The Role of Nuclear: Present and Future

Bruce Power

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Innovation at work

Introduction

Bruce Power is Canada's only private sector nuclear generator. It is the world's largest operating 8-unit nuclear facility, and is located in rural southwestern Ontario. The company is a Canadian-owned partnership of Ontario Municipal Employees Retirement System (OMERS), TransCanada Corporation, the Power Workers' Union and The Society of Energy Professionals.

Formed in 2001, Bruce Power has transformed its site by returning four units to service through billions in private investment in these publicly owned assets. It has also transformed its workforce through new hiring and training, extended the life of operating units through innovative planned maintenance programs, and positioned the site for long-term stability.

In 2015, Bruce Power signed a long-term agreement with the Province of Ontario that will see Units 3-8 refurbished over the next two decades, extending the life of the site to 2064. This $13 billion private investment program will guarantee one in three homes, hospitals, schools and businesses receive carbon-free nuclear electricity for generations. This means Bruce Power will provide Ontario with 30% or 6,300 megawatts of safe, reliable and carbon-free energy to the province through 2064.

A Safe Environment

To achieve optimum safety, Bruce Power, along with other nuclear plants, operate using a 'defense-in depth' approach. As part of our operating license, Bruce Power also maintains a robust and multi-faceted emergency response program. This includes our Emergency and Protective Services department, which features an award-winning security service, a fully equipped fire department, an ambulance and an around-the-clock emergency response organization.

Bruce Power keeps in constant contact with its independent regulator, the Canadian Nuclear Safety Commission (CNSC), in order to ensure our safety and operations standards remain at the highest level. The CNSC also has staff permanently based at the Bruce Power site. The CNSC's mandate is to regulate the use of nuclear energy and materials to protect health, safety, security and the environment, and to implement Canada's international commitments on the peaceful use of nuclear energy, while disseminating objective scientific, technical and regulatory information to the public.

Supporting Ontario's Climate Change Goals by Staying off Coal

Over the past 10 years, Bruce Power has returned all of its previously dormant units to service, supplying an additional 3,000 megawatts of carbon-free electricity to Ontario's grid. This influx of clean nuclear power provided 70 per cent of the energy the province needed to shut down its coal plants. As a result, 2015 was the first year with no coal-fired electricity in Ontario. With the refurbishment of the remaining six nuclear units slated to begin in 2020, Ontario's carbon-free energy future has been secured through 2064, ensuring clean air for generations. The phase out of coal-fired electricity in Ontario has significantly reduced emissions from the energy sector, making it the single largest climate change initiative in North America.

Ontario has short–, medium–and long-term climate change targets to significantly reduce GHGs. Ontario's long-term goal is to significantly reduce GHGs below 1990 levels. In 2014, the Ministry of Environment and Climate Change released an update on the progress being made toward this goal, which would see a six per cent reduction from 1990 levels by 2014, 15 per cent

by 2020 and 80 per cent by 2050. This is equivalent to a 10.62 Megaton (Mt) CO2 equivalent reduction by 2014, 26.55 Mt by 2020 and 141.6 Mt by 2050. Ontario reported emissions of 170 Mt for 2014 and has thus succeeded in achieving the 2014 target, largely as a result of reductions of emissions in the electricity sector, which were mostly achieved through the closure of all its coal plants. This was made possible through the return-to-service and refurbishment of four Bruce Power nuclear reactors from 2003-12, which provided 70 per cent of the energy Ontario needed to get off coal. The other 30 per cent was achieved through conservation efforts, the addition of renewables to the electricity supply mix and less demand in the business sector.

Coal closure alone put Ontario on track to eliminate 30 Mt of GHG emissions in 2020, compared to the business-as-usual scenario. As outlined in the Climate Change Action Plan, the electricity sector is again a major focus for Megaton reductions to help the province reach its long-term goals. In the short term, the electricity sector will see a slight increase in emissions while the upcoming refurbishment of nuclear reactors occurs at Bruce Power and Darlington (OPG), because natural gas generation will be relied upon to make up demand when necessary. Without the security of Bruce Power's nuclear output over the next three decades, achieving the ambitious 2050 goal of a 141.6 Mt CO2 equivalent reduction in emissions (80 per cent from 1990 levels) from the electricity sector may not become a reality.

