooperation of the RCMP and CSIS, licensees, and jurisdictional police agencies. These involved looking at the characteristics of postulated adversaries: the history of tactics which could be used; the types of weapons and explosives to be considered; the size of attacking force which might be expected; and the types of vehicles which might be used.

While the emergency security measures instituted in 2001 remain in force under the 2006 regulation amendments, significant improvements have also been included, such as the introduction of double-fencing for new installations to enhance delays, uninterruptible power supply for critical security systems, heavily managed key controls, and new requirements for Nuclear Security Officers. Qualified practitioners in the relevant fields must now certify Officers for physical, mental and psychological fitness. Security exercises and drills are now more prescribed and more frequent, including major performance exercises involving off-site forces.

As mentioned earlier, the development of new security requirements relied heavily on the IAEA recommendations and best practices. In the planning stages, the CNSC consulted closely with the licensees themselves, as they were ultimately responsible for implementation. Facilitating these discussions was the Inter-Utility Security Working Group, established in 2002 by the major licensees. For the

most part, licensees understood from the beginning the importance of these endeavours, but it was critical to consult with them at all stages, as well as with appropriate law enforcement agencies. Successful implementation depended on the ability to justify the measures being recommended. This was aided by the international recommendations. It was also important to demonstrate the credibility of need. This was defined through communication with law enforcement and intelligence agencies. The CNSC had to demonstrate perseverance and continue to follow-up to show that the regulator took this issue as seriously as licensees were being asked to.

The CNSC security staff has grown from being a three person section to a sizeable division, with numerous security inspectors and specialists in a variety of areas, including tactical response, security systems, personal security, and intelligence analysis. They monitor the implementation of these measures to verify compliance. The costs for implementation were significant. Total capital costs for the physical protection requirements are in the range of $300 million, with ongoing costs totalling close to $60 million annually. The majority of these costs are borne by licensees.

Aside from facility protection, a major issue for the CNSC is the safeguarding of high-risk radioactive sources. There are thousands of CNSC licensees in Canada authorized to use nuclear materials. Oil pipeline operators use radiography devices, nuclear gauges are used in factories, and nuclear imaging and therapy devices are widely used in the medical fields. Any lost source represents a potential health threat. There is also a risk that sources may be diverted to malicious uses, such as the construction of a radiological dispersal device (dirty bomb). In 2006, regulatory controls were strengthened through the establishment of a **Sealed Source Tracking System** within an upgraded National Sealed Source Registry. This placed obligations on licensees to report transactions involving sealed sources, using a secure system with data managed as Protected B under the Canadian information classification system. Canada is the first country to have implemented such robust inventory tracking controls.

Nuclear fuel waste is also subject to protection under the *Nuclear Security Regulations*. Within the protective barriers of each nuclear generating station in Canada, there is enough storage space for all the used fuel produced during the operating life of the station. Such storage is required to provide safe, secure containment shielding, with resistance to extreme site conditions, and are monitored to ensure continued integrity.

The adaptation of Canadian nuclear security to the post-9/11 world is continuing. In particular, 'next steps' being considered or implemented include a more rigorous export and import control program for nuclear materials; performance testing of security personnel and systems at facilities under realistic conditions; expanding internal intelligence analysis capabilities to relay information to licensees in a timely manner; and, the corollary technical standards and guidelines which will be developed based on the amended security regulations.

In addition to the changes in operational requirements for nuclear licensees, and at the CNSC to oversee that activity, the CNSC continues to receive information from CSIS, the RCMP, the Integrated Threat Assessment Centre (ITAC), and others. As such, the CNSC follows potential threats to ensure effective response, and to improve our understanding of postulated threats for further design basis threat analyses. This information, and the CNSC's involvement in the development of additional international standards, will drive the next generation of improvements in security for Canada 's nuclear industry, assuring Canadians that our nuclear security is based on the best expert recommendations from around the world.

Physical protection requirements are based on the concept of defence in depth- this includes an integrated combination of hardware (security devices), procedures (including the organization of officers and the performance of their duties) and facility design (including layout and minimization of access to vital areas). The principal security requirements resulting from the amendments, summarised below, apply to all nuclear power plants and high-risk facilities:

- Design basis threat analysis –to take account of the postulated threat definition in the design of a licensee's physical protection system.
- Threat and risk assessment – to evaluate local threats to a licensee's facility and to account for any credible threats in the design of their physical protection system. This is more site-specific or timely than the wider-range design basis threat analysis.
- Identification and protection of vital areas – to identify and apply physical protection measures to specific high-risk areas within a nuclear facility.
- On-site nuclear response force – to establish an armed response force on-site, available 24/7, capable of making an immediate and effective intervention.
- Predetermination of trustworthiness – requires unescorted employees to have a security clearance or an authorization appropriate to their level of access, including police and intelligence background checks.
- Responsibility for granting authorizations – to clearly define the licensee's responsibility in authorization of access to facilities.
- Access control – to have appropriate procedures and devices in place to positively identify and screen persons entering a nuclear facility.
- Uninterrupted power supply (UPS) – to have an uninterrupted power supply (i.e., back-up battery power) in place to maintain the operation of alarm systems, alarm assessment systems and the various essential monitoring functions of the security monitoring room.
- Contingency planning, drills and exercises – to validate physical protection systems through regular drills, and to develop and exercise contingency plans to manage anticipated security related emergencies.
- Vehicle barriers and portals – to reduce the risk of forced vehicle penetration into a nuclear facility through physical measures.
- Supervisor awareness program – to train supervisors to recognize behavioural changes in all facility personnel, including contractors, that may indicate an increase in risk to the security of the facility.

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GENERAL news

compiled by Fred Boyd

Government orders review of AECL

On November 29, 2007, the Gary Lunn, Minister of Natural Resources Canada, announced that the federal government will hire financial experts to advise on the future of Atomic Energy of Canada Limited.

"It is time to consider whether the existing structure of AECL is appropriate in a changing marketplace," added Minister Lunn. "This review will give us the information we need to make the right decisions for AECL and the right decisions for Canadians."

The review of AECL will be led by Natural Resources Canada, with the support of the Department of Finance and full collaboration of AECL, and with the assistance of outside expertise.

Michael Burns, AECL Chairman, wrote to staff that, "During the Review, it remains business as usual. AECL will continue to pursue opportunities for growth in our existing and potential markets. I know I can count on all employees to keep focused on customers and on the tasks at hand. The Executive Management Committee and I are committed to keeping you informed during the course of the Review."

Media and opposition critics have speculated that this is the first step towards privatization of the engineering group of AECL. Earlier in the fall AECL announced the creation of two operating divisions: CANDU Reactor Division, with Ken Petrunik as president; and the Research and Technology Division, with David Torgerson as president.

Canada joins GNEP

On November 29, 2007, Maxime Bernier, Minister of Foreign Affairs Canada accompanied by Gar Lunn, Minister of Natural Resources Canada, announced that Canada would join the Global Nuclear Energy Partnership (GNEP). The formal signing of agreement with the Statement of Principles would take place in a month or two. Canada would bring the total membership to 18.

Canada has been an observer at GNEP meetings. It is understood that there had been conflicting views within the Canadian nuclear community.

President George Bush announced GNEP as part of the USA's Advanced Energy Initiative in February 2006. Under GNEP, so-called 'fuel-cycle' nations would provide assured supplies of nuclear fuel to client nations, which would generate electricity before returning the used fuel. It would then undergo advanced reprocessing so that uranium and plutonium it contained could be recycled in advanced nuclear power reactors. Waste volumes would be greatly reduced by this process, and nuclear materials would never be outside the strictest controls, overseen by the IAEA.

South Africa announced in September that it would not be signing on because it did not wish to give up the right to enrich uranium or reprocess spent fuel.

Bruce Power to buy Energy Alberta

On November 29 Bruce Power announced that it has set up a subsidiary, Bruce Power Alberta, and has signed a letter of intent to buy certain assets of Energy Alberta Corporation, the company that has been promoting the use of nuclear power in the Alberta oil sands.

Bruce Power Alberta will now begin the process toward launching a full Environmental Assessment of the Peace Country site for potential nuclear generation.

"Energy Alberta deserves great credit for progressing the dialogue around nuclear energy to the point where we feel it's worthy of further exploration," said Duncan Hawthorne, Bruce Power's President and Chief Executive Officer. "In the Peace Country region, where an application has already been made to site a nuclear plant, we have a community that wants to learn more about our technology. This is a valuable first step, but much more information needs to be shared. Our partners are serious investors and we are a proven operator, but any decisions we make will rely heavily upon having a willing host community."

As part of this transaction, Bruce Power Alberta will acquire exclusive rights to use CANDU technology in Alberta and as a qualified proponent will advance the licensing process for the Advanced CANDU Reactor (ACR) design.

Bruce Power Alberta also intends to work with the Canadian Hydrogen Association to study the potential of converting electricity generated by nuclear units during off-peak hours into hydrogen. A similar study is being conducted in Ontario, where Bruce Power currently operates six nuclear units and is in the process of restarting two more.

In 2006, Bruce Power became the first Canadian company in a generation to file a site license application with the Canadian Nuclear Safety Commission to consider building new reactors. Since then, it has held extensive community consultations as part of what is expected to be a three-year Environmental Assessment process.

