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Thoughts on Radioactive Waste Management Policy Framework

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Introduction

This policy should be about Canadians, not just the nuclear industry. The nuclear industry is an important part of the current energy mix and discussions for a moratorium on this energy source are outside the scope of this policy framework. Continued use of radioactive sources for various measurements, for radiotherapy, for chemotherapy, etc. means that some radioactive waste will continue to be generated independent of the power industry. Given that the nuclear industry exists and that radioactive waste exists, the policy should address what might be socially acceptable and technically feasible for managing that waste. The discussion that follows is based on the premise that waste exists and must be managed in a socially and technically responsible manner.

Policy Principles, Roles, and Responsibilities

Some of my colleagues have used the term "robust" to describe the flexibility needed for this policy. Much of the work is cutting-edge engineering with the added variable of public engagement. With any good technical project, many solutions are possible for the many different conditions for a waste management environment. The policy should be clear that one size does not fit all. While all the policy statements are important, they are not necessarily equal and a balance is needed to address each situation. While all policy statements in this new framework must be considered and acted upon, each policy statement, principle, or guide should allow for some items to be more important and require more effort for some waste types and facilities than others. Those policy statements that cannot be compromised (e.g., safety of human health and the environment, now and in the future) must be highlighted and emphasized.

Remembering the difference between policy, regulation, and legislation is important. The policy should be the main ideas, concepts, and goals for radioactive waste management, and should address the core of the concerns expressed by society, business, and industry. It should avoid prescribing methodologies for dealing with the problem, and deal with the direction for acceptable solutions. Determining the rules for meeting the policy is the role of the regulator. It is impossible to separate these two issues, but care is needed to allow the Regulator latitude to apply the policy in light of scientific, technical, and societal changes that will arise in the future.

The issue of whether waste is waste is a red herring. Even if the waste was reconditioned, i.e., potentially useful components of the waste have been removed, there would still be waste, leftovers, to manage. To then declare that this waste can simply be placed in a conventional waste facility is arrogant. It is incumbent upon all waste handlers to ensure that any diversion of waste meets safety requirements. This should not have to be said, but a policy framework must make it clear that the end product is safe. Generally, this would mean that the dose falls within the limits of human and ecological safety, i.e., meets the requirements of clearance as defined by the regulator.

The policy should define the vocabulary that will be used in the policy – waste, disposal, storage, retrieval, and decommissioning. The reason is to avoid diverting attention from the intent of the policy to pedantic issues and details best left to the regulator to clarify. The policy should be clear that waste is material that the owner considers of no further use – which does not mean that the waste cannot be reconstituted to be valuable to somebody. The issue of whether waste is a resource or not should be outside the policy. Consequently, the policy should recognize that waste can go through a number of stages that includes segregation of reusable or reprocessable material, storage, and disposal. The terminology used to distinguish disposal from storage is particularly important and has implications on the definition of retrieval. By common definition, disposal does mean forever and it does mean without further action or activity. This does not mean there is no interim period of maintenance, or that we abandon all monitoring of the site. However, at some time, even these activities will cease to be

important. In contrast, storage means an intent for future action on the material(s) in storage. Storage implicitly means retrievable while disposal implicitly means not retrievable. The policy should distinguish between intentional retrievability (designed as part of the operation), operational retrievability (needed to accommodate unexpected conditions), and adaptive retrievability (needed for changes in future technology). While this policy should define decommissioning, it should be clear that decommissioning is outside the policy framework, but does apply to the waste generated and to the storage and disposal strategies developed for that waste.

The policy should clearly state the goals and principles for radioactive waste management facilities – specifically to safely isolate radioactive material. This allows flexibility for a range of facilities, from operational facilities (such as garbage cans as temporary storage receptacles) to disposal facilities. The policy could state that the facilities will be monitored, as reasonable, to ensure compliance with regulations (or law). This way, the policy does not become tied to changing regulations or knowledge. The policy could also state that the measures for safety and security of the waste within the facility will be commensurate with the hazard of the waste. One aspect of that may need to be included is the security of the facility closure – as will be discussed later, closure for disposal facilities is a unique consideration. However, closure of storage facilities is also important, and may need to be monitored or secured. The difficulty is that temporary storage facilities (collection bins) may not have (or need) secured closures, so the policy needs to be carefully worded to focus on the intent of the closure, and the need to monitor, remediate, and secure the closure. The details should be interpreted by the regulator, but the intent should not require the regulator to impose an untenable solution on an operator (e.g., particular closures for medical or sealed source waste that is driven by the closure seal of a used fuel repository).

