

**Roundtable discussion paper on the Nuclear Sector  
Roundtable Meeting, October 28<sup>th</sup>, 2009  
Boardroom, Canadian Nuclear Association, Ottawa**

### **1. Introduction**

The NRTEE is undertaking a major new research program on *Water Sustainability and the Future of Canada's Natural Resource Sectors*.

The NRTEE will examine the relationship between water and the forestry, mining, agriculture, and energy sectors. The Program seeks to evaluate what policies, approaches and mechanisms can be used by governments, industry and water management authorities to ensure that water is best-managed to foster both ecosystem health and the natural resource sectors' economic sustainability. The focus for the initiative is water availability. Our program will examine water quality issues to the extent that such issues affect the availability of water for other users.

### **2. Sector roundtables**

Recognizing that each sector has different water needs and experiences, the NRTEE is undertaking a series of expert sectoral roundtables in the fall of 2009. The purpose of these meetings is to gain information and facilitate a dialogue among practitioners and researchers over the use of water in each of the sectors. The meetings will inform the NRTEE's work in identifying water-related risks for various sectors and ecosystems, opportunities to improve efficient water use, opportunities and barriers to innovation, and views on integrated watershed management (IWM). The nuclear energy sector roundtable will be held in Ottawa on October 28<sup>th</sup>.

The focus of this meeting will be on the production aspect of the sector. However to the extent possible we would also like to explore the upstream uranium mining aspect of the sector.

#### **More specifically, the objectives of the meeting are to:**

1. *Identify the key current and emerging freshwater use and availability issues within the nuclear energy sector.*
2. *Identify data sources and characterize the state of freshwater use information in the nuclear energy sector.*

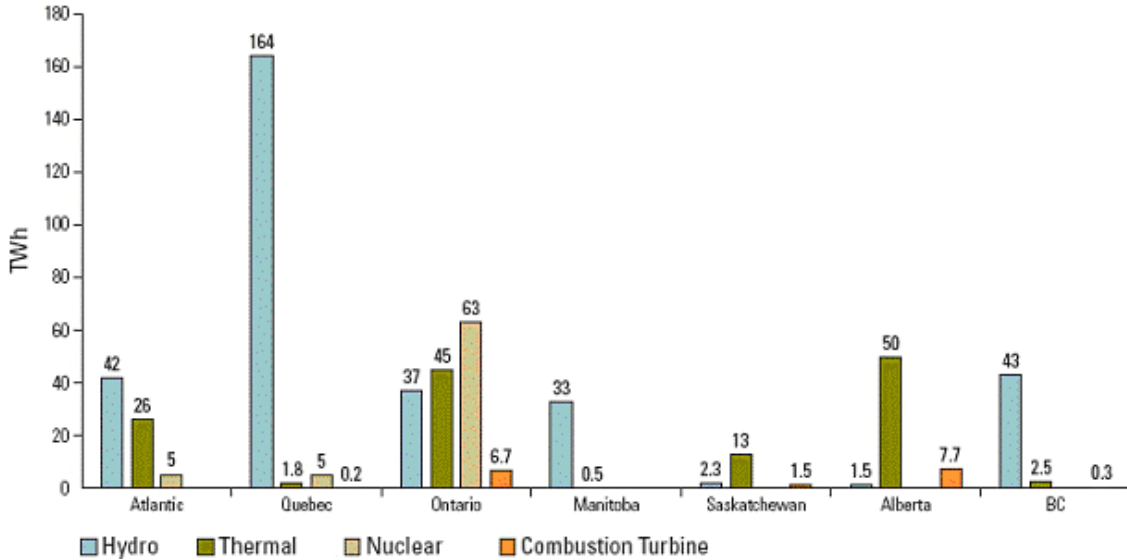
### **3. Overview of Nuclear Energy Sector in Canada**

#### *Energy Production*

The energy sector accounts for \$63 billion in GDP and is a critical enabler of Canadian industrial activity. Domestically, nuclear energy supplies 15 percent of the country's electricity needs and represents one of the few base-load solutions to reducing greenhouse gas (GHG) emissions. In Ontario, nuclear energy accounts for over 50 percent of electricity supply. Power operators exist in Ontario, New Brunswick and Quebec, and a robust supply chain that covers a range of high technology and high precision goods and services.

In 2005, Canada ranked seventh globally in terms of nuclear energy generation by amount (92,040 gigawatt hours) and 10th globally in nuclear energy generation on a per capita terms. By comparison, coal ranked 13th and natural gas ranked 22nd for electricity generation by amount; and in terms of a per capita basis, coal ranked 9th and natural gas ranked 38th.

In 2030 the share of nuclear energy power generation in Canada is expected to range from 13.77 to 15.70 per cent, close to the 14.7 per cent 2005 level, about the same is current levels.