Jobs and Economic Impact

Bruce Power will provide two-thirds of Ontario's nuclear in the decades to come, and it will be a source of jobs, tax revenue and economic growth, while growing the skills and knowledge of a generation of workers. The economic impact of the Bruce site through 2064 will create and sustain 22,000 direct and indirect jobs annually, while creating $4 billion in annual Ontario economic benefit through the direct and indirect spending on operational equipment, supplies, materials and labour income.

Over the next 20 years, as Bruce Power refurbishes its fleet as outlined in Ontario's Long Term Energy Plan (LTEP) the following additional annual economic impacts will benefit the province:

- Over 5,000 direct and indirect jobs annually.
- $980 million to $1.2 billion in labour income into the Ontario economy annually.
- $751 million to $1.07 billion in annual economic benefit through equipment, supplies and materials both directly and indirectly.

There is no single, well-established project, facility or infrastructure project in Ontario that will have such a significant economic impact. The jobs, investment and economic impacts will make a significant overall contribution to Ontario's economy, and are critical to providing a stable foundation for economic growth in southwestern Ontario. After having its economy disproportionately challenged – especially in the area of manufacturing – during the global economic downturn of recent years, refurbishing Bruce Power's six remaining units provides communities within southwestern Ontario economic opportunities not seen in decades due to an expected influx of skilled labour and long-term jobs to the areas surrounding the Bruce site.

Clean Nuclear Power, Safe Hospitals

Bruce Power has a long-term agreement to supply Cobalt-60 to Ottawa-based Nordion so it can use the radioactive isotopes to sterilize 40 per cent of the world's single-use medical devices and equipment. These supplies include sutures, syringes, gloves, surgical gowns and masks.

Cobalt-60 is also used to sterilize pharmaceutical wares and cosmetics, and irradiate spices and other consumer products that include fruit, seafood, poultry and red meat.

Cobalt is mined like any other mineral. It's removed from the ground and processed into pure Cobalt-59 powder, which is then compressed into slugs and coated with nickel. These slugs are then encapsulated and assembled into adjuster rods, which are used to control the reaction in Bruce Power's reactors, where the cobalt is activated by absorbing neutrons to become Cobalt-60. The Cobalt-60 rods are then stored in Bruce Power's secondary fuel bay, suspended on the bay wall about 14 feet below the surface.

Specialized fuel handlers extract the Cobalt-60 rods one at a time, and place them in a shielded flask to be shipped to Nordion's facility. Once the bundles are received by Nordion, the Cobalt-60 is removed from its encapsulation and welded into a new double-encapsulated source called a C-188. It is then shipped to the sites of Nordion's customers for use in irradiators.

Cobalt-60 can also be used to help stop the spread of the Zika virus.Cobalt-60 is the key component of the Sterile Insect Technique (SIT), a process aimed at eliminating or, at a minimum, suppressing the population of insects that spread disease or damage agricultural crops.

Bruce Power and Nordion have also expanded their partnership and entered into an agreement to supply High Specific Activity (HSA) Cobalt-60, also referred to as medical-grade Cobalt. HSA applications include non-invasive radiosurgery for the precise treatment of brain tumors as well as other external beam therapies that are used to treat more general cancer tumors in the body. This type of Cobalt-60 is produced in a limited number of nuclear reactors globally and used in radiation-based treatment of cancer and other diseases in Canada and around the world. For over six decades, Nordion's supply of medical-grade Cobalt has come primarily from the National Research Universal (NRU) reactor at Chalk River, Ontario. Recognizing that in a few years the NRU reactor will reach its end of life, this new partnership will create a new source of supply from Bruce Power.

Stable and Affordable Power

The Bruce Power site has been, and will continue to be, key to providing both price stability and a long-term source of affordable power that continues to be significantly below the average price families and businesses pay for electricity in the province.

Bruce Power provides more than 30 per cent of Ontario's electricity at 30 per cent less than the average residential price of power. Following the refurbishment of the six remaining units at Bruce Power, nuclear will offer stable prices through 2064. Once the Bruce Power facilities have been refurbished, they are not subject to large changes in price due to surrounding market fluctuations or increases in fossil fuel costs.

