

February, 13, 2006

Position Paper on the OPA's Recommendations to Rely on Nuclear Power for Continued Generation of Baseload Electricity in Ontario



SOCIETY OF ENERGY PROFESSIONALS

Representing Engineers, Scientists, Supervisors and other Professionals
at: Bruce Power, Ontario Power Generation, Nuclear Safety Solutions, Kinectrics
and other Corporations.



SOCIETY OF PROFESSIONAL ENGINEERS And ASSOCIATES

Representing Engineers and Scientists at AECL
Located at Mississauga, Ontario; Montreal, Quebec; and Overseas



CHALK RIVER TECHNICIANS AND TECHNOLOGISTS

Representing Technicians and Technologists at AECL
Located at Chalk River and Mississauga, Ontario.



***CHALK RIVER PROFESSIONAL EMPLOYEE GROUP OF THE
PROFESSIONAL INSTITUTE OF THE PUBLIC SERVICE OF CANADA***

Representing Scientists and Engineers at AECL
Located at Chalk River, Ontario

Executive Summary

ONTARIO'S ENERGY PROFESSIONALS ENDORSE RECOMMENDATION OF THE ONTARIO POWER AUTHORITY TO RELY ON NUCLEAR POWER

The unions that represent approximately 8,000 engineers, scientists and technologists in the energy industry in Ontario endorse the recommendation of the OPA to maintain nuclear power as the primary source of baseload electricity generation in Ontario. Nuclear power will continue to supply Ontarians with a clean, greenhouse-gas-emission-free and reliable source of electricity that will augment our quality of life and help to ensure the competitiveness of our economy.

The Canadian nuclear power industry supports over 30,000 high tech jobs, most of them in Ontario. Nuclear reactors generate billions of dollars worth of electricity each year in Ontario at stable prices. The Canadian reactor export industry is worth, for each two-reactor sale, almost \$800 million to about 1500 Canadian businesses, most of these in Ontario. Building new CANDU reactors in Ontario will promote the export reactor business, which will benefit Ontario even more.

Ontario is a world-leading supplier of medical radioisotopes, which are used to diagnose and treat disease in over 80 countries (about 40,000 treatments per day in North America). We are also world leaders in cancer therapy technology, and continue to supply 75 per cent of the world's cobalt-60 for cancer treatment and sterilization of medical supplies. All of these are successful spin-offs of our investment in nuclear technology.

We support the selection of Canadian power reactor technology for the addition of new generation capacity. CANDU reactors are amongst the best performing reactors in the world. In 2005 three CANDU units were amongst the top 25 performers in the world (out of 440 nuclear power reactors worldwide). Selection of a foreign reactor technology would, amongst other things, result in billions of dollars of capital leaving the Province and Canada, rather than being spent domestically, largely in Ontario. It would also likely result in the expatriation of many of the 30,000+ high tech jobs in the nuclear industry and the loss of the taxes that these highly skilled and paid workers contribute to the government, as well as the spending that they contribute to the economy.

Nuclear reactors do not pollute the environment and do not produce greenhouse gases so relying on them will help Canada to meet its Kyoto and post-Kyoto commitments. Nuclear power will provide Ontario with an inflation-proof source of electricity generation for the foreseeable future. Unlike electricity generation with fossil fuels such as natural gas, most of the cost of generation of electricity with nuclear power plants is due to the cost of building the plants. Uranium fuel is very cheap by comparison. The last six CANDU reactor new-build projects have been built on budget and on time (some ahead of schedule). With an unobstructed construction track and sound management, we are confident that new reactors can similarly be built in Ontario on time and on budget. Nuclear power will protect Ontarians from sudden shocks in the price of electricity, which will be welcomed by industries and residents alike.

Our members believe strongly in the work that they do and support passionately the industry that they work in. They believe that nuclear power will continue to provide us with clean air and contribute to Ontario's future prosperity as it has done in the past.

