**Risky Business: The Site Selection Process for Hosting Canada's Nuclear Waste Facility -19084**

Duane Bratt*, Renee Silke** and Xavier D. Philion***

* Mount Royal University (dbratt@mtroyal.ca)
** Canadian Nuclear Laboratories (renee.silke@cnl.ca)
*** Institute for Science, Society and Policy University of Ottawa (xavier.deschenes.philion@gmail.com)

## ABSTRACT

This paper focuses on the risk assessment and management of the site selection process for Canada's permanent high-level used nuclear fuel waste long-term management facility. It also examines the risk management approach related to the development of the transportation routes that will be needed to carry used nuclear fuel to the permanent deep geological repository (DGR). There are several types of risks (technological, environmental, human health, political, security and financial) and uncertainties (epistemic, semantic, and normative) that exist in this case. Our goal is to better understand how those different risks and uncertainties are assessed by different groups (in particular the lay public, stakeholders, and experts) and handled by the risk managers. The REACT (regulatory, economic, advisory, community, and technology) framework is used to assess risk management practices for siting a location for high-level nuclear waste. After a general introduction to the case, three descriptive sections will follow which describe the level of individuals' affectedness and dependency, the types of risk management intervention tools, and the level of democratization in the case. A particular emphasis is on the public consultation process for communities interested in hosting the DGR.

## A RISK MANAGEMENT FRAMEWORK IN THE NUCLEAR WASTE SECTOR: INTRODUCTION & CONTEXT

The @Risk research project aims to contribute recommendations to Canadian policymakers and regulators on when and how to incorporate broader public values into risk management processes in order to better address tensions that arise in public decision-making on risk issues. The project compares Canada's propensity for public engagement opportunities in risk management processes across six cases in three sectors: energy (site selection process for a high-level nuclear waste storage facility and hydraulic fracturing in Quebec and British Columbia), public health (childhood vaccination exemption policies and mammography screening), and genomics (newborn bloodspot screening and gene edited foods).

This paper examines the role of risk assessment and management in the decision-making processes for selecting a site for Canada's permanent high-level nuclear waste storage. Geographically, this study focuses on two areas: the potential storage sites and, once a site is selected, the transportation routes used to access the site. Temporally, this case study focuses on the planned site and route selection processes up until the facility is licensed to operate.

Waste management regulations and policy framework are under federal authority. Canada's radioactive waste management policy framework is defined by Natural Resources Canada (NRCan) while the Nuclear Safety and Control Act has established the Canadian Nuclear Safety Commission (CNSC) to act as an independent regulatory body responsible for regulating the use of nuclear material in Canada. The Nuclear Waste Management Organization (NWMO) is a not-for-profit corporation established under the *Nuclear Fuel Waste Act* (NFWA). The NWMO is responsible for implementing the Adaptive Phased Management (APM) approach accepted by the government for the long-term management of Canada's used nuclear fuel. Established in 2002, the NWMO is implementing a site selection process for a DGR to store Canada's used nuclear fuel.

According to the Canadian Nuclear Laboratories Inventory Summary Report (2016), there were 10,021 cubic metres of high-level nuclear waste existing at the end of 2013, and a predicted 20,660 cubic metres of high-level nuclear waste is projected to exist by 2050. A permanent solution must be developed in order to deal with the waste that currently exists and Canada's used nuclear fuel in the future. Temporary solutions include wet and dry storage at the nuclear facilities themselves. Licensees are required to maintain safe storage of their used nuclear fuel until a long-term solution is available.

The NWMO's plan, known as Adaptive Phased Management (APM), "requires used fuel to be contained and isolated in a deep geological repository. It also calls for a comprehensive process to select an informed and willing host for the project." (NWMO 2017a). The multi-step process involves finding a willing host community in a geologically suitable region in the Canadian Shield and conducting a vast array of tests with the support, and inputs, of the local citizens and surrounding communities, including Aboriginal groups.

The APM framework contains nine steps. The first two steps – Process Initiation and Initial Screening – are now completed. The third step, Preliminary Assessments of Suitability, is ongoing. In Step 4, the NWMO will proceed to detailed site evaluations, and Step 5 will confirm the acceptance of the willing host community. In Step 6, the formal agreement to host the repository will be confirmed, while the regulatory review and approval process will be conducted during Step 7. The two final steps will be the construction and operation of the facilities. From the initially interested twenty-one potential host communities in Step 1, there are now five communities still involved in the process: Hornepayne and Area; Huron-Kinloss; Ignace and Area; Manitouwadge and Area; and South Bruce (NWMO 2017b).