As of Jan. 1, 2016, Bruce Power has received a single price for all output from the site of $64 per megawatt-hour (MW/h). The average residential price of electricity in the province was $101 MW/h, through the end of 2015's fiscal year. This is the lowest-cost generation under contract with the IESO and the lowest-cost nuclear output in the province.

The price paid for Bruce Power nuclear is fully inclusive of all costs, including capital investments that have been made, funding for fuel, waste and decommissioning liabilities, and every element of the company's operation. Through Bruce Power's site lease with Ontario

Power Generation (OPG), the company will continue to fund decommissioning and waste management costs. The cost to manage these liabilities will be determined through the Ontario Nuclear Fund Agreement (ONFA) process and are reflected in Bruce Power's price of power.

There is often a misperception that, because of the upfront capital costs associated with nuclear energy, the cost of power will be high as a result. Since nuclear plants generate a large volume of electricity, with a high degree of reliability, the capital requirements of the facility are spread over significant amounts of generation, meaning the cost to ratepayers is affordable. In the case of Bruce Power, the price paid for the electricity covers all costs, including decommissioning of the facility when it reaches its end of life, the management of low-, medium- and high level waste, and capital investments in the facility.

From an overall supply mix perspective, the role of nuclear today and refurbished nuclear in the future will play a critical role in keeping electricity costs low for Ontario families and businesses.

Climate Change

As the world moves forward in addressing the growing demand for energy, it will be important to ensure that a balanced supply mix, with emissions-free options, are pursued. Decisions made on the energy fuel source must balance both the needs of today and future generations, without ignoring the correlation between air emissions, climate and human health. Nuclear power plays a key role in supporting the Canadian government's commitment to work toward reducing GHGs and improving air quality through the development of a pan-Canadian framework on clean growth and climate change that will meet or exceed Canada's international GHG emissions targets.

Since 2003, Bruce Power has generated 70% of the additional electricity Ontario needed to get off coal while at the same time serving as an active voice in the ongoing dialogue to achieve a balanced supply mix in the province. Under Ontario's LTEP, Bruce Power will continue to play this role for many years to come as part of a balanced, clean supply mix.

As indicated earlier, in the short term, the electricity sector will see a slight increase in emissions while the upcoming refurbishment of nuclear reactors occurs at Bruce Power and Darlington (OPG), because natural gas generation will be relied upon to make up demand when necessary. Without the security of Bruce Power's nuclear output over the next three decades, achieving the ambitious 2050 goal of a 141.6 Mt CO2 equivalent reduction in emissions (80 per cent from 1990 levels) from the electricity sector may not become a reality.

In an effort to provide factual and useful information to energy users, Bruce Power also launched an innovative calculator on our App and website that illustrates how critical our output is to achieving these targets, found here: http://www.brucepower.com/resources-and-publications/nuclear-education/climate-change-calculator/. Canadians can use these tools to understand the cost and environmental impact from various energy sources along with how to conserve electricity in their homes and understand the economics of driving electric. As the calculator illustrates, our 6,300 megawatts of output in Ontario's electricity system is the equivalent of keeping six million cars off the road each year and essential to meeting the 2020, 2030 and 2050 targets.

Another key element to the province's plan is enhancing electrified transportation and personal vehicles in particular, which is a position long advocated and supported by Bruce Power. This will only have a substantial impact if Ontario continues to have a clean electricity supply mix,

which today consists of 60 per cent nuclear. By continuing to deliver our long-term investment program, Bruce Power will continue to do our part.

Bruce Power has made investments in all eight units on site to offer additional flexibility to Ontario's electricity market. With the phase out of coal in particular, there has been a need to provide flexibility when demand in the province drops, while also ensuring availability to meet peaks given the unique nature of Ontario's energy market. Of the 6,300 MW of capacity from the Bruce Power site there is the capability, which has been significantly utilized by the province, for 2,400 MW of flexible or dynamic capability. The company has achieved this by enhancements to both our operations and physical upgrades on the non-nuclear side of the plant. For more prolonged system requirements, the site has also provided the Independent Electricity System Operator (IESO) the opportunity to remove units from service if needed. Both of these options provide the market significant flexibility to manage supply and demand. The Bruce Power units are the only nuclear facilities in Ontario that have this dynamic capability, which will be essential for the province moving forward.

Electric Vehicles

Bruce Power recently implemented its Sustainability Vision to be carbon neutral. From electric vehicles to energy efficient buildings, we will be a leader in clean energy infrastructure to position the Bruce Power site to better serve the long-term clean energy needs of the province.