That experience, tied to its successful track record of safe and reliable operations, positions Bruce Power well to complete the work begun in 2005 by Energy Alberta founders Wayne Henuset and Hank Swartout. In August, Energy Alberta filed its own site

license application after choosing a tract of private land adjacent to Lac Cardinal, approximately 30 km west of Peace River, as the potential site for a new plant.

Henuset will be staying on as an advisor to Bruce Power Alberta once the transaction is successfully completed.

Cameco Reduces Activities at Rabbit Lake

Located in northern Saskatchewan, Rabbit Lake is the longest producing uranium operation in Saskatchewan.

On November 28 Cameco Corporation announced that underground activities at the Eagle Point mine at the Rabbit Lake operation were being temporarily reduced as a precautionary measure.

The mine experienced an increase of water flow from a mining area at the same time as the capacity of the surface water-handling system was reduced due to an equipment upgrade. Limited mining activity will continue and the mill continues to operate with a small amount of stockpiled ore. This mine has encountered similar situations in the past and dealt with them successfully.

Cameco's regulators were notified of developments today. There are no safety or environmental issues associated with this event.

Increased water inflow is estimated at 40 to 50 cubic metres per hour. The mine has more than sufficient pumping capacity to deal with these levels. However, the capacity of the surface water-handling system is temporarily reduced due to previously planned upgrading that was already underway. In addition, the mine's designated water storage capacity, primarily in mined out areas underground, is sufficient to hold more than three months of the additional inflow entering the mine.

The water flow increase was from an area being mined about 90 metres below surface. All mining activities appeared normal until additional water began flowing into the area. Site crews are following customary procedures to stop the inflow.

The rock around the area is stable and Cameco's geotechnical engineers have found no evidence of weakness. The entire Eagle Point mine is located in stable, basement rock and is accessed by a ramp from surface. The company uses an open stope mining method in which the ore is drilled and blasted from a tunnel above and falls to a lower level. It is then picked up by scoop trams and transported by truck to surface.

AECL signs agreement with Russian company

On November 30) AECL signed a Memorandum of Understanding (MOU) with Russia's atomic energy agency to expand its nuclear power cooperation with that country.

The MOU between AECL and Russia's atomic energy agency, ROSATOM, was signed during a State visit to Canada by Russian Prime Minister Viktor Zubkov.

The signing ceremony on Parliament Hill in Ottawa was attended by a number of government dignitaries and AECL representatives, including Sergey Kirienko, head of ROSATOM; The Honourable David Emerson, Minister of Trade for Canada; Minister Alexey Gordeyev, Russian Co-Chair of the Intergovernmental Economic Commission; and AECL's David Torgerson, President, Research and Technology Division, and Romney Duffey, Principal Scientist.

There are currently 31 nuclear power reactors operating in Russia with a total operating capacity of about 20,800 megawatts. Russia is planning to add between 20 and 40 nuclear reactors to its fleet over the next 20 years.

Russia has previously supplied materials for AECL's pressure tubes, including those for Qinshan, and has partnered with AECL on testing the peaceful uses of weapons materials for Russia and the United States. Russia and AECL are also currently collaborating on Generation IV advanced reactor development.

Russia recently restructured their nuclear industry under ROSATOM and is a natural partner for further collaboration. The MOU sets out a number of areas in which AECL and ROSATOM have expressed their intention to co-operate in the advancement of technological development and deployment of civilian nuclear power.

AECL's intention is to bring together the specialized expertise of both AECL scientists and engineers and those from ROSATOM to move forward in a new and dynamic spirit of co-operation in advancing nuclear technologies for commercial applications.

CNA / WiN announce 2008 seminars

The Canadian Nuclear Association will hold its 2008 seminar on Thursday and Friday, February 28 and 29. It will be preceded by the all day Women in Nuclear Conference on February 27.

CNA has chosen *"Going the Distance – Nuclear Energy in the New Age"* as the theme of its seminar, while WiN's theme is *"Celebrating Excellence"*

In a departure from its usual one-day format the CNA seminar will run an extra half-day on the Friday.

WiN is offering a tour of AECL's Chalk River Laboratories on Tuesday, February 26, limited to 25 persons.

Social events include an opening reception on the Wednesday, lunch and an exhibition reception on the Thursday and breakfast and lunch on the last day.

The full program for both events and registration information can be obtained at the CNA website *www.cna.ca.*

CNSC releases Convention Report

As a signatory to the *Convention on Nuclear Safety* Canada is required to submit a review report every three years to show how it is complying with the terms of the Convention. The Canadian Nuclear Safety Commission, which is the responsible agency for preparing the report, has posted the most recent report (280 pages) on its website: *www.nuclearsafety.gc.ca*

Following are excerpts from the Executive Summary.

This fourth Canadian report demonstrates how Canada continues to meet its obligations under the terms of the Convention on Nuclear Safety (the Convention), for the April 2004–March 2007 reporting period.

During this reporting period, Canada effectively maintained — and in many cases enhanced — its measures to meet its obligations under the Convention. Enabled by a modern and robust legislative framework, these measures are implemented by a regulator and nuclear power plant (NPP) licensees that focus on the health and safety of persons and the protection of the environment.

During the reporting period, all NPP licensees fulfilled regulatory requirements. They also met expectations for most safety areas assessed by the Canadian Nuclear Safety Commission (CNSC). Although some NPP safety areas were judged to be below requirements at times during the reporting period, all safety areas at every Canadian NPP were judged in 2006 to meet or exceed CNSC requirements for the overall definition of programs as well as their implementation.

Safety-related issues that arose during the reporting period were addressed in an appropriate manner, although the resolution of many issues remains an ongoing priority. Reported events did not pose significant threats to persons or the environment (none were above level "1" on the International Nuclear Event Scale), and licensees followed up appropriately and effectively. During the reporting period, the CNSC did not have to engage in formal enforcement actions to resolve any safety-related issues at Canadian NPPs.

During the reporting period, all Canadian NPPs operated with acceptable safety margins, acceptable levels of defence-in-depth, and acceptable material and component conditions. The maximum annual worker doses at NPPs were well below annual dose limits. In addition, radiological releases from all NPPs were kept at approximately 1% of derived release limits.

During the reporting period, two licensees submitted applications to the CNSC to build new NPPs in Canada. Refurbishment of existing NPPs is also underway, and much activity is planned in the next reporting period and beyond. Various refurbishment projects involve replacing major reactor components and replacing and/or upgrading other safety-significant systems. This work will have a positive effect on safety in general and will increase some safety margins.

At the Third Review Meeting of the Convention, several actions were assigned to Canada regarding subjects that were unique to Canada or of interest to other countries. During the reporting period, the CNSC and the Canadian nuclear industry made progress in addressing the assigned actions and some major activities will continue into the next reporting period. For example, the CNSC is working to enhance the regulatory framework for both new NPPs and those that are being refurbished. Both the CNSC and the industry are also focusing on the possibility of implementing periodic safety review and on the improvement of safety margins for large loss of coolant accidents.

Finally, in response to another action on Canada, the CNSC requested a mission of the Integrated Regulatory Review Services. Pending discussion with the International Atomic Energy Agency, this mission is planned to occur in the next reporting period.

Bruce A rebuild continues on schedule

Bruce Power does an excellent job of letting everyone know how the Bruce A rebuild project is proceeding buy posting succinct reports every week on its dedicated website. To give a taste of the format and content, following is the report for the last week of November 2007.

What's New - Nov. 29, 2007

Steam generator replacement crews completed three boiler lifts in Unit 1 last week, one on Nov. 18 and two on Nov. 21. At press time, three lifts were queued up for this week, two out and one in, weather permitting. This would leave one old boiler to come out and four new vessels to go in.

The retube team removed the final end fitting from Unit 2 reactor on Nov. 23. At press time, crews were commissioning FROB (flow restricting outlet bundle) removal tools for a trial run by week's end. Installed in 238 fuel channels during reactor lay-up, the imitation bundles have to be removed before pressure tube removal.

In Unit 1, the team was scheduled to resume the removal of closure plugs from the reactor's 480 fuel channels on Nov. 30 after completing Y-drive connections and installing shielding frames on the reactor face work platforms. Earlier this month, the team removed 136 of the 960 closure plugs.

Bruce Power's Unit 1 and 2 Projects team removed two highly radioactive horizontal flux detectors from the Unit 2 reactor between Nov. and Nov. for temporary storage in the station's primary used fuel bay. The task was supported by AMEC's radiation protection team.

"The same work was completed a few years ago for Units 3 and 4 Restart," said Ron Zachariah, First Line Manager. "This time there was quite an audience, safety-wise, to ensure lessons-learned were implemented."

The same detectors, used to help monitor reactor conditions during operation, will be replaced in both Units 1 and 2 prior to restart.

Operations crews successfully tested new enhancements to the Control Equipment Room Powerhouse Emergency

Venting System (CER PEVS) on Nov. 25. Installed by the Unit 1 and 2 Projects team, the panels are designed to prevent steam from entering the Control Equipment Room if a large steam line was ever to break.

AMEC support crews working with operations staff began draining the heavy water moderator out of the Unit 1 reactor on Nov. 19. Similar work was completed in Unit 2 in August. Crews are working with dehumidification equipment to dry out the connecting auxiliary systems as critical-path retube activities permit in both reactor vaults.