During the initial screening phase (Step 2), the NWMO evaluated the potential suitability of the interested communities based on a list of screening criteria that had to be met for further consideration.[1] The twenty-one communities that passed this initial screening could request a more formal "assessment of suitability". By the end of 2014, all communities engaged in learning more about Canada's plan had entered Step 3. This step is currently underway.

The NWMO has four key guiding questions: Is there the potential to find a safe site? Is there the potential to foster the well-being of the community? Is there the potential for citizens in the community to continue to be interested in the process through subsequent steps? Is there the potential to foster the well-being of surrounding communities? (NWMO 2017l).

The preliminary assessment is conducted through a series of studies divided in two phases over several years. The first two phases have focused respectively on desktop studies and fieldwork and sought to conduct both scientific and technical studies as well as community well-being assessments. Resources to support communities are available in each phase.

For each community that has been excluded from the process, the NWMO website provides a timeline describing when the community entered the site selection process (with a formal expression of interest), the types of studies it conducted in, and with, the community and explains the reasons for its decision to exclude the community as a focus of study. Communities entered the process between 2010 and 2014 and were progressively excluded beginning in 2011. The most common reasons to exclude a community from the process are i) the limited geological potential, and ii) the NWMO's assessment that the community no

[1] The NWMO's list includes five screening criteria: "The site must have available land of sufficient size to accommodate the surface and underground facilities. This available land must be outside protected areas, heritage sites, provincial parks, and national parks. This available land must not contain known groundwater resources at the repository depth that could be used for drinking, agriculture or industrial uses, so that the repository site is unlikely to be disturbed by future generations. This available land must not contain economically exploitable natural resources as known today, so that the repository site is unlikely to be disturbed by future generations. This available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe." (NWMO 2017k,).

longer represents a potential host (NWMO 2018e). On the last point, however, the NWMO does not provide further explanations about why a given community no longer represents a potential host.

The NWMO plans to progressively narrow the number of communities down to find the best possible site and willing host, most likely by 2022, but no timeframe was put in place to allow flexible design and iterative planning. At the end of the site selection process, the NWMO will apply for a licence to build a deep geological repository to contain and isolate used nuclear fuel. The proposed technology consists of a "multiple-barrier system" made of nuclear fuel pellets inserted in Zircaloy tubes, then introduced into copper coated canisters and encased in bentonite clay boxes, placed 500-metre-deep underground.

Once the site is selected, and before the repository is built, conceptual routes may be selected to transport high-level nuclear waste from current on-site temporary storage facilities in Manitoba, New Brunswick, Quebec and Ontario to the permanent storage site. The transportation routes represent another important element of the overall risk management framework.

This paper has four parts. Part one describes the risks and uncertainties that are related to the nuclear waste management. Part two evaluates the level of affectedness. Part three analyzes the types of risk management tools involved in nuclear waste siting. Part four provides a preliminary assessment of the level of democratization characterizing Canada's decision-making process for the site selection process for the used nuclear fuel DGR.

## RISKS AND UNCERTAINTIES IN NUCLEAR WASTE MANAGEMENT

This section provides an exploratory reflection on the issue of risks and uncertainties. The key issues at stake are: How to manage risk? What are the different perceptions of risks from different actors involved in the process? And who's worth being trusted? "Risk perception is a subjective assessment of the likelihood and severity of an event with negative consequences occurring" (Bourassa et al. 2016: 202 in reference to Sjöberg et al. 2004). Risk management is intertwined with the understanding of uncertainties and assessment of how precautions are (or could be) taken to avoid the occurrence of undesired events.

There are six types of risk (technological, environmental, human health, political, security, and financial) and three categories of uncertainties (epistemic, semantic, and normative) applicable to the nuclear waste management case study. Technological risks deal with the safe construction, operation and closure of a geological repository. The repository and the nuclear waste storage casks must be capable of safely containing the nuclear waste for thousands of years, but must also be accessible should reprocessing solutions become feasible in the future. Environmental risks include geological processes, tectonic movement, and climate change, which could damage the repository. Risks to the environment include contamination of the soil and water around the repository, as well as possible contamination due to accidents along the transportation routes. Human health risks include exposure to radiation through the DGR or contamination of soil or water. These risks to human and environmental health are magnified by having a large quantity of high-level nuclear waste at one localized site. Accidents along the transportation routes could also impact human health.

In addition, the existence and perception of risks to the environment may have social effects with political and financial implications. Political risks may arise from the NWMO's requirement to consult with the affected communities. These affected communities not only include those being considered for the final site of the geologic repository, but also those communities on or near the transportation routes. There may even be political risks from communities that are nowhere near the DGR or the transportation routes; public opinion may just be opposed to a permanent nuclear waste site. Security risks include accidents or terrorist attacks during transportation or at the facility itself. The government's final decision to approve the DGR construction is also highly political. Will a federal cabinet be willing to support such a project if public opinion becomes highly mobilized against it, and a prime minister be willing to make such a decision part of his or her political legacy? Financial risks include the costs of building and maintaining the site and maintaining or improving the methods of transportation to the site (e.g.: roads, rail, airport, etc.).