### *Uranium Mining in Canada*

Mining companies in Canada with operations include Cameco Corporation and AREVA Resources. Currently, all uranium mining in this country takes place at three mines in Saskatchewan: McArthur River, Rabbit Lake, and McLean Lake. Cameco Corporation operates the McArthur River Key Lake mill, and the Rabbit Lake mine/mill and mine, while the McLean Lake mine is operated by AREVA Resources. The McArthur River Mine was also the largest producing in the world in 2006, producing 18.2% of the world’s total output. Rabbit Lake and McLean Lake are the world’s sixth and twelfth largest producers, respectively (CNA, 2008). While Canada is the world’s largest producer of uranium – providing over one quarter of total world production – it is the only nation that possesses high-grade ore. In production terms, Australia is rapidly closing the gap.

The McArthur River Mine in Saskatchewan has the highest grade of uranium of any mine on Earth. When the Cigar Lake Mine, also in Saskatchewan, comes on stream (currently slated for 2011) it will be the world’s second-best in terms of ore grade (CNA, 2008). Over 80 percent of Canada’s uranium is exported, mostly to the US and France (CNA, 2008).

## **4. Water use in the Nuclear Sector**

### *Energy Production*

Almost 100% of water used in nuclear generating stations is for cooling purposes and is withdrawn from freshwater sources. For the most part, the water is screened, used once, and returned back to freshwater sources with little treatment. Water consumption is low thanks to the high use of ‘open-loop’ cooling systems in Canada.

Nuclear power plants use over 700 billion litres of water per day. Water use intensity (per unit energy generation) is highest for hydroelectric generation, followed by nuclear and fossil fuel-fired generation. Nuclear power uses 3.6-5.7 m<sup>3</sup>/GWh Consumptive water, and 995,000 m<sup>3</sup>/GWh Non-Consumptive water. Therefore, water consumption is highest with nuclear energy production, followed by coal, and then oil/gas.

### *Uranium Mining*

Water management in uranium mining focuses on preventing water inflow into mines. Water balance at a uranium mine is similar to that of other mines in that the water balance of the mine site is critical,

with attention being given to water control structures, water pumping and storage, and water treatment to ensure that effluent from the mine site conforms to regulatory requirements.

## 5. Water use issues in the Nuclear Sector

### *Electricity Generation*

As noted, almost all water use in nuclear generating stations is for cooling purposes. The cooling systems are either a ‘once-through’ system, or a ‘closed-cycle’ (cooling towers) system. A once-through cooling system generally returns 99% of the water back to the water body, at a somewhat higher temperature, as allowed by the plant’s water permit. In contrast, closed-cycle systems withdraw less water than a once-through system, and discharge water at a temperature only slightly above, or at, that of the water body. But cooling towers consume 70% of the water they withdraw. Therefore, in general, cooling towers consume twice as much water as a once-through system. Once-through cooling systems may require plant operators to reduce electricity production to a small degree to observe the discharge water temperature limit during very hot days, while cooling towers do not have to reduce power for this reason. Most proposed *new* nuclear plants employ cooling towers, where discharge water temperature is not a consideration in electricity production. However it is noted that the choice of system often reflects the specific water availability, water temperature, aquatic life and habitat of the local ecosystem.

### *Uranium Mining*

The most important water issue at a uranium mine is ensuring proper water management. The need for segregation of water streams at the site is critical to: (1) prevent water inflows from coming into contact with the mine pits and mine footprint; and (2) ensure that contaminated water does not mix with ‘clean’ water.

## 6. Water use information

### *Why is water use data important?*

Just as monitoring debits, credits, and savings is crucial to financial success, water accounting is critical in informing the effective and efficient allocation of water for its sustainability. An understanding of how much water is accessible and when; where it’s located; who uses it; and what services it provides are basic necessities of effective water management. Ideal management would in theory be based on comprehensive, reliable, and frequent primary data. Yet, this kind of data infrastructure, management, and reporting can be very costly.

While several provinces have demonstrated efforts to improve their monitoring, implementation and allocation schemes, these processes are impinged by a general lack of primary data to inform policies. In water-rich regions there is little political incentive to monitor and regulate water use. However, international experience shows us that, unless carefully managed, the legacy of prior licensing decisions can result in over-allocation problems or misappropriate use that significantly impair the health of aquatic ecosystems, and ultimately the economic health of the industry.

Looking to the future sustainability of Canada’s natural resources, water demands are expected to vary regionally because of changes in climate, urban growth patterns, and growth of industry. These factors will have implications for allocation, trade, investments and infrastructure. The NRTEE seeks to understand what information is needed and how it can be better managed to improve the management of water to sustain aquifers and baseflow in streams while supporting the economy.