February 13, 2006

**SUBMISSION TO THE ONTARIO MINISTER OF ENERGY REGARDING THE
ONTARIO POWER AUTHORITY'S RECOMMENDATION ON THE SUPPLY MIX FOR
FUTURE ELECTRICITY GENERATION**

This submission is being made on behalf of approximately 8,000 engineers, scientists, technologists and other professionals in the employ of Ontario Power Generation (OPG), Bruce Power, Atomic Energy of Canada Limited (AECL), Kinectrics and Nuclear Safety Solutions (NSS) by their unions:

- The Society of Energy Professionals (IFTPE Local - 160), representing (6300) professionals at electricity related companies such as: OPG, Bruce Power, Kinectrics and NSS
- The Society of Professional Engineers and Associates, representing 660 engineers and scientists in the employ of AECL in Mississauga
- The Chalk River Technicians and Technologists, representing 580 technicians and technologists in the employ of AECL in Chalk River and Mississauga, Ontario, and
- The Chalk River Professional Employee's Group of the Professional Institute of the Public Service of Canada (PIPSC), representing 480 scientists and engineers in the employ of AECL in Chalk River, Ontario

Collectively, our members represent most of Canada's expertise in nuclear reactor design, operation, maintenance, safety analysis and research and development support. Our members play a key role in the operation of nuclear power plants in Ontario as well as their refurbishment in Ontario and New Brunswick. The AECL members of our "consortium" also play a key role in the construction of nuclear power plants around the world. Our members have a keen interest in the future of nuclear power and have a strong conviction that relying on this technology will lead to a cleaner environment and a more prosperous Ontario.

We endorse the Ontario Power Authority's (OPA) recommendations to maintain nuclear power as the primary source of baseload electricity generation in Ontario. Nuclear power will continue to supply Ontarians with a clean, greenhouse-gas-emission-free and reliable source of electricity that will augment our quality of life and help to ensure the competitiveness of our economy.

We also intend to comment on related issues that help to define the context for the critical future decisions that your government must make.

CANADIAN REACTOR TECHNOLOGY

Our members support the OPA recommendations for continued reliance on nuclear power and specifically support the selection of Canadian power reactor technology for the addition of new generation capacity. CANDU reactors are amongst the best performing reactors in the world. For example, three CANDU units were amongst the top twenty-five performers in the world (out of 440 nuclear power reactors worldwide).

Over 50 years ago the Federal Government made a strategic decision to pursue the development of a made-in-Canada nuclear reactor technology. This was one of a number of initiatives by C. D. Howe aimed at transforming Canada's economy from one that was primarily resource and agriculture based, into a modern industrial economy. The aim was to give Canada energy independence by developing an advanced electricity generation technology that could be constructed entirely using Canadian industrial infrastructure. This resulted in the successful development and deployment of the Canada Deuterium Uranium (CANDU) reactor, which is the workhorse of electricity generation in Ontario. This was a tremendous achievement for a relatively small country, particularly one better known for exporting lumber, minerals and oil. Ontario has been the greatest beneficiary of this far-sighted decision. This investment in Canadian technology has resulted in¹:

- Over 30,000 high tech jobs for Canadians, the vast majority of these in Ontario.
- A reactor-export industry worth, for each two-reactor sale, almost \$800 million to about 1500 Canadian businesses, most of these in Ontario. (Building new CANDU reactors in Ontario will enhance the export reactor business, which will benefit Ontario even more.)
- A world-leading supply of medical radioisotopes, which are used to diagnose and treat disease in over 80 countries (about 40,000 treatments per day in North America).
- Development of cancer therapy technology and a continuing supply of 75 per cent of the world's cobalt-60 for cancer treatment and sterilization of medical supplies.

In addition, an independent study has shown that the \$6 Billion invested over the last 50 years in the Canadian Nuclear industry has led to a return on investment of over \$160 Billion¹

When Ontario made the decision to build the first fleet of CANDU generating stations in the late 1950s and 1960s, the only viable alternative at the time to increase electricity production, thus facilitating economic expansion, was to build coal-fired and oil burning electricity generating stations. Ontario's decision to choose the nuclear option has:

- Avoided emission of almost 2 billion tonnes of greenhouse gases over the last four decades, plus millions of tonnes of acid-gases (nitrogen and sulphur oxides) and particulate air pollution – leading to thousands of lives saved from respiratory illness, and
- Avoided coal purchases (primarily from the U.S.) amounting to about \$1 billion annually.

Some, within the Provincial government, Ontario Power Generation and Bruce Power, have suggested that if new reactors are built in Ontario we should be open to vendors from other countries that use different reactor technology. We would caution the Minister to consider that what may be in the short-term interest of a particular utility's bottom line may not be in the best interests of Ontarians. Selection of a foreign reactor technology:

- Will result in billions of dollars of capital leaving the Province and Canada, rather than being spent domestically, largely in Ontario.
- Will result in the expatriation of many of the 30,000+ high tech jobs in the nuclear industry and the resultant expatriation of the taxes that these highly skilled and paid workers contribute to the government, as well as the spending that they contribute to the economy.