Uncertainty is reflected in the key common questions: 1. How do we know the nuclear waste disposal is going to be safe, and the technology durable, for a hundred thousand years? 2. More broadly, can we keep safely producing nuclear energy, and waste, in Canada in the future? While nuclear advocates believe the long-term waste disposal technology is safe and reliable, opponents argue that a series of epistemic modelling risks are left unanswered; corrosion, pressurization, earthquakes, future ice ages, or human interference could result in dramatic consequences for environmental and human health, according to them (concerns to which the NWMO replies that the rock formation where nuclear waste will be stored will be highly stable and the multi-layers system is a proven technology). Semantic uncertainty is also high: How do we warn future populations to stay away from the nuclear repository? The key concern here is how to ensure no one will dig out nuclear waste in the future. To do this, a universal sign that will be understood thousands of years from now saying: “Don’t dig here!” must be found. The NWMO has not yet addressed this semantic issue. Although not constructive towards dealing with existing nuclear fuel waste, normative uncertainty also remains about whether Canada should continue to produce nuclear energy. Opponents believe that the whole nuclear supply chain should be assessed rather than a single waste management project, and a progressive phase out from nuclear energy must occur.

It is also important to mention that not building a repository for used nuclear fuel is not risk free either. Interim storage facilities are currently present in four Canadian provinces: Manitoba, Ontario, Quebec and New Brunswick, both at nuclear power reactor sites (Bruce, Darlington, and Pickering in Ontario; Gentilly in Quebec, and Point Lepreau in New Brunswick) and Canadian Nuclear Laboratories sites (Whiteshell Laboratories in Manitoba, and Chalk River Laboratories in Ontario). Currently, bundles of used nuclear fuel are placed in water-filled pools for up to ten years before being placed into dry storage containers. As the NWMO describes it, “[d]ry storage containers are made of reinforced high-density concrete about 510 millimetres (20 inches) thick and are lined inside and outside with 12.7-millimetre-thick (half-inch) steel plate. The thickness of concrete provides an effective barrier against radiation” (NWMO 2018c). They are designed to last for at least 50 years, but life span extensions, or repackaging are possible options. Monitoring and regular inspections insure the safety of the interim storage facilities. Nuclear facilities managing used nuclear waste are licensed by the CNSC, under the *Nuclear Waste Fuel Act.*

Interim storage facilities are considered a safe and reliable option to manage nuclear waste in the short and medium term, but are not practical solutions for thousands of years into the future. According to the NWMO, “Although the used fuel's radioactivity decreases with time, chemical toxicity persists. The used fuel will remain a potential health risk for many hundreds of thousands of years. For this reason, it requires careful management” (NWMO 2018c). Questions remain about how long used nuclear fuel should remain stored in interim storage facilities? In addition, what are the implications of the status quo option in terms of risk/safety? Simply put, the “do nothing” option is not risk free.

## LEVEL OF AFFECTEDNESS

To assess the level of affectedness and the level of individual agency in the case of nuclear waste management in Canada, three questions guide the analysis: Do individuals have a voice? Do they have a choice? And are they able to mitigate risks? If one answers positively to all three questions, the decision-making process is individual-dependent (ID), which means that the public has agency over risk exposure. In turn, if all are answered negatively, decision-making is individual-affected (IA), i.e., the public is exposed to risks without having the ability to do anything about the situation. Between those two extreme scenarios different nuances may emerge. Also, depending on which stage of the generic public policy cycle (problem definition, agenda setting, policy development, implementation, and policy evaluation) is being assessed, individual affectedness may vary.

This case includes both individual-affected and individual-dependent assessments of risks. Canada's DGR will be located in a willing host community (individual-dependent), but the diffusion of risks may have some effects at a much larger scale (individual-affected). Under NWMO's APM approach, early stages of the site selection process are more prone to integrate public inputs, i.e., give Canadians a voice, and local communities a choice, regarding the site selection. But once the site has been selected, and technical work has commenced, the individuals may become more affected and people's agency progressively reduced.

**Individual-dependent**

Local communities living near the chosen site, and the surrounding area, are not only consulted but formally part of the siting process. Community approval is essential to the project's completion. The NWMO's APM approach explicitly "calls for a comprehensive process to select an informed and willing host for the project" (NWMO 2017a). What has yet to be explained, however, is to what extent the willing host community will remain involved in decision-making once the site is built, and nuclear wastes are progressively placed in the DGR over the subsequent decades. What will be the willing host community's level of agency in regards to the operation and monitoring of the DGR in the long-term?

