Submission to:

Mr. Dan Perrins

Chair of the Public Consultation Process

into

The Future of Uranium in Saskatchewan

Submitted by:

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Executive Summary

- Saskatchewan, as a primary supplier of uranium to the world should increase the value-added contribution of uranium in Saskatchewan and increase its nuclear engineering education and research. This could be done with a research reactor at the University of Saskatchewan that would also be capable of producing medical isotopes. In a complementary development, a new CANDU-6 electric power reactor could be fitted to produce Mo-99 in its power cycle.

- Saskatchewan should adopt base-load nuclear electric power via a CANDU-6 to power Saskatchewan's economic growth while, at the same time creating greenhouse gas credits as offsets to encourage/enable expanded resource-based and industrial value-added upgrading in Saskatchewan.

- Nuclear power reactors can be safely operated and low-dose radiation can be beneficial rather than harmful

- Saskatchewan has an enviable history of leadership in nuclear medicine which should be enhanced as a national centre of excellence.

- Saskatchewan should adopt a pro-active position to the development and site selection of a storage site of used nuclear fuel in its part of the Canadian Shield.

- In order to gain a broader base of public acceptance, both government and industry sources must provide ready access to essential information on costs, economic and environmental Life Cycle Analysis results of different options.

Introduction

This presentation will include a number of topics related to the acceptance of an increased role of the nuclear industry in the economic, social and demographic development of Saskatchewan.

This presentation will also address some of the issues raised by anti-nuclear presentations as they have appeared in Letters to the Editors and news articles of Saskatchewan's leading newspapers.

This presentation, with input from Members of the Canadian Society for Senior Engineers, asserts that the societal benefits of the peaceful uses of nuclear electric power and nuclear sourced medical isotopes far outweigh any potential adverse effects cited by critics.

A number of referenced articles will appear in Appendices to this report.

Reaching Full Economic Potential of Saskatchewan

The Saskatchewan Labour Market Strategy Report of May 27, 2009 on the future of needed work force growth for Saskatchewan states that in the order of 120,000 workers are to be added to the workforce by 2020, or 10,000 new workers a year on average to reach Saskatchewan's full economic potential. Adding over 120,000 workers and their families would cause the provincial population to approach 1.3 Million. This projected growth rate will put pressures on infrastructure and services, including demand for additional energy generating capacity.

If Saskatchewan is to achieve its potential, readily available electric power at reasonable cost, without increasing Saskatchewan's Green House Gas (GHG) emissions will be required. Of the options for the lowest Life Cost Analysis GHG for Saskatchewan, two are lowest: nuclear and wind. Since Saskatchewan doesn't have the wind resources of other neighbouring jurisdictions (Alberta & B.C.) or hydro (Manitoba), Saskatchewan's base load should be nuclear and, when demonstrated and available at affordable power costs, clean coal, with grid optimization for wind from the west and hydro from the east.

It would be fairly safe to assume that the higher than historical growth rate occurring in the resource sector (e.g. potash, uranium, gold, diamonds, other metals and minerals, oil and gas) and its supporting manufacturing and service industry sectors, will need more energy to flourish.

Growth in the capital and energy intensive resource sector requires a reliable supply of base-load energy with additional capacity over the currently available peak power generating capacity in Saskatchewan. With most of the resource sector activity occurring in Northern Saskatchewan, location of new power generating capacity should preferably be near the newly created load, which is in the North.

Substantial additional base-load capacity is germane to the aspirations of the full economic development potential of Saskatchewan. Without new generating capacity, shortages of capacity will have to be compensated by importing electrical energy from outside the province, providing that adequate electrical grid inter-ties do exist. If not, load has to be reduced by demand side management (DSM), rate increases or both, which in all probability would have a dampening effect on the Saskatchewan economy.

International Comparisons

Several energy generating sources are considered as potential options to supply increasing electrical energy demands worldwide. Each source has its own niche application, economic consideration and ecological footprint, depending on size of geographical areas, population densities and industry locations to be served. The world movement toward a cleaner environment with substantially carbon free sources of energy generation has led to the development of alternate methods of energy production from the traditionally fossil fuel based methods of electricity generation.