Transmission delay concerns Bruce Power CEO

Duncan Hawthorne, CEO of Bruce Power, has expressed concern about the delay in the construction of a needed new transmission line from the Bruce site to Milton, Ontario, northeast of Toronto.

In a talk to a local business group Hawthorne said that if Hydro One defers construction of the line Bruce Power will not be able to proceed with refurbishment of both Units 3 and 4 of the Bruce A station.

Hydro One is not communicating effectively with the people affected by the new line, he said.

(Deja vue – a similar problem developed at the time of the construction of Bruce A, when property owners along the way managed to delay the needed transmission line until after the completion of the plant. FB)

Controversy continues at Port Hope

Probably the most active anti-nuclear campaign in Canada has been going on in the Ontario town of Port Hope, the home of Cameco's processing plant and Zircatec's fuel manufacturing plant.

Although their numbers appear to be small, two anti-nuclear groups, FARE – Families Against Radiation Exposure – and The Port Hope Community Health Concerns Committee, have maintained a very active campaign.

Spurred on by the detection, a few months ago, of uranium contamination outside the Cameco plant the latter group had nine selected people tested by a UK laboratory called the Uranium Medical Research Centre which reported that five had elevated concentrations of uranium in their urine. The Committee issued the report with great fanfare in Toronto and the general media accepted it without question.

Dr. Jack Cornett, head of Health Canada's Radiation Protection Bureau, informed Port Hope Council that the levels found were within the range typical for the general population, but that did not stop the claims of the "anti" groups.

The local paper, the Port Hope Evening Guide, has been full of letters from the criticizing groups and, increasingly, from other citizens fed up with the negative image the criticism has given the town.

There does remain the low level contamination from historic operations of the original, pre Second World War, radium refinery of Eldorado Mining and Refining. A federally funded Low Level Radioactive Waste Management Office is over-seeing a final disposition of identified waste.

OECD/NEA issues statement on qualified human resources

In November 2007 representatives from OECD/NEA member countries unanimously adopted a statement on the need for qualified human resources in the nuclear field.

The adoption of this statement reflects concerns about the difficulties nuclear institutions in many OECD/NEA member countries are experiencing in recruiting qualified specialists. Recent studies have also shown that nuclear education and training have been suffering declines of various degrees. If no action is taken on this issue, the nuclear sector risks facing a shortage of qualified manpower to ensure the appropriate regulation and operation of existing nuclear facilities as well as the construction of new ones in those countries wishing to do so.

The NEA makes three recommendations to its member governments.

- that regular assessments are carried out of both the requirements and availability of qualified human resources to match identified needs
- governments, academia, industry and research organizations should collaborate both nationally and internationally
- governments, whether or not they chose to use nuclear energy, should encourage large, high-profile, international research and development programs.

50th Anniversary of Windscale Accident

On October 10, 1957, a fire broke out in one of two reactors at the Windscale site (now called Sellafield) in the United Kingdom.

The gas-cooled, graphite moderated reactor, which was primarily for the production of plutonium, was undergoing an annealing operation to remove stresses in the graphite when the release of the Wigner energy created by irradiation caused a runaway heating and subsequently burning of the graphite.

The fire was brought under control by flooding the core with water and turning off the cooling fans.

No one was directly hurt by the accident but a large amount of radioactive iodine was released, contaminating milk. This led to major studies of the effects of radioiodine and a focus on its release in reactor accident evaluations.

The IPCC Synthesis Report

by Fred Boyd

On November 17, 2007 the International Panel on Climate Change issued its Fourth Assessment Report, sub-titled Climate Change 2007: Synthesis Report.

The 76 page Synthesis Report is based on the assessment carried out by the three Working Groups of the IPCC. It provides an integrated view of climate change as the final part of the IPCC's Fourth Assessment Report. A 23 page "Summary for Policymakers" has been the most quoted document.

Six topics are covered.

Topic 1 summarizes observed changes in climate and their effects on natural and human systems, regardless of their causes;

Topic 2 assesses the causes of the observed changes;

Topic 3 presents projections of future climate change and related impacts under different conditions;

Topic 4 discusses adaptation and mitigation options over the next few decades and their interactions with sustainable development;

Topic 5 assesses the relationship between adaptation and mitigation on a more conceptual basis and takes a longer term perspective;

Topic 6 summarizes the major robust findings and remaining key uncertainties in the assessment In the introduction to the full report the IPCC presents the following illustration.

Following are the key statements highlighted in the Summary for Policymakers.

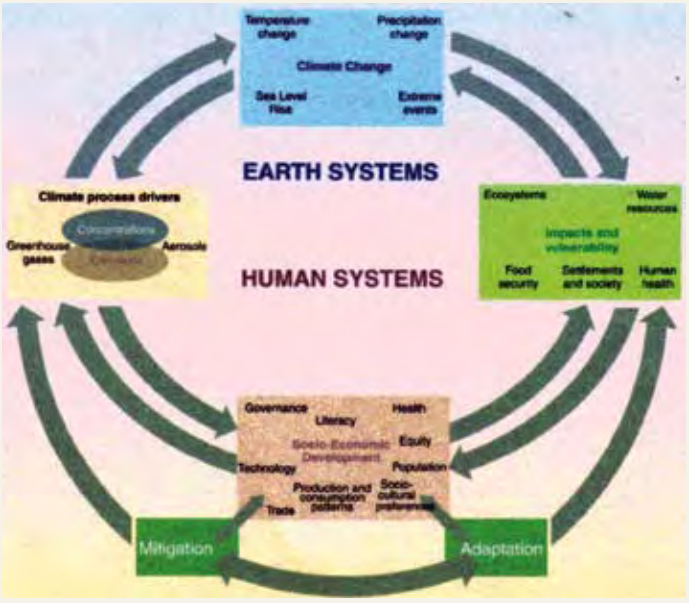

Figure 1: Schematic framework representing anthropogenic drivers, impacts of, and responses to climate change, and their linkages.

1. Observed changes in climate and their effects

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level
- Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases
- Their is medium confidence that other effects of regional climate change on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers

2. Causes of change

- Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004
- Global atmospheric concentrations of CO_2, methane (CH_4) and nitrous oxide (N_2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years
- Most of the observed increase in globally-averaged temperatures since the mid 20thcentury is *very likely* due to the observed increase in anthropogenic GHG concentrations. It is *likely* there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)
- Advances since the Third Assessment Report show that discernible human influences extend beyond average temperature to other aspects of climate
- Anthropogenic warming over the past three decades has *likely* had a discernible influence at the global scale on observed changes in many physical and biological systems

3. Projected climate change and its impact

- There is *high agreement* and *much evidence* that with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades
- Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global system during the 21st century that would *very likely* be larger than those observed during the 20th century
- There is now higher confidence than in the Third Assessment

Report in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extremes and sea ice

- Studies since the Third Assessment Report have enabled more systematic understanding of the timing and magnitude of impacts related to differing amounts and rates of climate change
- Altered frequencies and intensities of extreme weather, together with sea level rise, are expected to have mostly adverse effects on natural and human systems
- Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if GHG concentrations were to be stabilized
- Anthropogenic warming cold lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change

4. Adaptation and mitigation options

- A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to climate change. There are barriers, limits and costs which are not understood
- Adaptive capacity is intimately connected to social and economic development but is unevenly distributed across and within societies
- Both bottom-up and to-down studies indicate that there is *high agreement* and *much evidence* of substantial economic potential for the mitigation of global GHG emissions over the coming decades that could offset the projected growth of global emissions or reduce emissions below current levels. While top-down and bottom-up studies are in line at the global level there are considerable differences at the sectoral level
- A wide variety of policies and instruments are available to governments to create the incentives for mitigation action. their applicability depends on national circumstances and sectoral context
- More options for reducing global GHG emissions through international cooperation exist. The is *high agreement* and *much evidence* that notable achievements of the of the UNFCCC and its Kyoto Protocol are the establishment of a global response to climate change, stimulation of an array of national policies, and the creation of an international carbon market and new institutional mechanisms that may provide the foundation for future mitigation efforts. Progress has also been made in addressing adaptation within the UNFCCC and international initiatives have been suggested
- In several sectors, climate response options can be implement to realize synergies and avoid conflicts with other dimensions of sustainable development. Decisions about macroeconomics and other non-climate policies can significantly affect emissions, adaptive capacity and vulnerability

5. The long-term perspective

- Determining what constitutes "dangerous anthropogenic interference with the climate system" in relation to Article 2 of the UNFCCC involves value judgements. Science can support informed decisions on this issue, including by providing criteria for judging which vulnerabilities might be labelled "key"
- The five "reasons for concern" identified in the Third Assessment Report remain a viable framework to consider key vulnerabilities. These "reasons" are assessed here to be stronger than in the report. Many risks are identified with higher confidence. Some risks are projected to be larger or to occur at lower increases in temperature. Understanding about the relationship between impacts and vulnerability has improved
- There is *high confidence* that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change
- Many impacts can be reduced, delayed or avoided by mitigation. Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. Delayed emission reductions significantly constrain the opportunities to achieve lower stabilization levels and increase the risk of more severe climate change impacts
- There is *high agreement* and *much evidence* that all stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers
- The macro-economic costs of mitigation generally rise with the stringency of the stabilization target. For specific countries and sectors, costs vary considerably from the global average
- Responding to climate change involves an iterative risk management process that includes both adaptation and mitigation and takes into account climate change damages, co-benefits, sustainability, equity and attitudes to risk

(The only place nuclear power is mentioned is in a table in section 4 where it is included as one of several mitigation technologies in the energy supply sector.)