**Individual-affected**

There are both direct and indirect types of individual affectedness in the nuclear waste management case. Directly affected individuals are the communities living along the transportation route that will be chosen to carry nuclear waste to the DGR and communities that live near the selected site, but not close enough to be part of the decision-making process. Both could be affected by the transport of nuclear waste and, to some extent, by the increased traffic for the transport of resources, workers, and materials to build the waste repository.

Indirectly affected individuals also include the broader communities (in Ontario, Quebec, New Brunswick and even Canada as a whole) affected by the siting decision. The most important risk, although with very low probability of occurrence, is that of the movement of contamination from radioactive waste (through soil into the water table for instance).

## PRIMARY RISK MANAGEMENT INTERVENTION TOOLS

The REACT framework (regulatory, economic, advisory, community, and technological) describes the most prominent types of risk management intervention tools. In the case of the site selection process for nuclear waste, all five tools are important: a strict federal regulatory framework, economic incentives for host communities to participate in the site selection process, advisory interventions, community involvement in the site selection process, and technological developments. In this section, each risk management intervention tool is reviewed separately, but it is also important to note that they remain highly intertwined in practice.

**Regulatory Interventions**

The regulatory framework is central to the project's completion as it determines the boundaries of action for the NWMO (including the decision to require the host community's approval before proceeding with the project), guides the consultation and information process, determines the financial compensations for participation, determines the benefits to the host community, and so on. Nuclear energy, from cradle to grave, is a highly regulated field. The sole federal regulator for the nuclear industry in Canada is the CNSC, which was established in 2000 by the Nuclear Safety and Control Act. It replaced the previous Atomic Energy Control Board. The mandate of the CNSC is to regulate "the use of nuclear energy and materials to protect health, safety, security and the environment; to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public" (CNSC 2018).

The CNSC reports to Parliament through the Minister of Natural Resources, and CNSC's decision-making is kept at arm's length from the government. Neither the Minister nor the Governor in Council have a role in the CNSC's decision making or have a power of appeal. The Federal Court of Canada is the only body which can review decisions made by the CNSC, and while it cannot reverse a CNSC decision, it can refer a decision back to the CNSC for reconsideration if it believes the CNSC acted outside its mandate. The Canadian Parliament can also temporarily bypass CNSC decisions, although this has only occurred once.[2]

The regulatory framework used by the CNSC to fulfill its mandate consists of the laws passed by Parliament which govern the regulation of Canada's nuclear industry, and the regulations, licenses and documents that the CNSC develops (CNSC 2017). Regulatory documents include requirement and guidance information and remain subject to regular review. Requirements must be met by any licensee applicant, and guidance information directs licensee applicants on how to meet these requirements.

There are four federal laws to highlight: the Nuclear Energy Act (1985) legislates the research and development of nuclear energy in Canada; the Nuclear Safety and Control Act (2000) regulates the use of nuclear energy in Canada; the Nuclear Liability and Compensation Act (2017) defines responsibilities of liability in case of accident (see the Economic section for more details); and the Nuclear Fuel Waste Act (2002) regulates nuclear fuel waste management. As previously mentioned, the Nuclear Fuel Waste Act provides a framework for decision-making on the management of nuclear fuel waste. It also created the Nuclear Waste Management Organization and a trust fund into which every major owner of used nuclear fuel in Canada must deposit to finance the long-term management of used nuclear fuel (NWMO 2018d).

In addition to the legislative framework, the Radioactive Waste Policy Framework, implemented by NRCan, states that the "federal government is responsible for ensuring that long-term radioactive waste management is carried out in a safe, environmentally sound, comprehensive, cost-effective and integrated manner" (Natural Resources Canada 2015).

The CNSC is also subject to obligations under the Canadian Environmental Assessment Act, 2012 which stipulates that an environmental assessment must be conducted for designated nuclear projects. Thus, even after completing the public engagement process associated with finding a willing host community, additional public engagement and technical processes will likely be required under the environmental assessment or impact assessment legislation in place in the future and those associated with the CNSC regulatory process. The latter currently involve CNSC Regulatory Guide G-320, Assessing the Long Term Safety of Radioactive Waste Management, and Regulatory Policy P-290, Managing Radioactive

[2] In December 2007, the CNSC determined that Atomic Energy of Canada Limited (AECL) did not comply with its license to operate the NRU reactor because the two back-up pumps were not connected to the emergency power supply as required by the licence. Because, at that time, the NRU was the main producer of medical isotopes world-wide, Parliament, after an emergency late-night debate, unanimously passed legislation allowing AECL to operate the NRU reactor for 120 days while the back-up pump situation was rectified.

