SHOULD MANITOBA JOIN THE NUCLEAR CLUB?

L.A. Simpson[1] and Blair Skinner[2]

[1]Former Mayor, Pinawa Manitoba Canada

[2]Mayor, Pinawa, Manitoba

Abstract

Manitoba hosts the first nuclear community in Western Canada. AECL's Whiteshell Laboratories in Pinawa carried out research on reactor safety, waste management and a number of reactor types including small reactors for powering remote communities. The Whiteshell site is now being decommissioned but will likely remain under CNSC license for the next century. The site is ideal for a new power reactor with its location on a major river, a major transmission corridor that runs through the site, and its proximity to major markets. With the relatively small grid sizes in the Prairie Provinces, it makes sense for the provincial utilities to cooperate in the building of major projects so as not to overwhelm individual utilities with a large power rector. What is needed now is a formal feasibility study to address the economic factors in favour of a nuclear plant compared with the cost of remote hydro dams and expensive transmission costs.

With nuclear expansion now envisioned both east and west of Manitoba it makes sense for the province to become involved. Because of its history and knowledgeable and supportive population Pinawa could readily host a nuclear power plant or any other nuclear operation.

1. Manitoba's nuclear history

Pinawa was established in 1963 as a bedroom community for the employees of AECL's second research laboratory, named the Whiteshell Nuclear Research Establishment (WNRE). The Labs were located on the east shore of the Winnipeg River about 100 Km north east of Winnipeg. Pinawa was located 12 Km to the east of the lab at the end of a highway. While the location was fantastic in terms of the natural beauty and recreation potential, it was off the beaten track and visitors rarely came to town unless they had business there. Pinawa's isolation was not a concern since AECL's vision was that the town would grow to a population of 5000 with the anticipated expansion of the lab (one early model of the site showed four reactors, WR1 to WR4). The community actually grew to a population of about 2200 and WNRE did thrive while developing the organic-cooled reactor, studying other reactor concepts and researching reactor safety issues. Because of the early success of the Pickering reactors, AECL's interest in the organic-cooled concept waned, but emerging concerns about spent fuel disposal spawned the

Nuclear Waste Management Program (NWMP). The site name was changed to Whiteshell Laboratories. By the mid-nineties, the NWMP and the Reactor Safety Research Program were the main programs at the site, employing over 1000 employees. However there were clouds on the horizon. In 1995, because the nuclear industry was out of favour with the government of the time, AECL was instructed to cut back. A decision was made that AECL would consolidate core R&D (supporting CANDU) at Chalk River and attempt to commercialize the remaining programs, including the NWMP, at Whiteshell. Today there are still over 300 people working at the site, primarily decommissioning the facility. However there are still remnants of the waste management program and the reactor safety research program continuing. An example of this is the RD14 thermal-hydraulic loop which analyses the consequences of a loss of coolant accident in a CANDU Reactor. It is now being used to simulate accidents in ACR1000 geometry.

There is presently no intention of green-fielding the entire site which would be necessary to release it from a CNSC license. The current plan is to decontaminate most buildings and take them down, leave the WR1 reactor in a sealed up state for decades, and reduce the active area footprint to a minimal size. In addition, the high level waste will be stored in canisters on site until such time as a national storage/disposal facility becomes available. The low-level waste will continue to be stored at site in the waste management area in secure facilities.

The past 12 years or so have seen much discussion as to how to use the AECL site [1]. After looking at many non-nuclear options it was clear that the fact that the site was to be under CNSC control for the foreseeable future was an impediment to attracting new businesses. The logical solution was to look abroad in the nuclear industry and see if we could locate new nuclear activities at the site. With the current renaissance in the industry, now would seem to be a good time to move forward. The first place to look is with Manitoba Hydro and to see if a nuclear plant at the Whiteshell site would benefit the province.

2. Manitoba Hydro

When we are talking about base-load there are only two possibilities for Manitoba. Coal is not an option because of climate change concerns so that we are left with hydroelectric plants or nuclear plants. Manitoba Hydro currently has a generating capacity of about 5000 MW. About 96% of this is hydro power. There are six small stations on the Winnipeg River generating about 580MW with the bulk of the capacity, 4400MW, generated by the stations on the northern rivers, primarily the Nelson [2].