Different countries have developed different methods of electrical energy production, depending on availability of fuel resources, be it coal, oil and gas, hydro or nuclear and whether or not the demand is for base-load or peak-load demands. There has been an attempt, mostly by those who favour wind and solar for base-load energy production, to compare some small densely populated European countries. Denmark is often held up as an example of the successful use of non-fossil fuel-based (mostly wind) energy generation, compared to the province of Saskatchewan. Denmark has a population of 5.4 million, with over 1 million living in its capital city of Copenhagen. It covers an area 43,098 sq km, surrounded by sea, suitable for off shore wind power with relatively short transmission lines to their electrical grids. Denmark has two separate electrical grids. They are interconnected by 400kV lines to the larger Scandinavian power grids of Norway (Hydro) and Sweden (Hydro, Nuclear) to the East and to the central European grid (Germany, Coal) to the West. While wind power accounts for almost 20% of the power generated in Denmark, it covers only 10–14% of the country's demand.

Denmark could not achieve its current penetration of wind power generation without AC & DC grid connections to Norway and Sweden and AC and DC connections to Germany, where most of its backup power comes from East German's dirty coal-fired plants. Denmark is not anywhere near as "pure" as environmentalists claim. The net result is that Denmark actually has the highest amount of CO_2 per Kwh of western European countries. As of the mid-decade, Denmark's GHG emissions were over 11 times those of France, where France's electric power is some 80% from nuclear power generation.

Power in excess of immediate demand is exported to Germany, Norway, and Sweden. The latter two have considerable hydropower resources, which can rapidly reduce their generation whenever wind farms are generating surplus power, saving water for later. In effect, this is a cheap way for northern Europe to store wind power until it is needed – an opportunity which is not generally available for wind power generators in Saskatchewan. It will work for BC but not for Saskatchewan. In Saskatchewan wind energy can only displace energy from gas turbines which increases the cost of running the latter.

Denmark's choices of base-load and peak-load power generation are often compared with the much larger landlocked geographical and thinly populated area of the province of Saskatchewan (pop. 1.0 million (same as Copenhagen!), area 651,942 sq km). The question being asked is why Saskatchewan can't have the same non-fossil fuel-based energy generation as Denmark. The economic, geographic and technical parameters of the two areas are vastly different.

Saskatchewan, faced with long transmission lines and a few low capacity electrical grid inter-ties with neighboring jurisdictions, has met the economic and geographical challenges in serving all residents and industries well with a highly reliable network of electrical power in its very short history. Additional wind generated electrical power is being added. Today's wind farms are at the fringes of the provincial grid, facing long transmission lines and resulting power losses.

Alternate sources, mostly for peak-load demand have included various forms of mainly solar and wind operations, again each depending on the availability of suitable technologies, resources and government support programs. Because of the intermittency of wind and solar, even in Denmark a maximum contribution of 20% of base-load is the accepted maximum penetration for grid stability. Various governments in keeping with global agreements and economic considerations are setting targets for such alternate sources in each political jurisdiction. As economic reality sets in, there is a vast difference between aspiration and achievement.

Saskatchewan's logical choice for new base load capacity should be nuclear and, when demonstrated and available at affordable power costs, clean coal, with electric power grid optimization for wind from the west and hydro from the east.

Wind and solar are NOT suitable for peak loads or for base load. Both are spasmodic, depending on the wind or sun. In fact, for every KW of wind or solar installed on a grid there is a need for an equivalent secure, reliable and available source of generation. For instance, in Ontario it is primarily hydro that is varied to meet the changing load and varying generation of wind and solar. Nuclear plants can "load follow", that is increase or lower their output to meet the demand but can not do so quickly. Further, because of the investment and the potential strain on equipment most nuclear power plant operators choose to run their plants as base load, i.e., continuous. For "peaking" demand Ontario depends primarily on gas fired generation.

