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Oral Presentation

Submission from the Society of Professional Engineers and Associates

In the Matter of

Bruce Power Inc. – Bruce A and B Nuclear Generating Station

Request for a ten-year renewal of its Nuclear Power Reactor Operating Licence for the Bruce A and B Nuclear Generating Station

Commission Public Hearing – Part 2

May 28-31, 2018

Exposé oral

Mémoire de la Society of Professional Engineers and Associates

À l'égard de

Bruce Power Inc. - Centrale nucléaire de Bruce A et Bruce B

Demande de renouvellement, pour une période de dix ans, de son permis d'exploitation d'un réacteur nucléaire de puissance à la centrale nucléaire de Bruce A et Bruce B

Audience publique de la Commission – Partie 2

28-31 mai 2018

Canada

SPEA

Society of Professional Engineers and Associates

Bruce Power Application for License Renewal

Dr. Michael Ivanco – Past President SPEA

CNA

May 30-31, 2018

Background

- The Society of Professional Engineers and Associates (SPEA) is a union that represents engineers, scientists, technicians, technologists, designers and skilled trades who work for SNC Lavalin's Nuclear Division.

- Formerly our members worked for the reactor division of Atomic Energy of Canada Ltd, which was the designer of the Pickering A reactor, co-designer of the Bruce A reactor and designer of CANDU 6 reactors around the world.

- Our members currently design reactors and provide engineering, technical and procurement support for existing reactors around the world and in Canada, including those at Bruce Power

Role of Bruce Power in Ontario (1)

- The Bruce A reactor units were built in the early 1970s and the Bruce B units in the late 70s/early 80s. At this time Ontario's economy was expanding and in need of abundant and cheap electricity. With the easily exploitable hydro electric capacity already developed this meant building coal or nuclear.
- The Ontario government chose to build both types of electricity generation. The nuclear generation built at Bruce replaced, on a one-for-one basis, generation that would otherwise have been produced by burning coal.
- To date, the Bruce nuclear units have produced 1360 TWh of electricity and displaced 1.36 Billion tonnes of CO_2

Role of Bruce Power in Ontario (2)

- To put this quantity in perspective, Canada's annual emissions from all sources are about 700 million tonnes of CO_2
- Annually the station generates about 50 TWh of carbon free electricity, enough to power over 4 million homes, and avoids 50 million tonnes of CO_2 emissions.
- In 2017 Ontario's electricity demand was 132 TWh and Bruce Power generated 37% of it.
- Bruce Power has played a key role in reducing Canada's GHG footprint over the years.
- The return to service of Bruce 1 and 2 in 2012 was the single largest factor that enabled Ontario to shut down the last of its coal-fired plants.

Role of Bruce Power in Ontario (3)

- There is no currently technically or economically viable option for replacing Bruce Power's electricity, save for fossil fuel generation.
- As wind power generation ramps up in capacity, generating 50 TWh annually of replacement electricity with a combination of 25% wind[1] and 75% natural gas may be technically viable but would increase the province's greenhouse gas emissions by approximately 19 million tonnes – equivalent to adding 3.8 million vehicles to Ontario's roads.
- There is no option for replacing Bruce Power's electricity that is not a huge step backwards in the province's goals of reducing carbon emissions

(note: 1 – the average capacity factor for wind power in Ontario is approximately 25% and we have assumed 500 g of CO_2 emissions per kWh for Natural Gas-fired electricity generation)

Role of Bruce Power in Ontario (4)

- Radiation therapy, for the treatment of cancer, was developed at Atomic Energy of Canada (AECL) in the early 1950s and, before long, AECL built and sold the therapy machines.
- The source of the radiation is gamma from cobalt-60 and Canada is the source of the majority of the world's Co-60.
- Some of the reactor control adjuster rods in the Bruce reactors are made of Co-59, which activates to Co-60.
- 40 % of the world's supply comes from Bruce Power

Role of Bruce Power in Ontario (5)

- The Bruce Power site plays an important role in technical innovation and economic development, especially in the Bruce Peninsula region.
- Nuclear generation sites are “job factories.” An 800 MW gas fired plant employs about 25 people and produces electricity at a price comparable to, though slightly higher than, nuclear power in Ontario.
- An 800 MW nuclear plants, by comparison, employs about 600 people with expertise is almost all areas of science and technology.
- Bruce Power employs about 4,000 people and it not only helps power the economic engine of Ontario but is, itself, an economic engine for the Bruce Peninsula.
- MCR of 6 units will add thousands of jobs during the MCR timeline.

Key Factors for Consideration in Licence Renewal

- Robustness of Design
- Safety Performance
- Environmental Performance
- Safe Management of Used Fuel

Robust Design

- CANDU reactors are unique, compared to conventional pressurized light water reactors, be they Westinghouse type PWRs or GE type Boiling water reactors.
- Fuel is non-enriched and unused fuel can be handled, by hand, with no danger.
- Reactor core is multiplexed (480 channels), instead of one large pressure vessel, so that if there is ever a Loss-of-coolant accident (LOCA), it is likely to be confined to a single channel with no danger to the employees or the public (e.g. P2-G16 in 1983).
- Reactivity excursions, in case of any accident, in the reactor core are slow compared to light water reactors and therefore much easier to mitigate.
- There is an order of magnitude more water in a CANDU reactor, compared to a PWR or BWR, core to act as a heat sink in the event of a beyond design basis accident.