Waste – the two documents which most closely deal with handling the long-term management of radioactive waste, in addition to the requirements of the Nuclear Safety Control Act and its regulations.

It is also important to note that while the CNSC is the licensing authority, it works closely with other federal and provincial bodies to ensure that regulatory requirements are met, while recognizing that it is ultimately the responsibly of the licence applicant to meet all applicable requirements. Provinces are also responsible for protecting public health and safety, property and the environment within their borders; are responsible for the regulation of resource exploitation and extraction; and will likely require their own studies of the environmental effects of this project. Both provinces and municipalities will have their own permits, licenses, approvals, and/or bylaws that must be upheld (NWMO 2017n). All of these factors are taken into consideration for each specific project overseen by the CNSC.

The responsibility for regulating the transportation of nuclear waste is shared between the CNSC (through the Packaging and Transport of Nuclear Substances Regulations, 2015 - SOR/2015-145) and Transport Canada (Transportation of Dangerous Goods Regulations). As a result, the NWMO "will need to demonstrate to these authorities the safety and security of its transportation system." (NWMO 2018a).

To accomplish this, the NWMO must assess the safety and security of nuclear waste transportation to the permanent DGR, ensure they use a CNSC certified transport package that meets all the required certifications, licence requirements and regulations, and put in place a Transportation Security Plan, and an Emergency Response Plan. Periodic reviews and audits are also part of the plan. At the moment, a discussion document for "Planning Transportation for Adaptive Phased Management" (NWMO 2016a), and a questionnaire (NWMO 2016b) are available online for those who want to share their thoughts on this issue. According to the NWMO, transportation of nuclear wastes to the DGR should not begin before 2040.

**Economic Interventions**

There are two types of economic intervention tools in Canada's nuclear waste management sector. The first one is industry-related: the Nuclear Liability and Compensation Act (Canada 2015) establishes the compensation and liability regime in case of a nuclear accident. This act specifies that the nuclear operator is liable for damage caused within Canada at the facility or during transportation of nuclear material (including but not limited to bodily and property damage, economic loss, and environmental damage) of up to $1 billion.

The second type of economic intervention tool is community-related and refers to financial compensation as a core incentive for communities to host the DGR. Beyond the prospect of job creation within the willing host community, interested communities have already received money for participating in the site selection process. Each community (including First Nation and Métis communities) that has participated in preliminary assessment and engagement processes has been allowed to receive between $250,000 and $600,000 up to this point, depending on how far along they are in the ongoing assessment process. Some Aboriginal organizations have also received $150,000 for their participation in the process (NWMO 2017d, NWMO 2017e, NWMO 2017f).

The chosen willing host community should receive substantial financial compensation for hosting the nuclear waste facility, but the numbers remain unknown. Such financial compensations represent a key economic intervention tool in the process of finding Canada's permanent site for high-level nuclear waste and the authors believe this is the core reason communities are willing to host the repository.

**Advisory Interventions**

Advisory intervention tools refer to the knowledge transfer from experts on nuclear energy and waste management to the communities. During the site selection process, the NWMO has sought inputs from a variety of specialists. Two background papers have been written: *Developing a Siting Strategy for a Nuclear Fuel Waste Management Facility* by Richard Kuhn and Brenda Murphy (2006) and *Learning from the Experience of Others: A Selection of Case Studies about Siting Processes* prepared by Stratos Ltd. (2006). Two papers on economic benefits have also been published: The *Summary of Economic Benefits Linked to Adaptive Phased Management at an Economic Region Level* (Aecom Canada Ltd. 2009) and *A Preliminary Assessment of Illustrative Generic Community Economic Benefits from Hosting the APM Project* (Aecom Canada Ltd. 2010). Professor William Leiss has also prepared three expert papers exploring the concept of risk and risk communication: *Thinking About Risk and Safety* (Leiss 2009a); *How might communities organize their discussions about hosting a site for used nuclear fuel?* (Leiss 2009b); and *What is happening in other countries?* (Leiss 2009c).

Two other individuals seem to have develop considerable knowledge on the topic over the past few years and have become advisory experts communicating with the communities. Gordon Edwards, from the explicitly anti-nuclear Canadian Coalition for Nuclear Responsibility, and Jason Donev from the University of Calgary. Both Edwards and Donev have given presentations to community liaison committees in special meetings organized by the NWMO.