Global Governance Key To A Sustainable Energy Future

Ed. Note: The World Energy Congress held their 20th meeting in Rome on 11-15 November 2007. Below are their conclusions.

Conclusions
World Energy Congress
Rome, Italy
11-15 November 2007

To achieve a sustainable energy future will require an unprecedented level of global cooperation between industry and government, and deeper integration of regional and international energy markets, the World Energy Council said Thursday at the conclusion of its 20th World Energy Congress.

The three years leading to the Montréal 2010 World Energy Congress will determine the next 30 years of our energy system. To foster a high level of cooperation during these crucial years, WEC is expanding its global mandate, which will address the three most important challenges of energy sustainability: eradicating energy poverty, setting the global value of carbon, and establishing global rules of energy trading and investment amid growing energy nationalization.

To guide these decisions, WEC's new global mandate will from today include the following responsibilities:

A global framework to curb greenhouse emissions beyond 2012 that will also ensure a stable carbon price Global rules of energy trade and investment New financial schemes limiting investment risk and offering realistic returns More government engagement and public-private partnerships to address increasing global energy interdependence, a key strategy to eradicate energy poverty

Increased input by industry will lead to more effective government policies that ensure investment incentives are maximized for the long term. Substantial investments are needed to double global energy supplies by 2050 and will also result in lower energy intensity without a consequent rise in carbon emissions.

"WEC is optimistic a third energy revolution can be accomplished if urgent action is taken to vigorously pursue all energy options," said André Caillé, outgoing WEC Chairman. "Industry has all the latest available technologies needed to develop fossil fuels, nuclear, large hydro and renewables that reconcile development with climate change."

WEC believes fossil fuels will remain a main fixture of the world's energy supply for the next generation, but more spending on research and development of new technologies is needed to deliver cleaner and alternative forms of energy and to boost energy efficiency. Energy conservation must also become a high priority for future energy security.

"The Rome Congress has energized discussion of Italy's energy policy and highlighted the need to open public debate on the role of nuclear power," said Chicco Testa, Vice Chair of the WEC Rome Congress 2007.

Nuclear power will be an important and growing share of the energy mix. A global reduction in emissions will require an important focus on transport, including on the global development of biofuels.

"Our goals should be to move now towards responsible economic development, climate protection and the reduction of global inequalities. We have to act quickly to address those global issues involving governments and companies as well as individuals. With its worldwide membership, WEC is the perfect organization to assemble all stakeholders, which is vital to elaborate the concrete solutions we need today," said Pierre Gadonneix, Chairman of the World Energy Council, Chairman and CEO of Electricité de France.

www.worldenergy.org

Canadian Nuclear Achievement Awards

Each year, the Canadian Nuclear Society joins with the Canadian Nuclear Association to present awards to individuals and groups that have contributed significantly to the Canadian nuclear program.

A booklet describing the various awards and their criteria will be mailed to all on the CNS and CNA mailing lists in January 2008.

Read the booklet or go to the CNS website: www.cns-snc.ca for a description of the various categories and criteria.

Everyone in the Canadian nuclear program is urged to look around and identify persons or groups that should be honoured.

Then contact Doug Hink, Chair of the CNS / CNA Honours and Awards Committee – email: dhink@adhtechnologies.ca

McMaster University
Department of Engineering Physics

TENURE-TRACK FACULTY POSITION
NUCLEAR ENGINEERING

The Department of Engineering Physics at McMaster University invites applicants for a tenure-track faculty position in the area of Nuclear Engineering. The appointment is at the Assistant or Associate Professor level, however, consideration will also be given to exceptional candidates at the Full Professor level. This position will expand upon current McMaster expertise in nuclear engineering, nuclear safety and energy studies.

The applicant should have expertise in the field of nuclear reactor physics, plant/core designs, nuclear fuel cycles and advanced reactor concepts and be interested in developing a strong research program in these areas. This position will build upon departmental expertise in nuclear engineering, thermalhydraulics, reactor physics, and nuclear safety as well as the existing facilities and experience available through the McMaster Nuclear Reactor, the McMaster Institute for Energy Studies and the McMaster Institute for Applied Radiation Sciences. For detailed information on Department activities, research, and teaching please consult our web page at http://engphys.mcmaster.ca.

Applicants must have a Ph.D. in Engineering, Applied Physics or a closely related discipline. The successful applicant will be expected to develop an effective research program in nuclear engineering and must also demonstrate a strong commitment to teaching and curriculum development at both the undergraduate and graduate levels. The Department expects the successful candidate to become registered as a Professional Engineer in the Province of Ontario, and will provide assistance for this process.

Interested applicants should send a letter of application, curriculum vitae, statements of teaching and research interests, a selection of research publications, and the name and addresses of at least three references to:

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

This position is available immediately and will remain open until filled. Applications by e-mail will not be accepted.

All qualified applicants are encouraged to apply; however, Canadian Citizens and permanent residents will be given priority. McMaster University is strongly committed to employment equity within the community, and to recruiting a diverse faculty and staff. The University welcomes applications from all qualified applicants, including women, members of visible minorities, Aboriginal persons, members of sexual minorities, and persons with disabilities.

Book Review

SMELLING LAND
The Hydrogen Defence Against Climate Catastrophe

by David Sanborn Scott, Canadian Hydrogen Association (2007) ISBN 978-1-896881-73-7

This book is a "must read" for professionals engaged in the study of world energy futures. David Scott has put together a cogent series of arguments for and against various energy options. Those arguments lead to the conclusion that electricity and hydrogen (both produced from uranium-fueled generating stations) are the energy "currencies" of the future. He also provides many credible arguments concerning the feasibility of some of the other options proposed today.

The title of the book is easily understood by a mariner – when one smells land, there is danger. This sense of danger in our voracious consumption of fossil fuels – about one thousand barrels per second worldwide – is communicated clearly in Scott's text, and is confirmed today by many others, including Peter Tertzakian ("One Thousand Barrels a Second"), by Fatih Birol of the IEA, and by Matthew Simmons ("Twilight in the Desert"). Scott emphasizes the problems associated with global warming as well as those of energy supply.

Given such a broad undertaking, one cannot expect perfection in this sort of work. Some people will argue (some vehemently) against some of Scott's conclusions. Others will notice that the various Chapters are not perfectly interlinked – the writing of this textbook spanned a period of several years. Nonetheless, the book provides an excellent guide to disciplined examination of our energy future, a guide that can and will contribute positively to the ongoing discussion.

Dan Meneley
AECL Engineer Emeritus

Publications

CNSC issues new regulatory documents

Earlier this fall, the Canadian Nuclear Safety Commission introduced a single classification nomenclature for its regulatory documents. The new "RD" (regulatory document) class of documents will consolidate information of a broader nature on specific regulatory matters.

At the Commission's September meeting (not "hearing") CNSC staff presented five RD documents for consideration. The Commission approved three for issuance and two for publication for further consultation.

The three approved documents are:

RD-310 *Safety Analysis for New Nuclear Power Plants*

This document sets out expectations related to safety analysis, including the selection of events to be analyzed, acceptance criteria, safety analysis methods, and safety analysis documentation and review.

RD-204 *Certification of Persons Working at Nuclear Power Plants*

This document sets out competency criteria that must be met by persons in key operating positions working at nuclear power plants.

RD-360 *Life Extension of Nuclear Power Plants*

This document sets out expectations for nuclear power plant life extension projects

The following two documents have been issued for consultation

RD-346 *Site Evaluation of New Nuclear Power Plants*

This document sets out expectations for site evaluations for new nuclear power p!ants.

RD-337 *Design of New Nuclear Power Plants*

This document sets out expectations for the design of new nuclear power plants, consistent with modern standards and codes.

Copies are available from the CNSC website: www. nuclearsafety.gc.ca

"From Here To There" – The View From The CNS President's Seat

Exciting times. During the past few months the industry celebrated the 50th Anniversary of AECL's National Research Universal (NRU) Reactor in Chalk River (with the promise of many productive years to go), witnessed Canada's Global Nuclear Energy Partnership (GNEP) announcement, and been inspired by Bruce Power's announcement regarding possibilities in Ontario and Alberta. While Environment Canada is predicting the coldest winter in the past fifteen years, world leaders are gathering in Bali, Indonesia, to plot out the world's post Kyoto strategy. The interest in the world's climate and environment has never been greater, and the nuclear industry is well positioned to contribute in a very significant way.

What does this mean to us? The CNS's mandate is to promote the exchange of information in the nuclear sciences and engineering. The CNS's membership Chair reports a steadily increasing membership over the past seven years, an average of about 10% per year. The interest in specific courses and conferences also continues to rise, with no less than thirteen planned over the next few years. All this has placed considerable strain on our largely volunteer society. Our thanks to Drs. Murray Stewart and Robert Hemming for undertaking a study to review the best society practices in use, and to make recommendations as to how the CNS might best prepare to these future challenges.

The decisions facing our industry are largely political, and hence largely influenced by public opinion. We know that the technology works, that it is a safe, clean and cost effective form of generation, and that we can resolve the current and future technology questions. But each of us needs to do more. Each of us needs to do everything we can to ensure that an informed public ultimately makes the decision.