Response to Fukushima (1)

- The "order of magnitude more water" in a CANDU reactor gives it an inherent advantage in situations such as the one that occurred at Fukushima – i.e. station blackout with loss of all power.
- Water has a high heat capacity as well as a high heat of vapourization so the extra water "buys time."
- All reactors have decay heat that needs to be dealt with after shutdown. During normal operation this is provided by shutdown cooling systems.
- If these systems fail, as they did in Fukushima, and some external method of cooling the fuel is not found, the reactor core will collapse and eventually the reactor vessel will be breached.
- In Fukushima bad things started to happen after about 12 hours.
- If it had been a CANDU reactor instead of a BWR, there would have been much more time to find an alternative solution for cooling the fuel

Response to Fukushima (2)

- Nonetheless, the accident caused all reactor designers, operators and regulators to review their designs, operations and regulations.
- The CNSC created and integrated action plan and identified action items that consist of design changes, analysis of robustness of design in beyond design basis accident scenarios and also development of new regulations.
- In the case of the Bruce NGS, 13 station-specific action items were identified and Bruce Power has made good progress on these, closing 10 of 13 to date.
- The remaining 3 are relatively straightforward design modifications that are in progress.
- The general public should keep in mind, however, that a Fukushima type accident could not happen to reactors located on the Great Lakes.

Safety Performance (1)

- BRUCE POWER conducted a Periodic Safety Review (PSR).
- This comprehensive assessment of the design, current state of the plant, operations and performance is carried out once every 10 years.
- PSR addressed 64 modern standards and was found by the CNSC to be acceptable.
- This gives us assurance that Bruce Power has the capability to not only carry out this comprehensive assessment but operate the plants successfully.

Safety Performance (2)

- In addition, Bruce Power made a comprehensive assessment to determine the enhancements to the plant over the next 10 year period
- The CNSC assessed the performance of Bruce Power with respect to 14 safety and control areas, including management of used fuel.
- The performance of Bruce Power was found to be either satisfactory or fully satisfactory with respect to all of these.
- These factors also give us confidence in the ability of Bruce Power to manage the plant safely.

Refurbishment

- Bruce Power plans to refurbish the 6 units that have not yet been upgraded and is asking for a license extension to bridge them through the refurbishment of the first three of these units.
- Safe operation and management of the refurbishment process are activities that will be covered under the license extension.
- Refurbishment consists of major component replacement (MCR) and asset management of components that do not need to be replaced.
- The refurbishment of the 6 Bruce units will help Ontario to meet it's greenhouse gas emission objectives and clean baseload power is needed as Ontario continues to electrify its transportation sector.

Environmental Performance

- With respect to public dose, the 5-year public exposure is extremely low (ranging between 1.3 and 3.0 µSv/a). The higher number is approximately 1/750th of natural background radiation dose from natural sources in Ontario, such as radon gas in basements.
- Note that there are places in the world where the "natural" background dose is as high as 260,000 µSv/a (more than 86,000 times higher than the radiation dose near the Bruce NGS) with no apparent negative impact on health[1].
- The reported data shows that the radioactive release to the environment is in the range of 0.1% of the allowable limit as set by the CNSC.
- Note: 1 – The location referred to is in Ramsar, Iran and the high background is due to Ra-226 and it's daughter products, brought to the surface by hot springs.

License Extension (1)

- Bruce Power has requested the consolidation of three licences:

1. consolidated use of nuclear substances, for laboratories and radiation devices

2. industrial radiography, for non-destructive testing

3. irradiator facility, for instrument calibration

- SPEA supports the Bruce Power proposal to consolidate these three licenses with the assumption that there will be no decrease in regulatory oversight as a result of the consolidation

License Extension (2)

- Bruce Power has also requested the ability to operate up to 300,000 Equivalent Full Power Hour (EFPH)
- The limiting factor is the lifetime of the pressure tubes.
- Analysis and laboratory tests appear to support this request, so far, and the ability to operate to 300,000 EFPH is necessary in order to prevent the shutting down of more units than will already be off line because of MCR.
- The Bruce NGS plays a key role in Ontario's electricity generating system, both in terms of generation and management (Power setbacks at Bruce help the IESO balance generation and demand, especially in the middle of the night.

License Extension (3)

- SPEA supports Bruce Power's request to extend operation to 300,000 EFPH based on analysis and laboratory results to date and with the assumption that analysis and laboratory results continue to support extended operation beyond what was originally envisioned.
- Bruce Power is also requesting a license extension that is 10 years long, instead of the shorter periods granted in the past.
- License extensions of this length have been granted, most recently to Chalk River Labs.
- Bruce Power has demonstrated that it is a trustworthy and capable steward of the important Bruce NGS asset and SPEA supports this license extension to the year 2028.

Summary

- Electricity generation by the Bruce plant has avoided, and continues to avoid, large CO_2 emissions that would otherwise be necessary.
- Based on independent measurements, the release of radiation from the operation of the Bruce plant has been consistently low, less than 0.1% of the allowable limit.
- The CANDU reactor design is robust and provides high resistance to accidental release of radiation.
- Bruce Power has done an excellent job as a steward of the Bruce NGS, and important Ontario resource and invested $Billions into its improvement.
- On this basis, SPEA supports Bruce Power's 3 requests regarding the plant's operating license.

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Questions