### *How is water use data collected in Canada?*

The NRTEE conducted preliminary research on water use data that demonstrates that no single data source provides a comprehensive picture of water use for any of Canada’s jurisdictions. However, the

following sources of information (that may be relevant to the nuclear energy sector) can provide some insights to water use in Canada:

- Individual companies' sustainability reports;
- Provincial Water Allocation Databases, Licenses and Permits;
- Statistics Canada's Industrial Water Use Surveys;
- Provincial State of the Environment Reports;
- Environmental Assessments.

From the federal perspective, data on water use by nuclear power generation is obtained through a census by the federal government of all 120 electric power stations and presented in Statistics Canada's "Industrial Water Use Survey". The NRTEE is interested in learning about other sources of water use information that is collected by the industry, either on a mandatory or voluntary basis. And further, the extent to which the data is accessible and available.

## **7. Risk for ecosystems and other water users**

Historically, water has been managed using a supply-side perspective. Now that science has improved our understanding of ecosystem health, it is apparent that the complex interactions of flow regimes, ground and surface water levels, temperature and chemistry of aquatic systems must be considered if water resources are to be sustainably managed. A balance of objectives, for both human needs and the health of ecosystems, is required to ensure the economic viability of sectors into the future. By definition, ecosystems are a biological community of interacting organisms connected to their physical environment. All ecosystems are water-dependent and rely on the circulation of water through cycles. Every ecosystem has site-specific biological components essential for its functioning, the survival of its species and services it provides.

The nuclear energy sector requires water largely for cooling processes. This necessitates large withdrawals of water, as well as discharges back into freshwater bodies in a changed state. Therefore, nuclear operations impact ecosystems in a couple different ways. Large surface water withdrawals can kill fish, larvae and other organisms that get trapped against intake structures (impinged), or swept up (entrained) with water intake. 'Once-through' systems tend to discharge large volumes of water that is warmer than the water body into which it is released, which may alter the state of the water in the receiving body and affect aquatic life. Measures can be taken to minimize these impacts through management and operational procedures. The NRTEE is interested in learning more about the techniques and approaches in minimizing impacts and risks to ecosystems (water bodies) that are a part of nuclear energy operations.

## **8. Opportunities**

While recognizing that responsibility for regulating resource development rests with governments, Canada's nuclear energy sector does have a role to play in demonstrating corporate sustainability and social and environmental responsibility in order to protect its own development and financial objectives. There is a broad consensus about the link between corporate social responsibility and business success. The NRTEE is interested in exploring the current and potential management opportunities of the nuclear industry in pursuing improvements to its water management practices. This would also include a discussion of potential technological opportunities that may exist within the sector to lessen the water use and/or improve the water efficiency. Examples include, technologies that deploy advanced water-saving cooling system strategies such as recycling degraded water, and planned new plant projects that integrate water conservation approaches and technologies in their cooling systems.

## 9. Integrated Watershed Management

Integrated Water Management (IWM) is a term describing the development of a water management strategy incorporating management of land, water, and living resources, and which promotes conservation of water resources, as well as use of water in a sustainable way. This form of management typically takes place at the watershed, water basin or sub-basin scale and involves the collaboration of participants that represent the range of water uses present in the area in question.

As a starting point, most strategies require participants to define the values and services that they wish to obtain, maintain or preserve. The subsequent actions required are then defined based on both shared and self interest. Also part of the current thinking about IWM is the acceptance that water resources are in constant change, as are the needs of water users. Therefore, solutions must be grounded in adaptive processes, with monitored and enforced commitments, as well as benchmarks for success. The NRTEE is interested in hearing about any examples of integrated water management case studies that the nuclear energy sector is involved in, and the relative importance the sector sees of such approaches to water management as it pertains to the sustainability of the sector.

## 10. Questions:

The nuclear energy sector meeting will address the following questions:

1. What are the key/priority water use issues facing the sector (now/future; and real versus perceived)?
2. What are the barriers to effective management and efficient use of water in the sector (now/future)?
3. What opportunities exist to improve the sector's water use, and perhaps its competitiveness through innovation (or other means) in water use?
4. What is the state of knowledge regarding water use information in the sector?
5. What are the key issues that NRTEE should focus on?
6. What are the key information needs that NRTEE should study further?
7. What are some initial ideas on potential solutions to these priority issues that the NRTEE could investigate (policy options for example)?

This paper was produced to assist the NRTEE and sector roundtable participants to identify the key current and emerging freshwater use and availability issues within the nuclear energy sector, and to identify data sources and characterize the state of freshwater use information in the sector. However, the information as it is presented may contain gaps or highlight themes that are more or less relevant to the broader discussion of water issues in Canada.

**Comments on the paper are welcome in writing to the NRTEE and may be sent to Jill Baker at [bakerj@nrtee-trnee.ca](mailto:bakerj@nrtee-trnee.ca).**

**Figure 1: Schematic of water use by the nuclear energy sector**  
 (Developed by Marbek Resource Consulting Ltd. for the NRTEE)