Life Cycle Analysis and Environmental Concerns of Base-Load Options

There is a general consensus amongst scientific and engineering communities that sources such as wind and solar electricity generation options are most suited for peak-load demand and or local or small regional areas or remote locations to be served. This is on account of a fairly low level of availability of wind and solar energy supply, well below that demanded of base-load electricity supply. Because of the certainty of periods of no wind and darkness, wind and solar need 100% backup from hydro, nuclear or fossil fuel sources, which are the true base-load sources. Power transmission lines and distribution systems, as well as electricity storage facilities would require reconfiguration and sophisticated 'smart' grid network technologies to shift supplies from one end of the region to another in the hope of finding alternate sources that would be available at that time of power unavailability in a "blacked out" area. Current power grid configurations in Saskatchewan are designed for distribution from major electricity generating power plants; new power transmission lines would be required to connect solar or wind generating 'farms' to the existing grid.

Comparing alternate electricity supply options from an environmental perspective based on Life-Cycle Analysis (LCA) has been made over time. A recent study based on Canadian operations was made by the Canadian Energy Research Institute (CERI).

The Canadian Energy Research Institute (CERI) has conducted a rigorous Life Cycle Analysis (LCA) of base-load electricity generation from three alternative fuel sources in Ontario: nuclear, coal and natural gas. In this study, CERI has set out to develop a rigorous analysis of the environmental and other attributes of the nuclear power generation option. The overall objective was to identify and analyze current and potential life cycle environmental impacts (GHG emissions, other air pollutants, water pollution, and radiation) of electricity generation from nuclear, coal, and natural gas. All of these fuel sources are important contributors to Canadian electricity generation and have implications for the environment.

Life-Cycle Analysis (LCA) is a systematic approach used to evaluate environmental impacts associated with electricity generation from different sources over their life cycle (cradle to grave). This LCA analyses, completed in accordance to international standards (ISO 14040 series), can assist with future electricity generation mix decisions.

The CERI study's findings are:

• The study of the complete life cycle of nuclear power in Ontario found that nuclear power results in the emissions of 1.8 grams of carbon dioxide per kilowatt-hour (g/kWh) of electricity generated. These emissions occur mainly in the mining and refining of uranium fuel, not in the operation of the reactor.

• The study of the complete life cycle of coal in Ontario results in the emissions of 1050 g/kWh, mostly in the burning of coal in the power plant.

• The study of the complete life cycle of natural gas in Ontario to make electricity creates emissions of 540 g/kWh, mostly in the burning of natural gas in the power plant.

As can be seen from these study results is that nuclear power has by far the lowest level of carbon dioxide emissions per kilowatt-hour of electricity generated.

Others studies comparing peak-load options with base-load options shows that nuclear power generation compares favourably with wind and solar electricity generation.

A Broad Overview of Options

Saskatchewan's options are limited for base-load electricity generation. Basically they are coal, natural gas and uranium.

Saskatchewan's base-load electricity generation is mainly achieved by burning low-grade coal, supplemented with natural gas based electricity generation. A substantial research effort is being made in Saskatchewan into clean coal technology and the capture of carbon dioxide from the electricity generating process. Saskatchewan Power's first proposal to do this was shelved because it was uneconomic without massive government subsidies for the R&D.

Other countries are also conducting research in these areas and much further effort is required to eventually transfer that technology to operating coal power generating stations. Adding clean coal technologies to existing and aging coal burning power plant reduces its generating capacity by an estimated one third, leaving only two thirds of its total generating capacity to serve the growing network demand. While from a purely environmental perspective this might be desirable, from a need to add additional generating capacity to meet growing demand it does not. Saskatchewan has an abundant supply of low-grade lignite coal, which would provide a long-term fuel source for electric power generation, if clean coal technology actually economically reduces its emission levels to meet international standards.

Saskatchewan's second best available option is increasing the use of natural gas as a cleaner fuel source to generate additional electricity to serve its desired growth potential. From an environmental and sustainability perspective this option is better than coal, but uses up a dwindling supply of non-renewable resources, which could be better used to serve other domestic uses. Adding additional natural gas burning power plants could be a short to intermediate term option to meet immediate local demands, considering its relatively low initial capital outlay and short implementation lead time.