To bring the northern power to market requires high voltage DC transmission lines over distances of more than 700Km. Table 1 shows the current and projected capacities and costs for the northern plants.

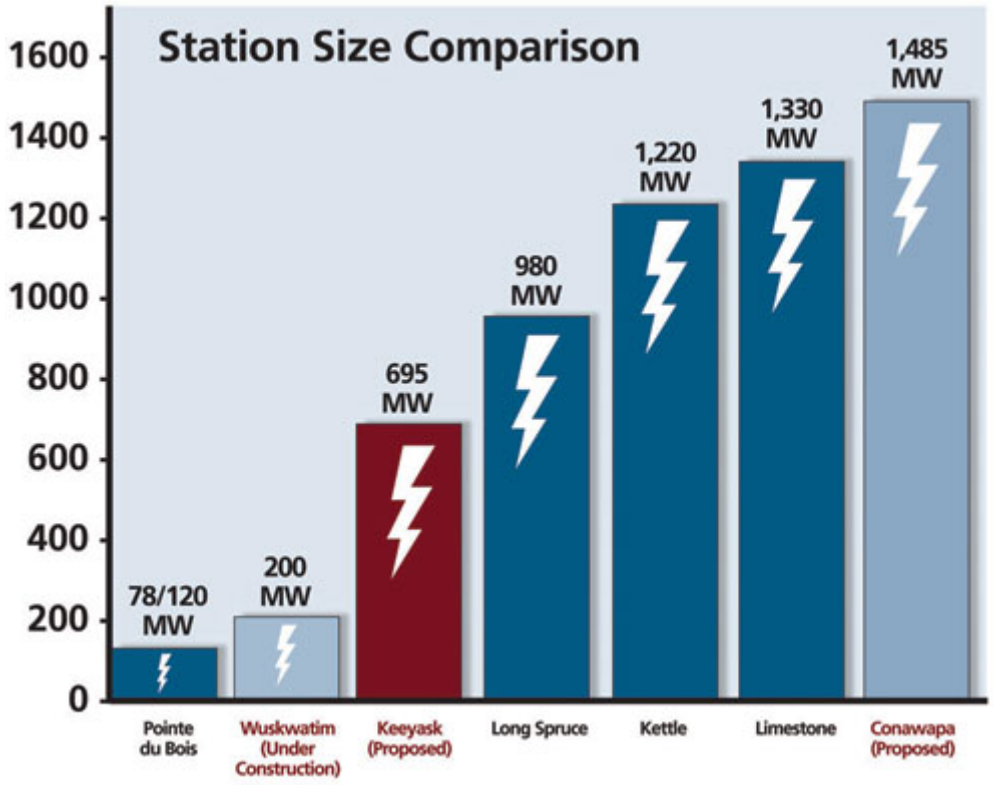

Figure 1. Some present and planned hydro electric stations on Manitoba's grid [2].

STATION	CAPACITY (MW)	DATE COMPLETED	COST M$	COST MW ($)	RIVER
KELSEY	223	1961	50	$ 0.22	NELSON
GRAND RAPIDS	479	1968	117	$ 0.24	SASKATCHEWAN
KETTLE	1220	1974	240	$ 0.20	NELSON
LONG SPRUCE	1010	1979	508	$ 0.50	NELSON
LIMESTONE	1340	1990	1430	$1.07	NELSON
CONAWAPA (PROP)	1485	FUTURE	7200	$5.14	NELSON
WUSKWUATIM	200	UNDER CONSTRUCTION	1600 (EST.)	$8.0	BURNTWOOD

Table 1. History of Manitoba's hydro construction program with original cost. [2]

Costs are very sensitive to the date built and the number for Conawapa is an estimate that includes the transmission line cost and is probably low. Coupled with this is an additional transmission cost of about 400M$ to bring the line down the west side of Lake Winnipeg rather that the shorter east side route. This reflects the current Premier's desire to have the east side recognized as a United Nation's World Heritage Site and is a highly controversial issue at present.