Your knowledge and experience is needed in the public debate in your area. While the CNS can not lobby, we can talk to the technology and the proven benefits thereof. We can all do our bit to ensure that the factual details are made available to the voting public.

These are intense times for our industry. Great performance, on schedule, on budget, "get it right the first time" are all obvious industry must do's. We must all treat everything that we are doing in this business as though it was on the 'critical path'. There is no place for complacency on any of our parts if this technology is going to realize its full potential. This attitude must start with each of us.

While there are a great variety of viable future options available in this business, we must all understand that they are confusing to the public and hence to the decision makers. We can not expect the decision makers to unravel the maze of options presented, and somehow select the optimum path forward. We must do our best to simplify the various paths forward, and reach greater agreement on the path that we as an industry collectively believe is best. Think about the various technologies available. Examine the pros and cons of once through fuelling processes and reprocessing. What do we really need in the way of permanent slightly used fuel storage? We can then start to understand that our pleas for their support, amongst the countless others that our decision makers receive, is nothing less than overwhelming. We must all do more to help them help us.

As a politician recently said to us: "do not come to us with your good ideas and expect us to choose for you".

And "if we allow the informed to be divided, then we are setting ourselves up for the uninformed to make the decision".

I had the pleasure of attending an American Nuclear Society (ANS) Teacher's Workshop in Washington recently. The one-day seminar was a 'very' hands-on enjoyable experience. The attendees had fun. The workshop explained the basics in layperson terms, and the attendees left the seminar with a multitude of practical, easy to administer, educational, and enjoyable activities. As well as copies of the understandable materials, each attendee took a working Geiger Counter back to their school. In an environment where over 75% of our educators are not qualified to teach mathematics and or science, these youth professionals left confident that they were prepared to teach the basics of our technology to their charges. The session was educational for the attending teachers as well. The quote of the day for me was one teacher who proclaimed after the session that they "had no idea that radiation was such an integral part of their lives, with so many beneficial qualities. Why didn't you tell us about this sooner."

The Teachers Workshop included such topics as: An introduction to radiation, hands on activities including 'seeing the unseen' (scattering experiments), modelling radiation types, half life activities, modeling decay, radiographs, cloud chambers, and Geiger Counters. Seminar presentations included: nuclear power for electricity generation; radiation in medicine; industrial, agricultural, and other applications of nuclear sciences and technology; nuclear waste and transportation; space applications; radiation monitors and how to use them; and Risk – How Safe is Safe Enough? Career opportunities at all levels were also discussed.

It was a pretty comprehensive program fitted into a one-day introduction. And it did not end there. Resources and contacts

were also made available for future use by the Teachers.

We have been involved with similar programs in Canada over the years. The "CanTeach" Program, the Deep River Science Academy, and 'Women In Nuclear's' young women's program. We need to greatly expand these programs, and each ask what we can do to educate those who are interested in our communities. My personal experience is that the schools are interested, that youth will attend such sessions (school professional development days off / youth group activities), and that companies are willing to support such activities. And great understandable time proven material is already readily available.

What are missing are folks like you and I to make it happen. I challenge each of you to think about the need of our technology at this time, of what you have to offer, and then do something about it. I suggest that the CNS Branches are in a good position to coordinate the challenge, and bring them to fruition. I note that some Branches are doing an excellent job in this area. Overall, however, we can all do better.

Our youth are our decision makers of tomorrow. They have already demonstrated their interest in the environment. We all know we desperately need more young people interested in the sciences, technology, and trades, and especially nuclear. Let's do our bit to encourage our youth to consider careers in nuclear/

As the expression goes: "If It Is To Be, It Is Up To Us".

Eric L. Williams, P.Eng
canoe.about@bmts.com

"Badge-Draw" Winners at the 2007 October CNS Reactor Safety Course

At the end of the CNS CANDU Reactor Safety Course, on October 3, 2007, 11 prizes were awarded by random draw from among badges returned by Course attendees.

The winners:

- Ray Kadkhodaie, of Areva NP Canada Ltd., won a CNS multitool
- Hugo Lécuyer, of Nucleonex Inc., Sanya Simic-Stefani, of AECL, and Nawal Chishty, of OPG, each won a CNS silk tie
- Dragana Zivkovic, of OPG, and Maryam Eskandari, of AECL, each won a book
- Maliha Masroor, of AECL, won a historical piece of graphite from the original ZEEP reactor at Chalk River
- Brian Phelps and Michael Aydogdu, of AECL, each won a CNS sweatshirt
- Tianjing Chen, of the University of Waterloo, won a CNS golf shirt
- Charles Hickman, of New Brunswick Power, and Gilles Beaulieu, of GE-Hitachi Nuclear Energy Canada, each won a complimentary CNS membership good to end of 2008

Congratulations to all the winners!

Gagnants de prix au tirage des porte-insigne au cours 2007 (octobre) de la SNC sur la sûreté des réacteurs

À la fin du cours sur la sûreté des réacteurs, le 3 octobre 2007, 11 prix ont été tirés au sort parmi les porte-insigne retournés par les participants au cours.

Voici les gagnants des prix:

- Ray Kadkhodaie, d'Areva NP Canada Ltd., a gagné un ensemble d'outils de la SNC
- Hugo Lécuyer, de Nucleonex Inc., Sanya Simic-Stefani, de l'EACL, et Nawal Chishty, d'OPG, ont chacun gagné une cravate en soie de la SNC
- Dragana Zivkovic, d'OPG, et Maryam Eskandari, de l'EACL, ont chacune gagné un livre
- Maliha Masroor, de l'EACL, a gagné un morceau historique de graphite du réacteur ZEEP à Chalk River
- Brian Phelps et Michael Aydogdu, de l'EACL, ont chacun gagné un chandail sport de la SNC
- Tianjing Chen, de l'Université de Waterloo, a gagné une chemise de golf de la SNC
- Charles Hickman, d'Énergie Nouveau Brunswick, et Gilles Beaulieu, de GE-Hitachi Nuclear Energy Canada, ont chacun gagné une adhésion gratuite à la SNC jusqu'à la fin de 2008.

Félicitations à tous les gagnants!

Welcome New Members

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

Payam Bahadorani, UOIT

Ardevan Bakhtari, Promation Engineering

Jeffrey James Baschuk, AECL

Gilles Beaulieu, GE - Hitachi Nuclear Energy Canada

Paul (Leopold) C. Berthiaume, AECL

John Clifford Bird, Bruce Power

Duane T. Bratt, Mount Royal College

Jaleel Mohamed Cassim, UOIT

Brian Chan, Technical Standards & Safety Authority

Woo-Jae Cheong, AECL

Bruce Edward Conning, Atomix Nuclear Services Incorporated

Emily Catherine Corcoran, Royal Military College of Canada

Daniel Côté, Canadian Nuclear Safety Commission

David Drinnan, Nocturne Communications Inc.

William Christopher Eason, Staubli Corporation

Peter Easton, Natural Resources Canada

Daniel Fournier, Hydro-Québec

Nava C. Garisto, Senes Consultants Limited

Brian Jin-Soo Gihm, AECL

Ryan Floyd Griffin, Hitachi Canadian Industries Ltd.

Gurmeet Singh Guliani, GE - Hitachi Canada

Scott Henuset, Energy Alberta Corp.

Paul Scott Hinman

Robert S. Howell, Savannah River National Laboratory

Brett Edward Hunsley, UOIT

Guy Huntingford, Energy Alberta Corp.

Steve Kamajian, Energy Alberta Corp.

Marin Kassakov, École Polytechnique de Montréal

Doddy Kastanya, AECL

Nous aimerions accueillir chaudement les nouveaux membres suivants, qui ont fait adhésion à la SNC ces derniers mois.

Randy Krishna Lall, UOIT

Hugo Lécuyer, Nucleonex Inc.

Gordon Robertson Leighton, Leighton Consulting

Yun CE Liang, University of Toronto

Huizhi Ling, University of Ottawa

Zhiyi Liu, Simon Fraser University

Steven Long S., Long Technical Consultations

Nadia Nan Ma, Neill and Gunter Limited / Pt. Lepreau GS

Michael Gerard McGill, NB Power Nuclear

Soorena Merat, Wardrop Engineering Inc. Nuclear Division

Derek F.C. Millar, Ian Martin Limited

Richard Moffett, EACL

David Montanari, Istituto Nazionale di Fisica Nucleare

Grant I. Nixon, MDS Nordion

Wargha Peiman, UOIT

Ricardo T. Perez-Concepcion, McMaster University

Sophie Pham, Nucleonex Inc.

Daniel Julius Pohl, McMaster University

Paul (Paulo) Ponomarev, Saugeen District Secondary School

Marata Ramakrishna Rao, Nuclear Power Corporation of India Limited

Djamila Sekki, Institut de Génie nucléaire, Ecole Polytechnique de Montréal

Muhammad Suleman, UOIT

Sajjad H. Syed, AECL

Catherine Anne Vizmuller, McMaster University

Lei Wang, Royal Military College of Canada

Jun Xue, McMaster University

Lawrence Y. Yu, Ontario Power Generation

Zhe Yu, UOIT

CNS meets more science teachers by Brian White

The CNS Education and Communication Committee (ECC) hosted an exhibit booth at the Science Teachers' Association of Ontario (STAO) Annual Conference in Toronto held November 15-17. (The previous booth experience at STAO 2006 was reported in the CNS Bulletin, 27, No. 4 pages 52-53.) The booth space was shared once again with Visions of Science Network for Learning. Both Atomic Energy of Canada Limited and Ontario Power Generation had exhibit booths at this conference.