Saskatchewan's best long-term option is using its abundant world-recognized uranium resources as the fuel to generate the expected and needed base-load electricity demand to reach the province's full economic potential. From a life cycle analysis of its emission levels, and its capacity to generate reliable base-load electrical power it appears to be the most desirable choice of technologies. High initial capital outlays and a long implementation time frame would make this option less suitable as a short to intermediate term application.

Nuclear Power Generation

While nuclear power generation technology is a well-established, proven and mature technology, there has been a long history of opposition, emanating from the late 1940's and 1950's by vocal anti-nuclear activist groups, often under the environmental protection banner of a clean and unpolluted world. Most criticisms are scientifically ill founded, technically obsolete or linked to the anti-war ban-the-bomb movement. Nuclear technology is a complex scientific and engineering subject, not readily understood by the general public. This has not stood in the way of uninformed sources expressing their opinions in pseudo-scientific language in attempts to sway public opinion and political leaders to abandon plans for the peaceful uses of nuclear technologies and power generation.

"Not in my backyard" opposition in the early years of the peaceful application of nuclear electric power development and early cost over-runs from permitting delays and 'one-off" engineering projects that didn't benefit from the learning curve, during a period of low cost fossil fuels, led to the abandonment of nuclear power generation plans and mothballing of some completed plants in the USA. Opposition to nuclear power generation was also created by the Chernobyl accident followed by the Tree Mile Island incident. Consequently, the USA and other countries shifted away from nuclear power generation to the use of fossil fuels for electricity generation and became oil dependent. Some European countries still managed to complete and safely operate an increasing number of nuclear power plants. Ironically the 'OPEC friendly' anti-nuclear movement hastened the oil dependency and the resulting high levels of Green House Gas (GHG) emissions they are now trying to curb. Those countries that were going to curb and reduce nuclear electric power generating capacity following Three Mile Island and Chernobyl (those were special cases that cannot occur with Canada's CANDU and other next generation reactors) are now seeking the GHG reduction benefits of nuclear power by re-licensing plants scheduled for shut down and licensing additions to their nuclear power capacity.

Nuclear Fears Unfounded

What is it that has driven the anti-nuclear movement to its position? The initial efforts of the anti-nuclear activists were to instil a fear of radiation. The Seaborn Panel on the Management and Disposal of Nuclear Waste in Canada called it the "Dread Factor"--- the perpetuation of the fear of radiation.

This fear is perpetuated by anti-nuclear activists with exaggerated and unscientific claims of adverse health effects and estimated high death rates from exposure to any level or dose of radiation. Such beliefs have been encouraged by sensational media stories and fictional Hollywood productions. Because radiation can't be seen, smelled or felt, people worry that they have no control over it. They therefore regard radiation as potentially more threatening than many higher risks that they encounter in daily life.

During the past two decades many advances have been made in radiation biology, in the understanding of carcinogenesis, and in the discovery of defenses against DNA damage and carcinogenesis. The erroneous conclusions of earlier extrapolation-based studies are that "no amount of radiation is small enough to be harmless" and that "a nuclear accident could kill hundreds of thousands" are not valid in light of current evidence. The old assumption, adopted some fifty years ago after studies of DNA damage in fruit flies, called the Linear No Threshold (LNT) assumption, extrapolates in a straight line the cancer data following high levels of radiation exposure and dose rates to low level radiation exposures and erroneously predicts a risk of cancer from low level exposures and dose rates, where there is no statistically valid evidence of increased cancer. The scientific findings of the last two decades contradict the LNT assumption and its applications and actually show beneficial effects on laboratory specimens and humans of low doses of radiation, as we receive from X-rays and CT (Computed tomography) diagnostic body scans,

Unfortunately, while scientifically incorrect, the LNT hypothesis is still embedded in much regulation created following the Second World War and the advent of peaceful uses of nuclear energy. Such deeply immoral misuse of our scientific heritage to predict cancer risks has been discouraged by prominent international scientific societies. These predictions of cancer risks were never realized and are contradicted by contrary evidence which shows lower risks of developing cancer at low levels of radiation exposure.