As might be expected with their very strong commitment to Hydro Power, Manitoba Hydro has not shown a lot of interest in building an infrastructure of nuclear expertise. They have however indicated a willingness to buy and market the power if it's produced by a private vendor who will build and operate the station. There appears to be a willingness from AECL to examine such an arrangement. Bruce Power also seems to be interested in such an arrangement in Saskatchewan. The time seems ripe for a feasibility study in Manitoba that will examine the economics of such an arrangement.

FACTORS AFFECTING CAPITAL COST	HYDRO	NUCLEAR
CONSTRUCTION COST	HIGHER	LOWER
OPERATING COST	LOWER	HIGHER
TRANSMISSION COST	HIGHER	LOWER
FOOTPRINT	KILOMETERS	METERS
LAND SETTLEMENT ISSUES	HIGH	LOW
SENSITIVITY TO DROUGHT CONDITIONS	HIGH	LOW
PERMANENT JOB CREATION	LOW	HIGH
CONSTRUCTION TIME (AFTER CONSTRUCTION LICENSE)	8-10 YEARS	4 YEARS

Table 2: Comparison of Capital Costs

3. Advantages of the Whiteshell site

3.1 Nuclear license

The Whiteshell site has been licensed for nuclear operations by the Canadian Nuclear Safety Commission and its predecessors since 1964. This included a license for the WR1 research reactor which operated at the site until 1980 when it was shutdown and defueled due to a lack of funds to continue development of the organic cooled reactor. The site now holds a decommissioning license renewable in ten years and present plans see the continued storage of some nuclear waste and the WR1 building indefinitely [3]. Given the fact that the site will continue to be under nuclear license, it makes most sense to locate new nuclear facilities there. Any new activity will naturally require a new license but this will be more easily obtained for a site that has held previous licenses. AECL has done extensive site characterization and collection of baseline environmental data, which would facilitate a successful application for a Site Preparation License and nuclear plant Construction License. The site has an ample source of cooling water supplied by the Winnipeg River.

During the initial stages of AECL's shutting down, many failed attempts were made to attract non-nuclear businesses to the site but the proximity to licensed facilities was a problem. While the federal government through AECL remains owner of the property, they are prepared to negotiate for new nuclear businesses to locate at the site, including a new nuclear power plant.

3.2 Winnipeg River

The WL site is located adjacent to the Winnipeg River, which will supply plenty of cooling water for a nuclear reactor. The flow of the river is relatively stable as it is controlled by 6 Manitoba Hydro Electricity Generating Stations, 3 upstream and 3 downstream of the WL site. The average flow rate upstream at the Slave Falls Generating Station is $860 m^3/s$. The once through flow rates for an AECL – Enhanced CANDU 6 is $43 m^3/s$ and an ACR 1000 is $67 m^3/s$ [4]. These are the upper limits to the required flow rates and normally the impact on the River flow would be less than the rates quoted. The Winnipeg River will supply adequate cooling for a nuclear reactor built at the WL site.

3.3 Transmission corridor

A Manitoba Hydro High voltage transmission line passes right through the site bringing power from the Winnipeg River dams into Winnipeg. Thus a corridor already exists for upgrading to handle a line from a nuclear plant. A new converter station (Riel) is planned for a location just north-east of Winnipeg to enhance the reliability of the Manitoba Grid and for power exports to

the USA. This is less than 100Km from the Whiteshell Site and would be an ideal location for directing exports.

Nuclear generated electricity is not dependent on the wind or the amount of precipitation. It would therefore add to the solid foundation and robustness of Manitoba Hydro's ability to produce electricity during all seasons and weather conditions. For example low water levels three years ago prevented Hydro from operating their stations at capacity and the normally profitable company lost $300M. Long unguarded transmission lines are also susceptible to severe weather and saboteurs and total dependence by the province on these transmission lines is a concern. The diversity offered by a nuclear plant on the grid would provide security of supply as Gentilly-2 did for Montreal during the ice storm in 1998.