- Will require a completely new infrastructure to support operator training, radiation and industrial safety, waste management and will require enhanced security at power plants. We will also become increasingly dependent on foreign high-tech workers in areas such as safety analysis and reactor service and maintenance.
- Will lead to the demise of AECL as we know it, which is where Canada's reactor design expertise is resident, and thus compromise Canada's ability to build and service its own reactors in future. It takes decades to develop the depth and breadth of expertise necessary to design, build and support the operation of nuclear power reactors but that expertise can be eroded with the stroke of a pen. *This will be familiar to those who remember that Canada once had a highly advanced military aircraft industry but now must import those aircraft to help defend its borders.*
- Will likely compromise Canada's ability to produce medical radioisotopes, which brings money into the province through exports while meeting the needs of over 50,000 clinical treatments worldwide each day.

We remind the Minister and the public that our pro-Canadian appeal is not a partisan one aimed at protecting high paying jobs. Many of our members work for utilities that support the operation of nuclear power plants and we will continue to have jobs regardless of the technology chosen. Many scientists and engineers within AECL, and other companies, would lose their jobs but the nuclear industry is undergoing a renaissance around the world and history has shown that highly skilled professionals working in a growing industry will not go without work. However, they would rather stay and work in Canada. We simply point out that it is not in the national interest to choose foreign nuclear reactor technology.

ENVIRONMENTAL ISSUES

There are no sources of electricity generation that come without environmental consequences. Burning coal or natural gas results in the release of greenhouse gases. Hydroelectric projects usually result in the flooding of large tracts of land that impact on local fauna and flora. Solar photovoltaic cells contain toxic heavy metals that must be contained during processing and safely disposed of after they are no longer functional². Wind power has been implicated in killing migrating birds and some complain of visual and noise pollution. Nuclear power reactors have used fuel that is radioactive and must be isolated.

One factor that is generally not appreciated by the public is that generating electricity from the burning of fossil fuels is made possible because of the release of chemical energy in the combustion process. Nuclear energy results from splitting the nucleus of an atom and this energy is one million times greater than the release of chemical energy from a comparable amount of material. What this means is that a typical CANDU power plant can provide the energy needs for 300,000 Ontario homes yet produce only a 10-foot cube of solid used fuel annually. Stated in another way, a CANDU fuel bundle, which weighs 23 kg, and is about the size of a fire-log, can provide all of the electricity requirements for the average Canadian home for 100 years. The compact and chemically inert nature of the used fuel makes it easily managed, and its radioactivity easily isolated from the environment. Currently the used fuel from nuclear generation is stored at the reactor sites; the total volume from four decades of production would cover a single soccer field to a depth of just over five feet.

A technology has also been developed for the long-term management of used nuclear fuel. The approach has been found to be technically sound by both an independent panel of experts and a federal Environmental Review panel. This plan, one of several undergoing further technical and public review by the federally-appointed Nuclear Waste Management Organization (www.nwmo.com), would isolate the fuel deep within the Canadian Shield, while preserving the option for future generations to recycle the fuel for its immense remaining energy potential (see later section, "Kyoto and the Future"). Moreover, since radioactivity naturally decays with time, this material becomes less toxic than natural uranium ore after several hundred years of isolation, contrary to claims of exceptional, enduring toxicity often made by its detractors.

ECONOMIC CONSIDERATIONS

One of the most important factors governing industrial growth, productivity and thus economic stability, is the affordability of energy and protection from volatility in energy prices. On this score the nuclear option scores well^{3,4,5}. Recent studies have shown that the cost of electricity generation from nuclear power is equal to, or lower, than coal-fired electricity generation and considerably cheaper (currently) than electricity from natural gas-fired stations. The largest portion, by far, of the cost of electricity from a nuclear power station is due to the capital cost of building the station itself. The electricity costs are very insensitive to the cost of the fuel. Indeed, if the price of fuel for a nuclear station were to double, the cost of electricity would only increase by less than 5%. By contrast, a doubling of the price of natural gas leads to nearly a doubling of the price of electricity from a gas-fired station. The high price of natural gas has spurred even CEOs of major gas supply companies like Enbridge and Trans Canada to state openly that it makes no sense to use natural gas for generating electricity at current prices⁶. They recommend that it should instead be used for heating, or as a chemical feedstock, where its value can be captured most efficiently. **It should send a strong message to Ontarians when even the CEOs of companies that stand to profit from an expansion in gas-fired electricity generating stations state that it doesn't make economic sense to build them.**