The Safe Operation of Nuclear Power Plants

The world has over a century of experience with radiation and six decades with nuclear reactors. This successful experience should dispel any negative images and implications of health risks, which are derived from unscientific extrapolation of harmful effects from high doses. It is clear from the performance of Canada's nuclear power plants that there is no evidence of a higher risk of developing cancer by either nuclear plant workers or the general public. Exposure levels outside Canada's nuclear power plants are no different from naturally occurring background radiation levels, with no demonstrated adverse health effects. The more than 440 operating nuclear power reactors in 32 countries have demonstrated an excellent record of safe performance. The Chernobyl accident was caused by a combination of unqualified personnel running the plant, bad design and poor construction and lack of regulatory oversight, none of which are factors of the Canadian-built and -operated CANDU nuclear power plants. The Three

Mile Island incident was fully contained with no loss of life or harm to the public. Improved technology and design, greater regulatory controls and qualified operating personnel have contributed since to the safe operation of the world's currently operating nuclear power reactors.

The anti-nuclear movement tries to instill a level of fear that is unsubstantiated by actual facts and experiences. The nuclear industry is the most intensively regulated industry in Canada in terms of environmental impact assessment and stringent performance criteria to be met during the life cycle of planning, construction, operation and eventual decommissioning of power plants. The close scrutiny by this multi-facetted regulatory process should instill a high level of confidence in the safeguarding of workers and the general public. The excellent safety performance record of Canada's CANDU reactors is a clear example of this to all Canadians.

A more recently expressed concern of the anti-nuclear activist groups is that of initial high capital cost of construction and potential cost overruns. While there are a number of examples of cost overruns, mainly with some "first of type" nuclear power plants, there are also excellent examples of within budget and within schedule performances of large-scale projects.

For instance, on the subject of capital cost of a CANDU reactor, it is a considered opinion that Saskatchewan should only consider the (700 MWe) **CANDU 6** reactor for Saskatchewan, <u>not</u> the 1150 MWe Advanced CANDU Reactor (ACR). Two CANDU 6 reactors were built <u>under</u> budget and <u>within</u> schedule in China; the fifth and sixth reactors in a row designed and built by AECL without either cost or schedule overruns. Many CANDU 6 reactors were built recently in Romania and Korea. The CANDU 6 is a proven design, AECL knows the costs and there is a well-established Canadian CANDU equipment supplier base. Building the new ACR reactor is a more uncertain proposition, so Saskatchewan should leave that risk for others to share.

Extremely strict regulations, often changed during construction, have added to the cost of construction of nuclear power plants, causing delays and cost overruns. As long as international regulations are influenced by the now considered obsolete LNT assumption, nuclear power plants tend to be over designed, as compared to the actual risks. Nevertheless, commercial operators of nuclear power plant consider such ventures viable commercial undertakings.

The world is experiencing a renaissance of nuclear power generation, with plans for many new plants. This expansion of nuclear power generation is driven not only by increasing energy demand, but also by the heightened concerns about meeting emission standards associated with climate change issues. With the recognition that nuclear power plants can be operated safely with reduced risk of ionizing radiation in the eyes of the public and the acceptance, indeed demand for radiation-based medical diagnostic and treatment procedures for cancer, heart and many other ailments, the attention of the anti-nuclear activists has shifted to criticize, what they call, "the unsolvable problem" of radioactive waste and that of the proliferation of nuclear weapons material.

Nuclear Waste Management and Disposal

Contrary to the views expressed by anti-nuclear activists, storage and disposal of nuclear used fuel is NOT an unsolvable problem. The fundamentals have been known for over three decades. The Seaborn Panel judged the concept to be safe. Canada and Saskatchewan in particular has excellent geological characteristics for such a facility. The amount of nuclear "waste" (used nuclear fuel) is indeed very small compared with the over 500 kg of municipal waste that the average Westerner produced per year. Each CANDU fuel bundle (10 cm diameter and 50 cm long) produces about 1 million kWh of electricity, equivalent to about 400 tonnes of coal, enough to supply 100 homes with their electricity needs for a year. The amount of used fuel to manage for this energy is just one bundle.