3.4 **Nuclear friendly population in Eastman**

Eastern Manitoba has been a major player in the nuclear industry since 1963. At its peak, the Whiteshell Lab employed over 1000 scientists, engineers and support staff with a budget of 85M$, mostly spent in the region. This was a significant economic driver for the province. There are now about 300 AECL employees at the site doing mainly decommissioning work but also work on waste management and reactor safety experiments. This would provide an excellent nucleus on which to build new facilities, not just a power plant, but any part of the fuel cycle. The communities of the North Eastman region of the province, particularly Pinawa and Lac du Bonnet, are already familiar with the nuclear industry, and the economic benefits it provides. In addition, because of the large ex-AECL retirement community, there is still considerable nuclear expertise in the region to support the development of a nuclear power facility.

The economic benefit of nuclear generating capacity is substantial. The construction project would be on the order of 3-10 billion dollars depending on the size and type and number of reactors constructed and the ongoing operations would provide over 500 full-time well paid jobs for 60 years. This would have a very positive impact on the communities of the Eastern Region of Manitoba, on Winnipeg, and on the Province of Manitoba. In addition to revenues generated from the sale of the electricity generated by the facility, the Province of Manitoba would realize a return on investment from Personal Income Taxes of the employees, Payroll Taxes from the organization, and Retail Sales Tax from the operation.

3.5 **Cost comparison**

A cost comparison is not simple as it depends on a lot of factors as shown in Table 1. We believe that it is necessary to use a $/MW basis as total capacities will probably differ when comparing specific station types. However it is our feeling that nuclear power delivered at Pinawa could show a favourable cost advantage to that from the northern rivers and that is why

we are inviting a feasibility study that takes in to account all the factors in Table 2. It is important to note that cost estimates for the production of electricity from a nuclear facility include decommissioning costs and the cost for the permanent disposal of the used nuclear fuel.

4.0 Safety concerns

There is a broad spectrum of public opinion on nuclear power. By and large the general population favours it by a slim majority with the most favourable views found close to areas where some aspect of the industry is operating. This reflects a higher level of knowledge about things nuclear and comfort in the safety culture that exists. The two most frequently stated concerns of the politicians are that "we don't know what to do with the waste" and "the plant emissions of radioactivity are dangerous". The last concern evolves from the statement by the more extreme elements that "there is no safe level of radioactivity". The CNSC determines the levels of radiation that the public can be exposed to and comes up with a value at the plant boundary of one milliseivert (mSv), roughly 1/3 of the average dose received by people from natural background and medical sources [5]. Plant operators actually target a much lower value of 0.01 mSv at the plant boundary. At these levels it is impossible to measure any effect on the local population and, in fact, for exposures up to 100mSv it has been impossible to detect any increase in cancer rates in the general population [6].

There are over 400 operating nuclear power stations in the world including 20 in Canada. Nuclear power plants worldwide have an excellent safety record and are subject to very stringent regulation. In Canada, the Canadian Nuclear Safety Commission ensures that nuclear facilities are designed and operated at the highest standards. Generally, the highest support for nuclear power plants is found in the communities closest to these plants.

There is regulation on all nuclear reactors although the details differ by country. In Russia, since the Chernobyl event 20 years ago, regulation has been brought up to western standards. Even by the original Russian rules, that reactor was carrying out an experiment under conditions for which it was not licensed and with all the safety systems shut off. Even with the explosion a proper containment building would have gone a long way to mitigating the consequences. Today the media is rife with statements of casualties from that event but as yet other than about 50 deaths of the reactor operators who received huge doses of radiation, and some cases of thyroid cancer which is usually treatable, the World Health Organization is unable to detect any increases of cancer deaths in the region. As a result of that accident, there has been strong collaboration among the OECD countries and Russia who have invested astronomical sums of money on severe accident research, so that today the severe accident probability that was originally very low has been reduced by at least another order of magnitude.

On the waste management issue, the federal government has formally chosen the Nuclear Waste Management Organization's Adaptive Phased Management method [6] of deep geological disposal of high-level waste, based primarily on research carried out at Whiteshell. The Nuclear Waste Management Organization is now in the process of developing criteria for site selection. A portion of revenues from the generation of nuclear power is segregated for the eventual construction and management of a disposal facility. When the repository is built the fuel will be safely stored in a retrievable way. This will ensure that it will still be available if the industry moves toward reprocessing spent fuel and recycling it in reactors. Many in the industry argue that burying spent fuel after one pass through a reactor is wasteful and we lose over 90% of the energy remaining in the fuel. By recycling the fuel, the long lived actinides are destroyed and the ultimate waste volumes are greatly reduced. Sixty years from now the decisions whether or not to recycle will have been made and permanent burial can then occur, either of the original spent fuel, or the much lower volumes of waste from the recycling process.