**Community Interventions**

Community interventions are central to the nuclear waste disposal facility site selection process. The NWMO has decided to use a bottom-up approach by initiating meetings and information sessions only with communities interested in welcoming the DGR. The eventual local host-community, and to some extent the neighboring area, must demonstrate its willingness to welcome the DGR on its territory. As a result, the community interventions (be it asking for more information, risk assessments, expressing questions and concerns about survey work, etc.) are at the heart of the NWMO's approach. However, what type of approval will be required and how the approval from the community will be achieved and sustained remains uncertain. So far, the NWMO argues that it is "committed that the project will only be located in an area with an informed and willing host" and that the "project will only proceed with the involvement of the community, First Nation and Métis communities in the area, and surrounding communities working together to implement it." Community approval, the NWMO suggests, "will need to be supported by a compelling demonstration of willingness." What constitutes compelling community willingness to host the site has not been substantiated by the NWMO. Questions then arise as to whether this will be done through a referendum, town hall meetings, local political support, or simply through the absence of local opposition?

The NWMO also recognizes the importance of Indigenous Knowledge as a different epistemology to consider in the site selection process: "Indigenous Knowledge is a complex and sophisticated system of knowledge drawing on millennia of wisdom and experience that constantly grows and expands with the experience of each generation. As we continue to move through the site selection process and engage with communities, there is an opportunity to learn from local Indigenous Knowledge and apply that learning to planning and decision-making processes" (NWMO 2017j). The NWMO also adds that it will "look to Indigenous communities and local Indigenous Knowledge holders in the areas surrounding interested communities to find ways to apply Indigenous Knowledge to the site selection process and protect it in its application" (NWMO 2017j). In order to do so, the NWMO has developed an Indigenous Knowledge policy (NWMO 2016j).

Some criticism has been raised in regards to the actual integration of Indigenous Knowledge into the NWMO's site selection process. Meagan Sarah Weatherdon (2017) argued that the NWMO has "interpreted Indigenous spiritual beliefs and philosophies in ways compatible with their own agenda" (2017: 94) and has limited First Nations' engagement. Weatherdon (2017: 97) also suggested that the NWMO's scientific epistemology seeks to co-opt the Indigenous traditional knowledges rather than truly listen to it: "the NWMO interprets indigenous spirituality within its own cosmological and commercial framework, which seems to grant transcendental power to technology and science." Genevieve Fuji Johnson (2015) also raised the flag over First Nations' involvement in the NWMO's consultation process. She argues that "there is evidence that participants' perspectives were not weighted equally. There were many accounts of how views were dismissed and excluded from the NWMO's assessment framework and recommendation" (Johnson *et al*. 2015: 79). This was especially true for the Assembly of First Nations in 2005 and the Congress of Aboriginal Peoples (AFN 2005) who claimed, in the earlier stages of the process, that they did not have sufficient time and funding to assess the project and express their concerns.

The Aboriginal and treaty rights of Aboriginal peoples in Canada are recognized in section 35 of the *Constitution Act, 1982*. The Supreme Court of Canada has found that the Crown (the federal and provincial governments) has a duty to consult Aboriginal peoples whenever it contemplates conduct that could adversely impact potential or established Aboriginal and/or treaty rights. The courts have struck down infrastructure projects that do not meet the standard of the duty to consult. Since all of the potential sites, and transportation routes to them, are on or pass through treaty areas, asserted or established traditional territories, or near First Nations communities, the duty to consult is an essential component of the nuclear waste site selection process.

**Technological Interventions**

Techno-scientific expertise has been, and will be, highly solicited during the DGR's site selection and construction process. This includes determining the potential geological zones where the project would be appropriate and conducting seismic surveys at the potential sites.  As well as, the provision of information to willing host communities, the construction of the site, the transportation of nuclear waste, and the maintenance and closure of the site.

The deep-geological repository the NWMO plans to build once a site is selected consists of a "multiple-barrier system".  This includes nuclear fuel pellets "made from uranium dioxide powder, baked in a furnace to produce a hard, high-density ceramic", which are then inserted in a sealed tube made of Zircaloy, a corrosion-resistant metal, and then bundled with other such tubes to create a log-shaped package. This fuel bundle is introduced in a fuel container made with carbon steel pipe and copper. Finally, each of these containers "will be encased in a highly compacted bentonite clay buffer box" 500-metre-deep underground (NWMO 2017c). The NWMO asserts that placing nuclear fuel deep underground is a proven method with minimal risks. In Finland, where the world's first civil spent fuel DGR is currently under construction, a very similar technology is being used.