It is not the technology that holds back its implementation; it is the social and political resistance. One feeds on the other; the fear is fanned by the constant casting of doubt on the abilities of science and engineering, and the constant reference to the single occurrence of the accident at the Chernobyl Station. The nuclear industry can do a much better job of educating, explaining and consulting with the public to offset the negative images being portrayed by anti-nuclear activists.

Sociological science does not appear to be in step with the evidence of actual radiation experiences, or to keep pace with or to accept the technological developments and the continuous improvements in safety and security being made by the nuclear industry.

Environmental Assessment and Review Process

The disposal and management of nuclear waste, more appropriately called used nuclear fuel, continues to be a concern with the public. To address this concern the federal government appointed an Environmental Assessment and Review Panel (a.k.a. the Seaborn Panel) in 1989.

This Panel spent almost a decade evaluating the concept of deep underground storage and eventual disposal of nuclear used fuel; the Panel's involvement with the Canadian public included:

Scoping meetings in 14 communities (autumn 1990)

Workshops on Aboriginal issues

Public hearings in 16 communities (mostly in Northern Canada).

The whole process was divided in three Phases, each with its own series of hearings, i.e.:

Phase I – Broad Social Issues,

Phase II – AECL (Technical) Concept,

Phase III – Public's Opinion on Safety and Acceptability

The Panel heard from 531 registered speakers and received 536 written submissions.

The Panel heard oral and written closing statements from many participants.

The Panel's Final Report was issued February 1998.

In spite of this, some people still claim that there has not been sufficient public consultation and discussion on the subject.

Panel Conclusion

After long and sometimes arduous deliberation among the great diversity of Panel members, and consultation with its Scientific Review Group, the Panel concluded that:

"From a technical perspective, safety of the AECL concept has been, on balance, adequately demonstrated for a conceptual stage of development, but from a social perspective it has not."

The Nuclear Waste Management Organization

About three years after the Final Report and Recommendations the government formed the Nuclear Waste Management Organization (NWMO).

The NWMO has held many open meetings and Dialogue Sessions across Canada for another three years. The NWMO has since then adopted an *"Adaptive Phased Management"* approach, meaning:

1. Storage on site at nuclear generating plants
2. Shallow below ground retrievable storage
3. Disposal in deep underground repository

In June 2007, the NWMO was given responsibility for implementing Adaptive Phased Management (APM). NWMO is now moving forward with a multi-party dialogue on the proposed process to select a site for the long-term management of Canada's used nuclear fuel.

Several countries are well advanced in this process. The Canadian Nuclear Waste Management Organization (NWMO) consults regularly with other countries (e.g. Finland, Sweden) and contributes to the world body of knowledge in both the technological and sociological areas.

Safety of the Public and Nuclear Workers

With respect to the safety of the Canadian design of used fuel management and disposal facilities the exposure of workers and the public to any possible radiation is well below natural background levels, safety regulations and health standards. Concerned by the then (1990s) conflicting evidence of the effects of a low dose or a low dose rate of radiation, and the safety measures to be followed by the industry, the Seaborn Panel posed the question in its Final Report: How safe is safe enough?

"From a technical viewpoint: if the predicted radiological or chemical dose rates are well below natural fluctuations does it make sense to try to reduce them further through expenditures or additional safeguards?"

Adherence to outdated, incorrect models and unscientific beliefs by opponents of the nuclear industry, as well as insufficiently clear information from the nuclear industry, stand in the way of an informed and rational public decision-making process. Our political leaders should be careful in expressing negative comments and statements about the prospects of a nuclear used fuel repository in Saskatchewan without having the facts and presenting any evidence to back up their statements. Natural radiation from Saskatchewan's world-richest uranium deposits would be greater than engineered sub-surface or deep underground spent nuclear fuel storage and eventual disposal, if needed. Ongoing dialogues and discussions, as well as dissemination of clear language information, are clearly in the public interest.