Long term projections of the price of natural gas, suggest that its price may stabilize and even decrease in the coming years. The reasons for these optimistic projections is a belief that as the price of the commodity rises the economic incentive to export natural gas between continents in liquefied form, in specially designed ships, will lead to a worldwide market in the commodity and thus lower the price. Currently natural gas is in tight supply in North America but in relative abundance in Asia. These optimistic projections ignore certain facts, however.

- To import natural gas from another continent requires the construction of large and expensive Liquefied Natural Gas (LNG) terminals. Many attempts to build such terminals have been stopped due to local opposition concerned about the explosion hazards. The opposition to LNG terminals has been much greater than anticipated and there is considerable scepticism as to whether LNG shipments can make up for decreasing North American production.
- As a global commodity, the price of LNG should closely track that of oil, a development supported by recent prices for LNG in Europe.
- If, despite opposition, sufficient LNG terminals could be built in North America to achieve an effective worldwide market for the commodity, our supply will become dependent on exports from other, sometimes unstable, parts of the world. Decades of dependence on foreign oil imports from unstable parts of the world have caused our neighbour to the south

to announce a major initiative to greatly reduce this dependence. **Energy independence = economic stability.**

- In 2003 the consensus prediction for 2005 natural gas prices was \$4.24 (Can)/GJ⁷. However, the average price of natural gas in 2005, was actually \$7.96 (Can)/GJ, almost double what was predicted only 2 years ago. If the most knowledgeable prognosticators of commodity prices cannot predict near-term prices, how can we have any confidence in long-term projections? Certainly no responsible government could base energy policy on projections that are little better than a *roll of the dice*. Imagine for example, that a major source of fuel for electricity generation in North America was oil. As recently as three years ago, no one would have predicted that we would see long-term sustainable prices for oil in excess of \$50 per barrel. Yet such prices, and even higher ones, are what we can expect for the foreseeable future. This would have led to a doubling in the price of electricity had oil been our fuel-of-choice for generation. Natural gas prices have more than doubled in the last three years and in the last decade they have increased by over 700%⁸. **Electricity produced by nuclear power, by contrast, is inflation-proof!**
- The price rise in oil that has occurred in the last three years, has led to unprecedented expansion plans to extract oil from the Alberta Oil Sands. Extraction of oil from the oil sands requires large amounts of high-pressure steam and hot water. Currently, and for the foreseeable future, burning natural gas generates this steam and hot water. Once the oil is extracted it must then be upgraded by adding hydrogen to it. The hydrogen is produced by a process called steam-methane reforming, which also consumes large quantities of natural gas. These two activities, aside from adding large quantities of greenhouse gases to the environment, are also increasing the demand for natural gas in Canada far beyond what was envisioned two years ago and natural gas is already in tight supply. Not surprisingly, some oil companies are now considering the nuclear option for generation of steam, electricity and even hydrogen (the latter through water electrolysis).

For reasons mentioned above, we applaud the suggestions by the OPA that we not rely too heavily on natural gas for generation of baseload electricity.

Much has been made, by opponents of nuclear power, about past cost overruns in nuclear build projects in Ontario. We would like to point out that we agree that past performance is the best indicator of expected future performance. The AECL engineers, scientists and technologists that we represent play a key role in the construction of nuclear power plants around the world. They are keen to point out that **their company's last six reactor projects have been completed on or under-budget and schedule**. Their most recently completed project in China was four months ahead of schedule. **They believe that if they can build nuclear reactors on time and on budget in locations that are half a world away from most of their suppliers and in countries where English or French are not the main languages spoken, surely they can build them on time and on budget in Ontario, their home base.**

KYOTO AND THE FUTURE

Canada has told the rest of the world that it is committed to the reduction of greenhouse gases. Nuclear and hydroelectric power are the only large-scale methods of generating electricity that do not produce greenhouse gases but most of our hydro-electric potential has already been exploited. Wind power is growing in acceptance and we applaud the OPA's decision to expand this

potentially valuable resource. However, it represents an intermittent source of supply, with a relatively small capacity factor. Since it needs to be backed up, likely by gas-fired electricity generating stations, it will ironically perpetuate greenhouse gas emissions. It is difficult to imagine that we could keep our commitment to reducing greenhouse gases, and thus mitigate global warming, without nuclear power. A number of high profile founding fathers of worldwide environmental movements, Professor James Lovelock, who first put forward the Gaia hypothesis, and Patrick Moore, co-founder of Greenpeace, have recently come to the same conclusion.