Early during the site selection process (*Step 2 – Initial Screening* and *Step 3 – Preliminary Assessment of Suitability*) the NWMO's APM plan has sought to determine which interested communities have a potential for suitability based on a list of technical criteria. One key criterion is that the "available land must not be located in areas with known geological and hydrogeological characteristics that would prevent the site from being safe." It is also specified that sufficient land above and underground must be available; that the site must be located outside protected areas; away from groundwater resources "at the repository depth that could be used for drinking, agriculture or industrial uses, so that the repository site is unlikely to be disturbed by future generations"; and free from "economically exploitable natural resources as known today" (NWMO 2017k) Once preliminary desktop studies (Step 3 – Phase 1) and field studies (Step 3 – Phase 2) are conducted, detailed site evaluations will be made (Step 4). Finally, an underground demonstration facility will first be built in order to confirm the site suitability (Step 8) before constructing and operating the high-level nuclear waste facility (Step 9) (NWMO 2017m).

## LEVEL OF DEMOCRATIZATION

In this section, a preliminary assessment of the level of democratization associated with the siting of the DGR is presented. Four criteria, based on democratic principles, guide this assessment: transparency, inclusiveness, deliberative quality, and accountability. Further assessment will be needed to evaluate the level of democratization in the case of nuclear waste management more systematically. Focus groups are planned with the affected communities in order to assess: How did the NWMO interact with local communities? Did local communities feel that their concerns were addressed and their voice heard? Do Indigenous communities perceive that they were properly involved in the decision-making process? These are among the key questions that need to be answered through direct enquiries. By doing so, divergences may be observed between the NWMO's perception of democratic practices and communities vision of that aspect of the interaction with the project proponent.

### Transparency

Providing publicly available information about nuclear energy and waste management safety is a central part of both the CNSC's and the NWMO's mandates. The CNSC's REGDOC-3.2.1: *Public Information and Disclosure*[3] (CNSC 2017) clarifies how the licensed nuclear facilities, licensees and licence applicants must "develop and implement a public information program that includes a disclosure protocol. Through an effective public information program, a licensee or licence applicant establishes an atmosphere of openness, transparency and trust."

The CNSC has organized outreach activities for communities and Aboriginal peoples who have expressed interest in learning more about the CNSC's regulatory role and the licensing process for any application for a deep geological repository for Canada's used nuclear fuel. The CNSC has held 65 meetings with communities and Aboriginal groups over the last eight years (12 meetings in 2017; 9 in 2016; 8 in 2015; 12 in 2014; 9 in 2013; 6 in 2012; 8 in 2011; and 1 in 2010). Through these meetings, the CNSC informs communities about how they regulate nuclear energy and waste and how they can participate in the public hearing process. During these meetings, CNSC staff are also interested in hearing about the most effective ways to involve communities and Aboriginal groups and how to best provide information to those who want to know more about the CNSC and other relevant matters within the scope of CNSC's mandate.

The NWMO also organized seventeen regional public information sessions between May and December of 2009 in Ontario (7 meetings), Quebec (3), New Brunswick (4), and Saskatchewan (3). "The regional public information sessions were held in an informal open house format, inviting attendees to review the proposed process for selecting a site and provide comment on it. Attendees were invited to pick up a copy of the discussion document, view story boards, obtain background information, watch an NWMO video, complete a workbook and have discussions with NWMO staff." (NWMO 2010). Overall, 717 persons attended the regional public information sessions, including people from the government, members of Parliament, political parties, environmental groups, industry, unions, First Nations and Métis, social and educational organizations, media and members of the public.

[3] Supersedes *CNSC, RD/GD-99.3, Public Information and Disclosure*, March 2012.

Each of the five remaining municipalities currently in the nuclear waste repository siting process has a Community Liaison Committee (CLC) which seeks to engage with the local community, provide information and education, and listen to the citizens. It also provides advice to the municipal council regarding the NWMO's site selection process and Adaptive Management Framework. Information is centralized on one website[4] in which each municipal government has its own webpages describing their mission statement, who is in the committee, how they proceed (meetings, minutes & agendas, public information sessions, news, open houses, etc.) and a Question and Answers page. Each of the five CLC's holds a monthly meeting open to the public and publishes the agendas and meeting minutes on their respective website. The NWMO is sometimes invited to those meetings to make presentations and inform the population about the ongoing site selection process. The CNSC may also be invited to explain their role in regulating the nuclear sector. The CLC's do not claim to advocate for the repository site, but rather seek to gather the best possible information to help inform the decision-making process. For instance, Elliott Lake's CLC's mission statement mentioned: "Our intention is not to persuade you with any arguments pro or con regarding the issue of nuclear waste disposal, but rather to bring you as much information as we can on the activities of the Community Liaison Committee (CLC) and the status of the Deep Repository program of the NWMO in Elliot Lake" (Elliott Lake n.d.). Similarly, the Hornepayne Nuclear Waste Community Liaison Committee was "established by the Township of Hornepayne Municipal Council in October 2011. Our objective is to help Hornepayne learn about Canada's plan for used nuclear fuel and involve Hornepayne residents in these learning activities".