From a technology perspective the storage and disposal of used nuclear fuel in Saskatchewan is a safe development. In itself it will be one of the highest, if not the all time highest investment project to be undertaken in this province. The NWMO in its 2005 final study report estimated the cost of Adaptive Phased Management (APM) to be in the range of $5 to $6 billion (stated in present value as of January 1, 2004) assuming 3.6 million used fuel bundles would be produced over the life of Canada's existing nuclear reactors; almost the entire cost being borne by the producing provinces of Ontario, Quebec and New Brunswick as well as AECL. Both from a technological and economic perspective constructing and operating a storage and disposal facility for used nuclear fuel would have to rank as one of the most favourable and beneficial options to expand the uranium industry in Saskatchewan.

The Canadian onsite and retrievable method of storing previously used CANDU reactor fuel will prove to be a unique resource in the future as technology is rapidly advancing to reprocess used reactor fuel to use the resulting isotopes in the next generation of fast breeder reactors.

Medical Isotopes

The recent crisis in the production and availability of medical radio isotopes, caused by the shutdown of the NRU reactor at Chalk River and the discontinuing of the construction of the MAPLES as its successor has drawn much attention to Canada's historically preeminent role in the field of medical radio isotopes and the impact on world supplies and medical treatments.

From the outset of the development and the application of ionizing radiology in the treatment of cancer, Saskatchewan has played a leading role with the introduction of Cobalt-60 therapy in Saskatoon.

The first Cobalt – 60 teletherapy unit was installed at Victoria Hospital, London, Ontario, for cancer treatment. It was developed and supplied by Eldorado Mining and Refining Limited's Chemical Division in Ottawa (now MDS Nordion). However, Dr. Harold Johns, of the University of Saskatchewan, and two of his graduate students Sylvia Fedoruk (later the Honourable Sylvia O. Fedoruk, Lieutenant Governor of Saskatchewan) and Gordon Whitmore (later Dr. Gordon F. Whitmore of Princess Margaret Hospital renown) in a parallel effort shortly thereafter demonstrated a competitor Cobalt – 60 teletherapy unit. Currently, the Saskatchewan Research Council operates a 20KW SLOWPOKE research reactor, designed and supplied by AECL, at its Saskatoon Centre.

The Expert Review Panel on Medical Isotope Production is now examining several options as possible solutions to this crisis. Among these is the interesting development, albeit very preliminary, namely the July 8, 2009 announcement by Premier Brad Wall that the Government of Saskatchewan and the University of Saskatchewan had entered into a partnership agreement to pursue the construction of a nuclear research reactor in Saskatoon that would produce medical isotopes while also serving as a facility capable of enabling Saskatchewan to conduct a broad program of basic research. Although preliminary, the Saskatchewan announcement merits careful consideration recognizing the pioneering and very significant nuclear science and engineering contributions of the Province and particularly the University of Saskatchewan and its graduates. Such a platform would provide the impetus for a renewed and reinvigorated program of nuclear physics and engineering and nuclear medicine education in Saskatchewan.

Conclusions

For Saskatchewan to reach it full economic development potential, coupled with its projected growth of its labour force, it will have to adopt a determined plan to add new base-load electrical generating capacity.

International and national agreements on environmental standards will need the adoption of low Life Cycle Analysis Green House Gas emission technologies for electrical power generation.

While an electrical energy generating mix of various technologies appears to meet short- and intermediate-term energy demand, long-term reliable base-load energy supply points to the installation and operation of nuclear reactors, using Saskatchewan's abundant Uranium resources via a CANDU-6 to power Saskatchewan's economic growth.

Saskatchewan should build on its enviable history of leadership in nuclear medicine, which should be enhanced as a national centre of excellence. This could be done with a research reactor at the University of Saskatchewan that would also be capable of producing medical isotopes. In a complementary development, a new CANDU-6 electric power reactor could be fitted to produce Mo-99 in its power cycle. Saskatchewan should be aware of alternate technologies to produce medical isotopes.

Nuclear power reactors, as well as storage of used nuclear fuel facilities can be safely operated and low-dose radiation can be beneficial rather than harmful.

Saskatchewan should adopt a positive attitude to the storage of used nuclear fuel as part of completing the cradle to grave cycle of the use of Uranium in a suitable site on its part of the Canadian Shield.

In order to gain a broader base of public acceptance, both government and industry sources must provide ready access to essential information on costs, economic and environmental Life Cycle Analysis results of different options.

Acknowledgements and References

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