Transportation is one of the largest contributors to greenhouse gases (GHGs) in Ontario, with 7.6 million vehicles on the road in the province producing about 36.8 million tonnes of C02 annually. That's why Bruce Power believes the time is right for electric vehicles (EVs) to play a greater role in Ontario. These vehicles emit approximately 90 per cent less C02 than a gas car, and Ontario-made electricity is generally 80 per cent less expensive than gasoline.

The company purchased its first EV in 2013 and has used it as an educational tool at events and appearances to spread the word to both employees and the public on the benefits of EVs. The vehicle is also featured prominently on Bruce Power's website, in its iPad App and through an easy-to-use online comparison calculator at http://www.brucepowerapp.com/

Bruce Power also installed two dual-wand charging stations at the Bruce Power Visitors' Centre, which is one of the few public charging stations along the rural Lake Huron shoreline. We have also established a partnership with Plug'n Drive and are working with the organization to explore the potential opportunities for further charging station installations in the area, including Kincardine, Port Elgin, Southampton, Walkerton and Wroxeter, which are all situated along the area's busiest corridors and popular tourist destinations.

Bruce Power's long-term plan is to replace its on-site, gas-powered vehicle fleet with EVs, and this corporate strategy will continue to develop in the coming years. Bruce Power and Plug'n Drive partnered on a new iPhone app, providing people with tangible proof of economic and environmental benefits of driving an electric car. The collaborative initiative, which builds off the existing platform of Bruce Power's iPhone app, will feature a number of interactive items for people who want to switch to electric vehicles. These include interactive maps of charging stations across Ontario, information on grants, and electric vehicles on the market, as well as a unique calculator where people can determine the economic and environmental benefits of going electric.

Aboriginal Engagement

Bruce Power also works closely with local Aboriginal communities, on whose traditional lands our site is located. The company has Protocol Agreements and values a strong working relationship with the Saugeen Ojibway Nation, Historic Saugeen metis and the metis Nation of Ontario.

In 2015, we launched a $1.2 million Aboriginal Community Investment Fund, which will invest in key community, educational, environmental, training and youth development initiatives in local Aboriginal communities from 2016-20. Bruce Power also introduced a four-year Aboriginal Scholarship Program in 2015 to assist post-secondary students as they further their studies. A separate Aboriginal Scholarship for Post-secondary Education Beyond First Year Program supports students from our local Aboriginal communities of Saugeen, Nawash, Historic Saugeen metis and metis Nation of Ontario Region 7 after their first year of post-secondary school, when scholarships are more difficult to obtain. Ten students receive $2,000 through this program.

In April 2016, Bruce Power held its inaugural Aboriginal Employment and Economic Forum in Owen Sound. This is a new, permanent measure to enhance opportunities for Aboriginal peoples on the Bruce Power site. The forum provided a one-stop shop where interested individuals, businesses and organizations from Aboriginal communities could engage with Bruce Power, our unions and suppliers on employment and business development opportunities. It was a great success with about 150 local Aboriginal people learning about careers in Ontario's electricity sector.

Bruce Power is also an active member of the Canadian Council for Aboriginal Business and was awarded a Gold level certification in its Progressive Aboriginal Relations program, which is the highest level offered by the CCAB. Bruce Power is only one of 12 companies in Canada to receive this designation. We also work closely with our suppliers and contractors, encouraging them to become active members of the CCAB.

We also hold many events each year on our site, including Aboriginal Day celebrations, which welcomes members of our First Nation communities to our site to teach employees about their culture.

Public Private Partnership Structure

Bruce Power is a Canadian-owned partnership of the Ontario Municipal Employees Retirement System (OMERS), TransCanada Corporation, the Power Workers' Union (PWU) and The Society of Energy Professionals. A majority of employees are also owners and investors in the business.

Bruce Power is Canada's largest public-private partnership. The assets on the Bruce site remain owned by the province and operated by Bruce Power, a private company. Bruce Power's partners meet all investment requirements, including $7 billion of their own money since 2001. This means that all the investment required to secure the role of Bruce Power as outlined in Ontario Long Term Energy Plan (LTEP) can be achieved without impacting the balance sheet of the taxpayers of Ontario, allowing the government to stay focused on priorities like health care and education, while also working to balance the provincial budget.