So basically, the politician's views are more attune to not raising the issue of nuclear power with their constituents than based on facts.

5.0 Interprovincial cooperation

In Canada it has become common to design nuclear plants of high capacity (1000MW+) to achieve economy of scale. This is certainly the reasoning behind the ACR 1000 and other vendors are offering similar sizes for domestic base-load. For utilities in Ontario this is not a problem as the Ontario grid delivers more than 28,000MW. However Manitoba's grid delivers up to about 5000MW and the sudden addition of 1200MW would have a large impact on the total. However Manitoba Hydro's proposed hydro stations are of similar capacity, and they plan to market the sudden excess of capacity in the USA and neighbouring provinces. Both Saskatchewan and Alberta are considering building nuclear stations and their generating capacities are 3,000 and 12,000 MW respectively. Both provinces would like to replace fossil plants with carbon free sources. Saskatchewan also is interested in supplying the US market. When the three provinces and the US market is looked at as a whole and with improvement in interprovincial connections, there would be much more flexibility in absorbing a nuclear station.

6.0 Activities of the nuclear committee of council

Since the municipal elections in 1998, the Council of the Local Government District of Pinawa has been aggressively focussed on economic development including the development of other activities at the WL site. Over the last 4 years, the Council has been steadily building support for developing the WL site for nuclear electricity generation. The first formal step was taken when a Resolution was tabled at the November, 2006 annual convention of the Association of Manitoba Municipalities. The resolution read:

"THEREFORE BE IT RESOLVED THAT the AMM lobby Manitoba Hydro to give serious consideration to a nuclear power station in its future plans for base-load generation, in particular maintaining a detailed cost comparison between nuclear and hydro and recognizing the advantages to the economy of Manitoba of having the long-term, high paying jobs for the life of the plant;

AND BE IT FURTHER RESOLVED that Manitoba Hydro recognize the suitability of Pinawa and the site of Whiteshell Laboratories for a nuclear plant with its proximity to cooling water, an existing transmission corridor, the fact that the site will continue to be under nuclear license for at least a century and the familiarity and comfort of the people in the region with the industry."

Perhaps surprisingly, no one chose to speak against the resolution during the debate and the resolution passed very easily with very few opposed. Since the delegates represent all municipalities in the province, one could conclude that the "grass roots" opposition to nuclear was not as great as many have anticipated.

In 2007, the Nuclear Option committee of the Pinawa Community Development Corporation was formed to pursue this initiative. The Mayor, one Councillor and two other Directors of the PCDC board are on the committee. We have also received a formal letter of support from the Nuclear Workers Council and a local representative sits on the committee. AECL has agreed to participate as a resource. The Town and Rural Municipality of Lac du Bonnet have both agreed to participate in the process. Recently, Mayor Skinner updated the Eastern Manitoba Mayors and Reeves on our activity, and again, no one seems to have any deep concerns over the initiative. People seem to recognize that the nuclear industry has operated for many decades in Canada, with little impact on safety or the environment. Consequently, the jobs created, the economic impact, the need to fight global warming, all seem to outweigh the concerns about safety and nuclear waste disposal.

We have had a presence at the CNA Winter meetings where we also met with other members of the Canadian Association of Nuclear Host Communities. We recently attended a conference in Regina focussed on nuclear energy [8] and are here at this conference. These meetings provide valuable information about the current status of the nuclear industry and excellent networking opportunities to build support of our initiative to get a feasibility study for Manitoba.