Over the 2½ days the CNS booth was staffed by Bob Walker (OPG, PWU), Ben Rouben (CNS), Jeremy Whitlock (CNS ECC / AECL), Bryan White (CNS ECC), Ginni Cheema (CNS, WiN, Candesco), Jad Popovic (CNS ECC, WiN), Fahad Haseen (CNS, Candesco), and Evan Houldin (CNS, Candesco). (Bob, Bryan, Ginni, and Evan also attended the CNS booth in 2006.)

The booth included a mousetrap demonstration of a chain reaction and the Aware Electronics RM-80 Geiger system. Clumping cat litter (powdered bentonite clay) was introduced with NoSalt® (KCl) to demonstrate NORM sources that are conveniently available in grocery stores. Six fact sheets – 3 revised and 3 new ones were available in both English and French. (These are all available on the CNS web site Education page.) The WANO World Map of nuclear power stations was available as a 12" x 18" colour poster. The CNA supplied copies of the 2007 handbook.

Photo of Julianne Burton of St. Jean de Brébuf Secondary School, York Catholic District with Jad Popovic receiving her RM-80 Geiger system.

The CNS Tangle Jr.®

The teachers who visited the booth left with over 150 pre-packaged sets of fact sheets, and 133 registered for the booth draw prizes. The prizes included 3 RM-80 Geiger systems (1 in 2006), and copies of Douglas Lightfoot's "Nobody's Fuel" DVD. The Geiger system winners are: Julianne Burton of St. Jean de Brébuf, York; Jaspal Ugrha of C.W. Jefferys Collegiate, Toronto; and Kirsten McCoy of Iroquois Ridge HS, Oakville.

Jeremy Whitlock presented a workshop at 12:30 on Thursday for elementary teachers entitled: "Nuclear Energy – the factor of one million" that targeted the Grade 6 unit on electricity. Those attending included only three teachers. The workshop included instructions and a "kit" for demonstrating a human chain reaction using ping-pong balls. Alas, the attendance at the workshop was insufficient to execute it.

A special item was available as a token for especially interested teachers who visited the CNS booth. Cerenkov-blue, Tangle Jr.® toys bearing the CNS name and website were received with enthusiasm by the more than 100 lucky recipients (www.tangle-toys.com).

CNS Membership Renewal Time

Time to renew your CNS membership for 2008 (and more)! By the time you read this, you will probably have already received your CNS membership-renewal form. And you certainly don't want your membership to lapse! If you have not yet returned your renewal form, please take a moment to do it now. If for any reason you have not received a renewal form, you can simply copy one from the CNS website at www.cns-snc.ca.

Thank you!

Note: Your individual CNS ID number is shown on your renewal form, and it also appears on the CNS membership card which you receive every year. Keep your card and ID number handy – it is proof of your membership, and you are asked for it when you register to a CNS Conference or Course!

Ben Rouben
Chair, Membership Committee

Renouvellement d'adhésion à la SNC

C'est le moment de renouveler votre adhésion à la SNC pour 2008 et plus ! Quand vous lirez ceci, vous aurez sans doute déjà reçu votre formulaire de renouvellement. Et vous n'aimeriez certainement pas perdre les bénéfices de votre adhésion ! Si vous n'avez pas encore renvoyé votre formulaire, veuillez prendre un petit moment pour le faire tout de suite. Si par hasard vous n'avez pas reçu de formulaire de renouvellement, vous pouvez en copier un du site web de la SNC, à www.cns-snc.ca.

Merci bien !

Ben Rouben
président du comité d'adhésion

N.B. : Votre numéro de membre de la SNC apparaît sur votre formulaire de renouvellement, ainsi que sur votre carte de membre, que vous recevez chaque année. Veuillez garder votre carte et votre numéro de membre à portée de la main – c'est votre preuve d'adhésion, et on vous le demande quand vous vous inscrivez à une conférence ou à un cours de la SNC !

CNS members among AECL awardees

Three CNS members were among the employees of Atomic Energy of Canada Limited that the company honoured this fall in its Employee Awards of Excellence program.

Laurence Leung and **Yu-Jun Guo** were members of the **Boiling-Length Average (BLA) team** who was honoured for their exceptional contribution in developing a methodology for calculating critical heat flux that shows significant gains in critical channel power and four to six per cent increases in Neutron Overpower Protection set points. This new methodology resulted in increased reactor power output, a simplified licensing approach related to safety margins across CANDU plants, and increased revenue for CANDU utilities and AECL. Based on the teams' technical contribution, assessed by Bruce Power, Ontario Power Generation and Bruce Power have adopted the BLA method as their future approach to licensing. In addition, it has been accepted by the Canadian CANDU industry, through many presentations and concentrated customer communication, in providing a unified methodology for all future licence applications.

John de Grosbois was a member of the **MMIRSIM team** honoured for significant technical innovation and exceptional teamwork in the development of a computer program to simulate the dynamics of the MAPLE reactor under a variety of conditions. The MMIRSIM program offers a systematic approach to control system design, and eliminates a time consuming, expensive and ineffective conventional approach. The MMIRSIM's summarized and reusable modules can be used for rapid development and modeling of other complex systems, and are expected to become the basis for development of similar design/verification tools for control system design and analysis for ACR and other projects. In addition, MMIRSIM will enhance AECL's research and development reputation through publication and paper presentations.

CNS at PNC and INSC

The Canadian Nuclear Society is a member of two international organizations of similar societies or associations around the world.

They are: the **Pacific Nuclear Council** (PNC) and the **International Nuclear Societies Council** (INSC). Both organizations held meetings in Washington D.C. in early November in conjunction with the winter meeting of the American Nuclear Society.

Of the two the PNC has been the most active, probably reflecting the active nuclear programs in many of the countries in its area. It has met once in Canada, in 2006, at the time of the CNS Annual conference.

Membership of the PNC includes both scientific societies and professional associations from countries around the Pacific Rim. (Both CNS and the Canadian Nuclear Association are members.)

The PNC "owns" the large international Pacific Basin Nuclear Conference that is held every two years and a major activity is selection of societies to host PBNC. The last PBNC held in Canada was in 1998 in Banff. The 2008 PBNC will be held in Aomori, Japan, October 13-18. At the Washington meeting the PNC approved the proposal from the Mexican Nuclear Society to hold the 2010 PBNC in Cancun, Mexico, also in October.

The PNC operates primarily through Working Groups. One of the active ones, on Codes and Standards, is chaired by Shami Dua of AECL. Another, on Advanced Reactors, is co-chaired by Jerry Hopwood of AECL.

The INSC has, in recent years, been less active, possibly because its largest membership is in Europe where nuclear programs have been mostly dormant over the past decade or so. It has, in the past, prepared several reports on various topics, which were published in "hard" copy by the American Nuclear Society. An agreement has now been reached for these to be placed on the INSC website.

Another international activity of the CNS is bilateral agreements with nuclear societies in other countries. CNS now has 22 agreements in place. Kris Mohan, chair of the International Committee ensures all agreements are renewed and contacts maintained.

A number of nuclear "pioneers" met in Toronto on October 2, 2007. on the occasion of a visit by Ernie Siddall who now lives in B.C. Ernie was involved in early nuclear safety studies and first proposed a "risk-based" criteria. He, Bill Morison and Fred Kee were primarily responsible for the safety design of Douglas Point and Pickering A.

Pictured from left to right are; Bill Morison, Elgin Horton (both former vice-presidents of Ontario Hydro), Ernie Siddall, Neil McPherson, Fred Kee, Sam Horton, Don Anderson (also both former V.P.s of OH).

(photo courtesy of Don Anderson)

The **Canadian Nuclear Safety Commission (CNSC)** regulates the use of nuclear energy and materials, in order to protect Canada's health, safety, security and environment, and to respect Canada's international commitments on the peaceful use of nuclear energy.

As part of the CNSC team, you will work on a variety of exciting projects and have the opportunity to share your ideas with specialists in your field.

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For more information, and how to apply, please visit our Web site at **www.nuclearsafety.gc.ca** and click on **"Careers"**.

The CNSC is an equal opportunity employer and encourages women, Aboriginal people, members of visible minorities, and persons with disabilities to apply for employment. We thank all candidates for their interest, however, only those considered for an interview will be contacted.

La **Commission canadienne de sûreté nucléaire (CCSN)** réglemente l'utilisation de l'énergie et des matières nucléaires afin de protéger la santé, la sûreté, la sécurité et l'environnement et de respecter les engagements internationaux du Canada à l'égard de l'utilisation pacifique de l'énergie nucléaire.

Au sein de l'équipe de la CCSN, vous participerez à toute une gamme de projets forts intéressants et vous aurez l'occasion de partager vos idées avec d'autres spécialistes de votre domaine.

Joignez-vous à notre équipe et faites la différence!
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Vous cherchez des nouveaux défis et souhaitez faire avancer votre carrière? Nous avons besoin de talentueux professionnels de l'ingénierie au sein de notre siège social à Ottawa et dans nos bureaux à travers le Canada dans les domaines suivants :

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Pour plus de renseignements et pour postuler, visitez notre site Web à l'adresse **www.suretenucleaire.gc.ca** et cliquez sur **« Carrières »**.