Fossil fuels, particularly those used for transportation, are in decline. People argue about when this will happen but one thing is clear. Be it coal, natural gas or oil, these are finite resources. The same is true of uranium. However, Canada has the world's largest reserves of uranium and it is believed that many more will be found with further exploration. Until recently there has been no financial incentive to explore for more uranium, it having been in over-supply. So while these resources are finite, there is every reason to believe that they will far outlast fossil fuel resources.

Nuclear reactors also uniquely have the ability to create new fuel (breeding) as they burn existing fuel. Used fuel has a tremendous amount of potential energy content that has not been exploited simply because we have so much cheap uranium in Canada. Hence, there has been no incentive. In addition, CANDU technology is the best choice for using fuel other than uranium. One such alternative fuel is thorium, which is, effectively, 400 times as abundant as uranium^a. Most of the world's thorium resources are in China and India. It comes as no surprise then that countries like China and India, where domestic uranium is not abundant, are exploring the use of CANDU type reactors for burning thorium as part of their long-term vision for electricity supply.

As transportation fuels decline in abundance, many believe that these will be replaced by hydrogen. Hydrogen is the most abundant element in the universe, and burning hydrogen, or using it in fuel cells, generates no greenhouse gases. However, all of the hydrogen on earth is tied up in water and other molecular forms, from which it must be separated. One of the most effective methods for separating hydrogen is to run an electric current through water (electrolysis), and nuclear power can provide the immense energy supply needed for this process without adding to the planet's greenhouse-gas and air pollution burden. To have this option in the future, however, one also needs to maintain the nuclear option today.

SUMMARY

The approximately 8,000 Engineers, Scientists and Technologists in our respective unions, represent most of Canada's nuclear technology capability. This is a technology that they support passionately and one that they believe will continue to provide us with clean air and contribute to Ontario's prosperity. Nuclear power will provide for Ontario an inflation-proof source of electricity, thus providing cost certainty for industrial and residential consumers. Nuclear power has helped provide Ontario with clean and cheap electricity in the past, which is key to attracting and keeping industry, and we believe that there is no reason why it cannot continue to do so for the foreseeable future.

^a Note: Thorium is about 3 times as abundant as uranium but only 0.7% of uranium found in nature is the fissile 235 isotope whereas 100% of thorium found in nature is the fertile 232 isotope, hence thorium is, effectively – in terms of potential energy content, about 400 times as abundant as uranium.

REFERENCES

¹ Prince, J.P., Economic Impact of the Nuclear Industry in Canada, Canadian Energy Research Institute (CERI), Calgary, Alberta, July 2003.

² Union of Concerned Scientists (see http://www.ucsusa.org/clean_energy/renewable_energy_basics/environmental-impacts-of-renewable-energy-technologies.html)

³ Canadian Energy Research Institute (CERI) (2004) - Levelised Unit Electricity Cost Comparison of Alternative Technologies for Baseload Generation in Ontario(see also http://www.cna.ca/pdf/CERI_LUEC_Report_August_27_2004-ed.pdf)

⁴ IEA and OECD-NEA (2005 - earlier editions too) - *Projected Costs of Generating Electricity*
<http://www.nea.fr/html/pub/ret.cgi?id=new#5968>

⁵ 2005 World Nuclear Association (WNA) Report, The Economics of Nuclear Power (See <http://www.world-nuclear.org/economics.htm>)

⁶ Jim Schultz, CEO of Enbridge Gas Distribution Inc, Speaking on October 20 2005 to a Luncheon of the Ontario Energy Network and Hal Kvisle, President and CEO of TransCanada (See <http://www.thesociety.ca/pages/news.html>)

⁷ Government of Alberta 2003 Budget Summary (See <http://www.finance.gov.ab.ca/publications/budget/budget2003/eco.html#8> (Note: Prices are given in \$ (Can)/1000 cuft and are converted to \$/GJ in the text)

⁸ Data is the historical AECO hub price from Energyshop.com (see <http://www.energyshop.com/es/business/gas/gaspriceforecast.cfm?c>)