Twice in 2008, we met with the senior officials of AECL, Manitoba Hydro and the Minister Responsible for Manitoba Hydro to stimulate Manitoba's interest in the nuclear option. The provincial Minister indicated that it was an idea that the provincial government could not immediately embrace since Manitoban's had not had an opportunity to have a dialogue on the subject. MB Hydro indicated that they have several major hydro projects in various stages and

that all of their resources were focussed on those projects. Nuclear would eventually become part of the mix but would be after all the potential hydro capacity was developed. The province agreed that nuclear was a viable option should development of hydro in the north be delayed to the point where Manitoba could not deliver on export contracts. While these reactions may seem negative, recognize that the government is not going to rush into nuclear power without strong political and economic support. This is why our first goal is to get the feasibility study which should provide this information. While Manitoba Hydro is fully involved in dam building they have indicated they would consider including in their grid, a station built and operated by a private organization.

The issue of nuclear power in Pinawa has been raised by the newspaper media and CBC radio in Winnipeg twice over the past 18 months. Both times, it was expected that a significant opposition voice would be heard, but in fact, the response has been generally positive. There is a local resident who is opposed to nuclear, but his only argument is that it is not needed by Manitoba and it should be built where the power is needed. This argument has minimal merit, however, since Manitoba along with the rest of Canada produces many commodities that are exported. Electricity is among them. Indeed, the Province of Manitoba has recently concluded agreements to sell power to Minnesota and Wisconsin. It is reasonable to assume that these markets are going to expand. After all, it does not make sense to burn coal, oil, or gas to power electric cars. Recently, there have been newspaper reports of discussions between Sask Power and Manitoba Hydro on strengthening the grid between the two provinces. This includes the possibility of using federal infrastructure funding for improving this important asset. This would greatly increase the potential for export of electricity to the West.

We believe that the time has arrived to have the public debate on nuclear generated power in Manitoba. We are supportive of development of all potential hydro resources and wind power but it should be in the context of a thorough alternatives analysis. The nuclear option would provide important diversification for the Manitoba's domestic and export electricity needs and reduce the impact of weather on supply. The economic benefits far outweigh the concerns over safety and the disposal of spent nuclear fuel. The incremental environmental impact of a nuclear project would be minimal as the footprint is already well established and is adequate and suitable for nuclear reactors. To further this argument, we are currently working on developing support for a feasibility study. This would provide all of the information required to have an informed debate on the nuclear option.

Should Manitoba Consider Nuclear? We have the first two ingredients required for a nuclear power station: a suitable site and a willing host community. Pinawa, Manitoba and Western Canada should capitalize on this important asset.

7.0 Summary

We have an ideal site, a willing community, but no immediate need for an additional power plant if Manitoba goes ahead with its plans for more northern hydro stations and more long transmission lines. However, if an economic and social argument can be made to build a nuclear plant in the south then perhaps some long range plans should be reconsidered. Also the future projects for transportation including electric and hydrogen powered vehicles could cause a substantial increase in electrical power in the next decade or two. West of Manitoba there is clearly a need for more energy to replace fossil plants and to supply the oil sands projects with clean energy that saves precious natural gas. It makes sense for more collaboration between the three prairie provinces, with their small grids, to improve transmission interconnections and plan the acquisition of new facilities together. Hopefully, this paper will serve to increase awareness of each other and of our nuclear site in Pinawa, where we have held nuclear licenses for nearly 50 years and would be a willing recipient of a new nuclear facility. Hopefully too, it may serve to help allay fears of those opposed to nuclear power.

8.0 References

[1] L.A. Simpson, “Pinawa, twelve years later”, Canadian Nuclear Society Bulletin, Vol. 29, No. 3, 2008, pp 9-14.
[2] Manitoba Hydro Website, “www.hydro.mb.ca/projects”.
[3] Renewal (2008) of the Whiteshell Site Decommissioning Licence -Information Presented for the One Day CNSC Public Hearing, November 5, 2008.
[4] R. Oberth, Atomic Energy of Canada Ltd., Private communication, May 2009
[5] Government of Canada, “Nuclear Safety and Control Act”, Ottawa, May 2000.
[6] Committee on Medical Aspects of Radiation in the Environment (COMARE), Twelfth Report, Health Protection Agency, UK, 2007.
[7] Nuclear Waste Management Organization, Final Study, “Choosing a Way Forward”, Toronto, November 2005
[8] “The nuclear option in a carbon constrained world”, Saskatchewan Environmental Industries and Managers Association, and Manitoba Environmental Industries Association, Regina, Canada, 2009 March 16-17.