Public information and disclosure is key to the very existence of the CLCs. Their educational role is very well understood. What seems less clear, however, is how public input is taken into account by the local authorities and the NWMO, and for what purpose. One other area where questions about the transparency of the process remain is: Under what criteria is a community is deemed unfit to become the deep geological repository's willing host and thus removed from the process?

**Inclusiveness & Representativeness**

A wide range of inclusion and representation measures exist as part of Canada's nuclear waste site selection process, including First Nations' consultation (e.g. integration of Indigenous Traditional Knowledge), the involvement of local communities and surrounding area, the participation of local elected officials (and the implementation of community liaison committees), and consultation with experts in various fields. The site selection process was developed through a vast consultation process with interested Canadians. According to the NWMO, "[p]eople participated through a variety of means, including multi-party dialogues, national surveys, e-dialogues, and public information sessions. Dialogue sessions were also designed and implemented by Aboriginal groups. Through this dialogue, a broad cross-section of Canadians and Aboriginal peoples shared their thoughts on what an open, transparent, fair, and inclusive process for making this decision would include. This was captured and formalized in the design of the siting process" (NWMO 2017h). The NWMO public input and information design included five multi-party dialogue sessions (held respectively in Saskatoon, Ottawa, Toronto, Montreal and Saint John), a nation-wide survey, two E-dialogues, citizens' panel dialogues and public discussion groups sessions, public information sessions, and regional Aboriginal dialogues to connect with communities (NWMO 2017h).

The Council of Elders and Youth "is an advisory body to NWMO management. It provides counsel on the application of Indigenous Knowledge in the implementation of Adaptive Phased Management. In

[4] See: http://clcinfo.ca/

addition, the Council of Elders and Youth provides advice on issues that could enhance the development and maintenance of good relations with Aboriginal communities" (NWMO 2017i).

The CNSC's REGDOC-3.2.2: *Aboriginal Engagement*, "sets out the requirements and guidance for licensees on Aboriginal engagement. REGDOC 3.2.2 also provides procedural direction for licensees in support of the whole-of-government approach to Aboriginal consultation implemented by the CNSC in cooperation with federal departments and agencies" (CNSC 2016).

**Deliberative Quality**

Non-expert public in the interested communities are involved through the different steps of the APM process and invited to collaborate (express concerns, ask questions, participate in local meetings) with the NWMO and the CNSC. Genevieve Fuji Johnson (2015: 85) mentions that the process "went an impressive way toward meeting basic elements of deliberative democracy", especially in terms of transparency, openness and large public participation. However, she also argues that "the outputs of the process appear to have had limited substantive impact on the organization's recommendation to the federal government and, ultimately, on the ensuing policy" (Johnson 2015: 85). She notes through many references to public, expert and Aboriginal inputs, that the process "was very much NWMO-driven and its output were ultimately NWMO-controlled" (Johnson 2015: 73).

The deliberative qualities of the NWMO's site selection process will have to be assessed continually as the next steps of the APM process unfold over the upcoming months and years. Consultation, surveys, or interviews with directly affected communities would help assess their perception of the deliberation process.

**Accountability**

The concept of public accountability is widely used in democratic systems to describe the fundamental relationship of trust between the citizens (or the public) on one side, and the governing authorities, agencies and public enterprises who are trusted to make good use of public resources on the other (Bovens 2005).

The NWMO is at arms-length from the government and is accountable both to the public and the federal government. Oversight of the transportation of nuclear substances is shared between two federal departments, the CNSC and Transport Canada (see Regulatory Interventions). If the Commission grants a licence in the future, the CNSC will oversee the NWMO's activities and insure its compliance with the licence granted by the Commission. It is also important to note that while the CNSC is the licensing authority, it works closely with other federal and provincial bodies to ensure that regulatory requirements are met, while recognizing that it is ultimately the responsibility of the licence applicant to meet all applicable requirements.

According to the NWMO, accountability is one of the organisation's key values, along with safety, integrity, excellence, collaboration and transparency. However, the only thing they mention in regards to accountability is that: "We take responsibility for our actions, including wise, prudent and efficient management of resources" (NWMO 2018b).

A critical issue that will be key in the future is the overall perception of the NWMO in the public's view. Is there a perception gap between public officials and communities in regards to the NWMO's accountability? If so, how does it affect the site selection process?

## CONCLUSION

This paper has sought to provide preliminary information to summarize the risk management framework for the site selection process for a DGR for Canada's high-level nuclear waste. It has also described the level and type of affectedness, identified the risk management intervention tools through the REACT framework, and assessed level of democratization in the case. These three assessments will, in a comparative perspective with the other cases analyzed as part of the @Risk research project, help in understanding, and perhaps strengthening, risk management capacity in Canada.

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