La CCSN est un employeur qui souscrit au principe de l'égalité d'accès à l'emploi et qui encourage les femmes, les Autochtones, les membres des minorités visibles et les personnes handicapées à postuler pour un emploi. Nous remercions tous les candidats de l'intérêt qu'ils manifestent à l'endroit de notre organisme. Nous communiquerons seulement avec les personnes dont la candidature sera retenue aux fins d'une entrevue.

29th Annual Conference of the Canadian Nuclear Society
and
32nd Annual CNS/CNA Student Conference

"Sustainable Development through Nuclear Technology"

2008 June 01-04
Toronto Marriott Eaton Centre, Toronto, Ontario, Canada

Call for Papers

The 29th Annual Conference of the Canadian Nuclear Society and the 32nd Annual CNS/CNA Student Conference will be held in Toronto, Ontario, Canada, 2008 June 01-04, at the Toronto Marriott Eaton Centre.

The central objective of this conference is to provide a forum for exchange of views, ideas and information relating to application and advancement of nuclear science and technology, and energy-related issues in general.

- Invited speakers in Plenary sessions will address broad industrial and commercial developments in the field.
- University students in Student sessions will talk about their research and academic work.
- Speakers in technical sessions will present papers on industrial, research and other work in support of nuclear energy.

Conference Website

http://www.cns-snc.ca/conf2008.html

Deadlines

- **Receipt of Abstracts: 2008 January 11** ***Extended!!***
- **Receipt of full papers: 2008 March 01.**
- **Notification of accepted paper: 2008 April 01.**

Paper abstracts (<100 words) should be submitted to the Conference Website. Please note that the abstract submission represents the author's commitment to submit a full paper on or before 2008 March 01 and, if the paper is accepted by the Conference Paper Review Committee, to present it at the Conference.

Guidelines for Full Papers

Papers should present facts that are new and significant, or represent a state-of-the-art review. They should include enough information for a clear presentation of the topic. Usually this can be achieved in 8-12 pages, including figures and tables.

The use of 12-point Times New Roman font is preferred. Proper reference should be made to all closely related published information. The name(s), affiliation(s), and contact information of the author(s) should appear below the title of the paper.

Note

For a paper to appear in the Conference Proceedings, at least one of the authors must register for the Conference by the "early" registration date (2008 April 15).

Paper Submission Procedure

The required format of submission is electronic (Word). Submissions should be made through the Conference Website by 2008 March 01.

Questions regarding the Conference Program may be sent to:

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CNS 2008 Conference Executive Chair
e-mail: jdharvie@rogers.com
Tel: 613-833-0552

General questions regarding the Conference may be addressed to:

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Canadian Nuclear Society
Société Nucléaire Canadienne

10th International Conference on CANDU Fuel

Delta Ottawa Hotel and Suites,
Ottawa, Ontario
2008 October 5-8

CALL FOR PAPERS

The Canadian Nuclear Society (CNS) cordially invites you to submit a paper for the tenth International Conference on CANDU Fuel, to be held at the Delta Ottawa Hotel and Suites, Ottawa, Ontario, 2008 October 5-8. Canada's capital shall play host to this premier event for CANDU Fuel. This conference provides the best forum for CANDU Fuel experts from around the world to share experience, present innovations, discuss research, renew old acquaintances and network with their peers.

We Invite Papers Relating to all Aspects of CANDU Fuel Including the Following Topics

Fuel Performance: Station experience, post-irradiation examination (PIE) studies/techniques, fuel behaviour (normal operating conditions and extended burnup);

Fuel Safety: Licensing issues, accident analysis, fission-gas release, fuel behaviour and experimental simulation;

Design and Development of Fuel and Fuel Cycles: Modifications to designs, quality assurance in fuel design and development, MOX, slightly enriched uranium, recovered uranium, Thoria cycles, CANFLEX™, low-void reactivity, environmental, economical and societal implications of fuel cycles;

Fuel Model Development: Predictive capability on thermal, mechanical, irradiation and fission-gas-release behaviour under either normal operating or accident conditions;

Manufacturing & Quality Assurance: Fuel manufacturing experience, advances in manufacturing & inspection technologies and quality assurance;

Fuel Management: Fuel management schemes, fuel physics analysis and operational problems;

Fuel Bundle Thermalhydraulics: CHF and CCP assessments, reactor aging, crept pressure tube and fuel simulations;

Spent Fuel Management: Handling technology, spent fuel storage and disposal approaches, in-storage fuel behaviour;

History of CANDU Fuel: Developments of CANDU fuel from design, testing and manufacture viewpoints, implementation of manufacturing quality assurance standards, development of fabrication technologies for CANDU fuel, and development of computer codes demonstrating fuel performance.

Human Factor Engineering, Criticality Safety and other safety, work place and environment related papers.

Abstract & Paper Submission

Interested authors should submit a <300-word summary/abstract indicating the planned content for the session chosen from the above list. Summaries must be received by **May 30th, 2008**. Authors will be notified of the acceptance of their submissions by **July 16th, 2008.** Final copies of the papers must be received by **September 1st, 2008.** All accepted papers would be issued as part of the Conference Proceedings. Summaries should be submitted in electronic form to fuel2008@cns-snc.ca or in hard-copy to:

Holly Hamilton (stn. 63)
Chalk River Laboratories
Chalk River, Ontario, Canada K0J 1J0
Tel: (613) 584-3311, ext. 6049; Fax: (613) 584-8214

The organizing committee is looking forward to receiving your abstracts.

Alberta, *Duane Pendergast*

October and November remained quite busy for Alberta Branch members.

CNS President Eric Williams spoke to a group in Lethbridge called the Southern Alberta Council on Public Affairs on October 25. That talk was very well attended. As a member of that organization, I've received considerable feedback from the audience. Aside from the anticipated negativity from the self-named environmental contingent, audience members were appreciative. An article in the Lethbridge Herald indicated that nuclear energy "promoter" indicated that concerns about nuclear had been dispelled. That triggered a letter recommending a Pembina Institute report as a good source of information on nuclear energy. Laurence Hoye countered with a review of the report indicating Pembina has financial interests in the wind energy business. Audience members noted and appreciated the way Eric interacted with them before and after the formal discussion. The presentation audio is available at *www.sacpa.ca.*

Energy Alberta staff members Guy Huntingford and Scott Henuset attended the presentation. Eric and Lethbridge members met with them after to discuss ways the CNS could help with educating Albertans. Subsequently Energy Alberta provided a list of topics to CNS, which they have found to be of highest priority.

Alberta Branch membership grew by three in November. We welcome Guy Huntingford, Scott Henuset and Steve Kamajian, all from Energy Alberta.

Chalk River, *Blair Bromley*

Over the months of October and November the following events have occurred:

- On October 25, 2007, we held our Annual General Meeting (AGM). A new executive was elected for 2007/2008. Key changes in the executive were that Chris Canniff is taking over as treasurer, and that Tammy Yankovich (AECL) is also joining the executive There are still open positions on the executive for members-at-large, and liaisons for WiN and NA-YGN.
- Following the AGM, Don MacKinnon (Power Workers Union) gave an excellent presentation of the perspective of the PWU on the current electricity supply situation in Ontario and how it should evolve to ensure a reliable, economical supply of electricity in the future. The presentation generated a lot of interest and discussion. Approximately 20 to 25 people attended the seminar.
- In the week of October 29 to November 3, there were celebrations and special guest tours for the National Research Universal (NRU) reactor at AECL – Chalk River Laboratories, in honor of its 50th anniversary for its initial criticality. CNS Chalk River Branch Chair Blair Bromley and CNS President Eric Williams participated in the VIP guest tour on Friday, November 2, 2007, and had the opportunity to visit the NRU control room, the reactor floor where several neutron beam experiments were being performed, and to go to the top face of the reactor. Letters of congratulations were sent from the CNS to AECL – Chalk River Laboratories.

The Chalk River Branch is planning the following activities for the upcoming year:

- Establish a scholastic award for graduating high school students in Renfrew County.
- Hold joint events with NA-YGN and WiN
- Speakers for winter and spring seminars are being arranged, possibly including the following:
  - o Syed Zaidi (AECL) – Point Lepreau Refurbishment (Dec. 13, 2007)
  - o Wayne Thompson (Deep River) – (January 24, 2007)
  - o Eric Williams (CNS President) – February, 2007 – special dinner meeting.
  - o Kuran Sermet (AECL) – CANDU in Oilsands (Jan/Feb/Mar 2007)
  - o Stephen Yu (AECL) – ACR-1000 update
  - o Pamela McKay (formerly with New Brunswick Power)
  - o Ron Mitchel (AECL)
  - o George Legate (Nu-Tech)
- A panel of experts to reflect upon the 50th anniversary of NRU; likely to do this in late spring when NRU staff are less busy.
- Ragnar Dworschak (membership chair) will be leading an effort in December 2007 / January 2008 to recruit new members for the CNS and to encourage renewals for existing members.
- Jintong Li is leading the effort to promote our 5th Annual Essay Contest on the Applications of Nuclear Science and Technolgoy. The deadline for essay submissions will be on January 11, 2008.
- We still need to prepare a financial report on the joint CNS/PEO Symposium (Discussing the Viability of a New Nuclear Power Plant in Renfrew County) that was held in Pembroke, Ontario on May 12, 2007. There are other follow-up activities that need to be completed. It is not certain when these will be completed.
- Jintong Li will also be leading the effort for the CNS Chalk River Branch's 2nd Annual Poster Contest on the Applications of Nuclear Science and Technology. This will be due in May of 2008.