In 2001, the Bruce Power Public-Private Partnership received the Gold Award for Infrastructure by the Canadian Council for Public-Private Partnerships (CCPPP) in its National Awards for

Innovation and Excellence in Public-Private Partnerships, and it has proven worthy of that gold standard over the following 15 years.

The site is leased from the Province of Ontario under a long term arrangement where all of the assets remain publicly owned, while the company is responsible for operating and investing in the units, including all refurbishment and maintenance costs. Bruce Power is also responsible for waste management costs, while contributing to fund the decommissioning of the facilities at their end of life to ensure this liability is fully funded.

In December 2015, Bruce Power and the Independent Electricity System Operator (IESO) entered into an amended, long-term agreement to secure up to 6,400 megawatts at peak of electricity from the Bruce Power site, through a multiyear investment program. Beginning in 2020 and running for nearly two decades, Bruce Power will refurbish Units 3-8, securing a clean, reliable and affordable source of electricity for Ontario families and businesses for decades to come.

The amended agreement enables the company to progress with a series of incremental life-extension investments, including refurbishment. The asset management and refurbishment projects will cost a combined $13 billion, all of which will come from private investment, with no risk to the ratepayers and public on cost or schedule over-runs, as per the agreement.

The agreement secures Bruce Power in its long-term role as supplier of low-cost electricity and allows the company to immediately invest in life-extension activities to Units 3-8 to support the overall long-term refurbishment program that will commence with Unit 6 in 2020. By optimizing the operational life of the site, significant ratepayer and system benefits will be realized.

Highlights of the arrangement include:

- On Jan. 1, 2016, Bruce Power received a single price for all output from the site of $65.73 per megawatt hour (MW/h). This compares to the 2015 price paid to Bruce Power of $64.90 MW/h against an average price of residential electricity in the province to date in 2015 of $98.90 MW/h to the end of the third quarter (January 2015-September 2015).

- Bruce Power, as a private sector operator, will continue to meet all investment requirements for the site. While there is a process to determine the cost of refurbishment and off-ramps, it is estimated the six refurbishments in the agreement will cost $8 billion ($2014), in addition to $5 billion ($2014) in a range of other life-extension activities from 2016-53. In the short-term, between 2016 and 2020, the company will be investing approximately $2.3 billion ($2014) as part of this plan. This is incremental to the company’s ongoing financial investments to sustain eight units of operation.

- The refurbishment of each unit will add 30 to 35 years of operation, extending the life of the Bruce site to 2064. Over the past decade, Bruce Power units have undergone numerous life-extending maintenance programs which allows the sequencing of refurbishments while optimizing asset life.

- Bruce Power will bear the risk of delivering these projects on time and budget with upside-sharing for better-than planned performance with the IESO. The price of these

refurbishments will be finalized prior to each project through a defined, transparent process in the agreement.

- The program will secure an estimated 22,000 jobs directly and indirectly from operations, and an additional 3,000- 5,000 jobs annually throughout the investment program, injecting billions into Ontario's economy.

- Consistent with the LTEP, a series of realistic off-ramps have been built into the agreement related to both refurbishment performance and if the province's market conditions change.

- Bruce Power will continue to provide approximately one third of its output (2,400 MW) as flexible generation, allowing the province to permanently balance system needs in a post-coal environment. This is a feature that only the Bruce Power units can provide, and has been used frequently by the IESO since 2009.

- As has been the case since 2001, Bruce Power will continue to assume responsibility for operating the site. In Canada, nuclear facilities are regulated by the federal government through the Canadian Nuclear Safety Commission (CNSC) and Bruce Power, as a licensee, will be responsible for meeting all regulatory requirements and gaining the necessary approvals to implement the investment program. The refurbishment timetable is consistent with Bruce Power's current site licence that runs to 2020, which assumes there will be no refurbishment within this period.

Conclusion

Bruce Power is proud to be part of Canada's nuclear industry and looks forward to helping ensure Canadians continue to enjoy clean air, a strong economy, and healthy communities. The role of nuclear today, and refurbished nuclear in the future, will play a critical role in keeping electricity costs low for families and businesses. We thank the Committee for this opportunity to submit our brief, and we look forward to continue working with you in the future.