Many thanks are expressed to members Uditha Senaratne, Ragnar Dworschak, Jintong Li, Morgan Brown, Marcel Heming, Bryan White, Chris Canniff, Nihan Onder, Jeremy Whitlock, and Syed Zaidi, and Tammy Yankovich for their efforts and contributions. Thanks are also extended to Tracy Gagne of WiN – Chalk River Branch.

Golden Horseshoe, *Dave Novog*

The Golden Horseshoe branch has scheduled 3 upcoming seminars for GHB members and students at McMaster. In December, Dr. H. Khartabil will be presenting Canada's GEN-IV

program, in January, Mark Girchakov will be presenting a seminar on environmental assessments for Bruce and Dr. C. Zaluski will speak about inspection methods and analysis of feeder thinning. We are planning a seminar in February on Bruce 1&2 progress and challenges.

New Brunswick, *Mark McIntyre*

The NB Branch hosted Roger Steed talking about his book *"Nuclear Energy in Canada and Beyond"*. The lecture took place on November 23 and was very well attended.

The NB Branch is looking forward to Christmas socials (one in Saint John and one in Fredericton). This event allows CNS members to gather in a social setting while giving them a convenient time and place to renew their membership.

Ottawa, *Mike Taylor*

On 25th October, the Ottawa Branch had a very interesting talk from David LeBlanc on *Molten Salt Reactors*. We are currently engaged in helping a local High School to purchase a geiger counter as part of the CNS education initiative and we are planning to participate in further educational enterprises in 2008.

Quebec, *Michel Rheaume*

- On Saturday November 17, 2007, Dr. Gregory Kennedy from École Polytechnique of Montréal spoke at a seminar, held at the Université du Québec à Montréal, on: *Energetic Choices, Environment and Health*. It was organized by: La chaire de recherche du Canada en éducation relative à l'environnement de l'université du Québec à Montréal . Dr Kennedy spoke on the use of nuclear energy as a mean to reduce the production of greenhouse gases .A few Québec Branch Members were present.
- Monday Nov. 26, 2007 the CNS-Quebec Branch organized a meeting at McGill University at which Dr. Jerzy Szpunar, one of the Quebec Branch Directors, presented a lecture entitled: *A Role of Microstructure in Controlling Oxidation and Hydrogen Ingress in Zr-Nb Pressure Tubes*. This presentation was followed by a laboratory visit. A few students and Quebec Branch Members were present for this activity.

Sheridan Park, *Adriaan Buijs*

The Sheridan Park branch had one seminar during the reporting period. It was given by the CNS president, Eric Williams, titled *"Let's Not Pooch It Up This Time !"*. The seminar was specifically on the BRUCE A retube, but the title referred more generally to the second chance the nuclear industry seems to be getting to make nuclear power acceptable to society. The seminar was very inspiring and very well attended.

At Sheridan Park, an issue is emerging in that a) the main conference room is hardly ever available, and b) access restrictions to visitors will take effect on December 10th. This will affect the way the branch conducts meetings.

CALENDAR

2008

Jan. 23 - 25
CANDU Fuel Technology Course
Hilton Garden Inn
Oakville, Ontario
website: www.cns-snc.ca

Feb. 27
WiN Canada 2008 Conference
Westin Hotel, Ottawa, Ontario
website: www.cna.ca

Feb. 28, 29
Canadian Nuclear Association 2008 Seminar
Westin Hotel, Ottawa, Ontario
website: www.cna.ca

Apr. 23 - 25
Canadian Society of Nuclear Medicine 2008 Annual Scientific Meeting
Marriotte Eaton Centre Hotel
Toronto, Ontario
website: www.csnm-scmn.ca

June 1 - 4
29th Annual CNS Conference and 32nd CNS/CNA Student Conference
Marriotte Eaton Centre
website: www.cns-snc.ca

June 8 - 12
American Nuclear Society 2008 Annual Meeting
Anaheim, California
website: www.ans.org/meetings

June 8 - 12
ICAPP 2008
2008 International Congress on Advances in Nuclear Power Plants
(Embedded in ANS 2008)
Anaheim, California
website: www.ans.org/goto/icapp08

Sept. 7 - 11
PSA 2008
International Topical Meeting on Probabilistic Safety Assessment and Analysis
Knoxville, Tennessee
contact: George Flanagan
email: flanagangf@ornl.gov

Sept. 20 - 26
IYNC 2008
International Youth Nuclear Congress
Interlaken, Switzerland
website: www.iync.org

Sept. 30 - Oct. 4
NURETH 12
International Topical Meeting on Nuclear Reactor Thermal Hydraulics
Pittsburgh, Pennsylvania
website: www.nureth12.org

Oct. 5 - 8
10th CNS International Conference on CANDU Fuel
Delta Hotel, Ottawa, Ontario
website: www.cns-snc.ca

Oct. 13 - 18
16th PBNC
16th Pacific Basin Nuclear Conference (16PBNC)
Aomori, Japan
website: www.pbnc2008.org

Oct. 19 - 24
IRPA 12
12th International Congress of the International Radiation Protection Association
Buenos Aires, Argentina
website: www.irpa12.org.ar

Nov. 2 - 4
CNS Simulation Symposium on Simulation Methods in Nuclear Engineering
Marriotte Hotel, Ottawa, Ontario
website: www.cns-snc.ca

Port Hope Conversion Facility

That Was Then

by Jeremy Whitlock

In honour of the 50th anniversary of the old girl herself, NRU - a bit creaky but still going strong - this ode to mountains climbed and rivers crossed is offered to anyone thinking of raising a glass:

In days of old
When men were bold,
And neutrons weren't invented,
We stoked our fires
On carbon pyres,
And felt ourselves contented.

While Rutherford bleat
That as for heat,
His atoms were a Bohr,
'Twas Meitner's muse
Lit Fermi's fuse,
And the beggars won a war.

Came C.D. Howe
To take a bow,
For Canada played a role,
In Montreal
They caught the ball
(But didn't catch the Mole).

Laurence's pile
Was all the while
The first, but quite sub-par,
Kowarski's Zeep
Ran cold and deep
And critically raised the bar.

To Lewis the spoils
Of wartime toils,
When Cockroft's job was done,
'Twas time for dreams
Of Brockhouse beams,
And cancer on the run.

To Oiseau Rock
Began to flock,
Young scientists in the know,
With NRX
They craned their necks
To see how far they'd go.

They did so well,
AECL
Was born to lead the show,
Barely weaned,
"100" cleaned,
It said "Okay, let's go!"

The NRU,
Conceived and grew
Of vision cobalt-plated,
When brains unleash
There is no niche
That can't be dominated.

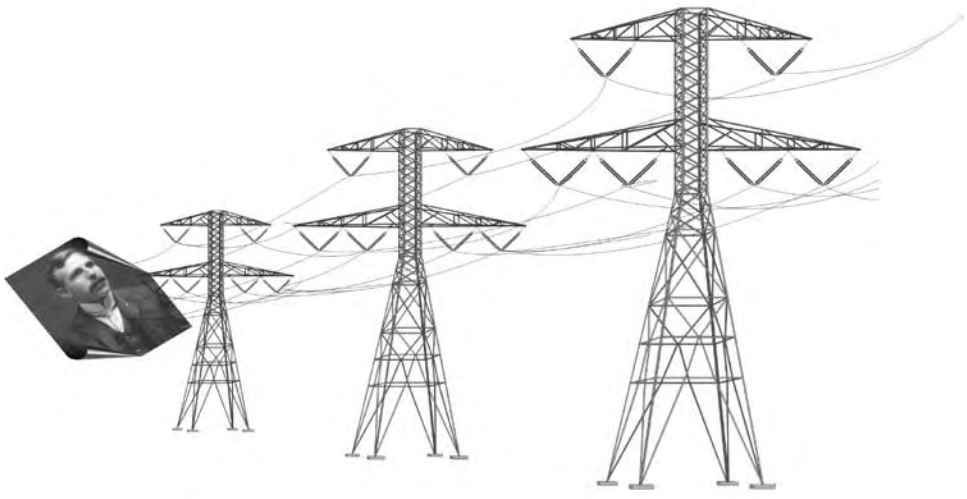
Young mountaineers
Defied frontiers,
With nuclear fire in the belly,
Peaks unclear,
None showed fear,
But Ewan et al turned to Ge(Li).

Laurels reaped,
Discoveries heaped,
A Nobel Prize belated,
The Quest was still,
The best until,
Summarily spallated.

Pollution free
Electricity
Emerged the driving goal,
Natural U
CANDU it too,
With Canadian heart and soul.

Foster's team
Designed the dream,
McRae and MacKay got it done,
Howey led
The thoroughbred,
And McConnell's crew let it run.

And now, ensconced
And renaissanced,
It's days of old again.
'Tis time for dreams
Once more it seems,
Onwards, women and men!



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http://www.cns-snc.ca

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