The policy should avoid establishing the duties of particular agencies. Determining the parties that act (other than the owner of the waste) should be determined by legislation – the creation of both the CNSC and NWMO are acts of Parliament. If another agency is needed, the creation and terms of reference for that agency would be the responsibility of the Federal Government. This distinction is important as limitations of overly prescriptive policy can lead to inaction. An example is the evolution of the waste management policy in the USA. Initially, the policy included several candidate geologic formations for disposing their commercial high level waste. As political and social concerns grew, largely because of poor consultation and NIMBYism, the policy eventually prescribed a specific site. The program is currently in limbo and work on alternatives is not directly funded because the policy does not allow for any alternatives to be considered for disposal. Public survey results consistently show the public's preference for a solution to and funding of radioactive waste management that is the responsibility of the current generation (user pay). Delaying the search for a solution is contrary to public sentiment.

The policy must put safety above all else. For Canada, although superseded, the principles in CNSC policy P290 and guidance G320 are good statements for a policy (see Appendix) that are consistent with the IAEA principles (although the statement of safety is missing because it is implicit in the regulations). The principles are embedded in Regdoc 211.1, but are easily lost in the document. The regulation should not need to restate the policy, but should show how the regulation addresses policy. Care should be exercised to avoid defining regulations because the prevailing state of knowledge and technology may change with time, but the ideals of the policy should not. Focusing on the intent to achieve a technical and social solution can then evolve as more information becomes available.

It is important to recognize international bodies (P290 g and h), such as the IAEA, for their guidance in the technical matters of radioactive waste management. The IAEA documents are best practice guides based on consensus by many International Agencies. By necessity, each of these independent agencies have their own political slants, and their own individual concerns. Due care and consideration is recommended when deciding the extent of adopting these international guidelines.

The use of environment and impact assessments assures long-term safety for human health and the environment and should be embedded in the policy framework. The policy should describe the intent to

apply these safety assessments regardless of the type of waste management facility (storage, processing, disposal) to be developed. The concepts in the current impact assessment process should also be included in the policy framework, i.e., socioeconomic health, value ecosystem components, as well as the more obvious natural systems that need protection. The role of the regulator, which should be a jointly held responsibility between the nuclear regulator and the environmental regulator, must be to perform competent and rigorous reviews of any proposed waste management system, and perform conscientious oversight to identify both major and minor omissions in the proposal. Remedial activities should be based on the safety outcomes, and not necessarily the "completeness" of the case. Uncertainties and long term predictions must be embedded in the regulator's assessment and criteria for acceptance. The longer the isolation needed, the greater the reliance on tools such as risk. The policy should also recognize that no solution is perfect and no solution can produce no risk. However, the regulator should be allowed to set the numerical value for acceptable risk based on established international agreed limits.

Public engagement and consultation, transparency, and indigenous inclusion must be part of the policy. These are important principles that need to be in the policy to minimize the impact of legislation that may attempt to limit this process for other non-nuclear environmental issues. Early participation to engage community solutions must be a cornerstone of the policy. The policy must limit the ability of the public to change the technical solution when such changes would compromise the safety of the facility. The policy should embed responsibility and commitment into this engagement process, a commitment to fair dialogue and timely action. The weight of the opinions must be balanced – assuming that safety has been met, the opinions of the local residents (indigenous and non-indigenous) must be weighed more than non-residents. Access to independent experts, for NGOs, government agencies, etc. should also be part of the policy. The extent of consultation may be graded, and should be determined by an appropriate regulator.

The issue of funding is important, and there should be segregated funding for non-fuel waste, in particular, the wastes arising from decommissioning. The issue of accurate costing is problematic because it is impossible to predict costs and technologies thirty to forty years into the future. No other industry is required to formulate such an activity in order to proceed. Taxpayers routinely cover the cost of decommissioning, dismantling, removing, and disposing. While some of these costs may be easier to recover for conventional facilities because of the simplicity of their construction, it does not change the fact that these costs are not included in the lifecycle cost.

Although outside the scope of a policy for managing radioactive waste, funding arrangements should be legislated and controlled for the organization responsible for disposal. The arrangement should be through a separate agency, independent of the waste producers, and at arm's length from the regulator (government). This is the way the NWMO was established, and an "obvious" solution is to extend the NWMO's mandate to include all nuclear waste. From the public's view, this may be a weak strategy because the funding may be seen as mixed (a general revenue) and detractors may claim not enough funding goes to a particular waste. Instead, it may be useful to create a new organization that is responsible for all non-fuel waste. This organization would collect funds from all organizations and develop a formula for the fraction of funding needed to design, operate, and close the facility. The funding formula would include the medical industry, industries using sealed sources, and traditional nuclear institutions. The focused agency would drive the search for appropriate solutions for a particular problem, and would have the mandate to propose solutions based on centralized management for some industries, and individualized management for others. The legislated mandate, as always, is safety first. In this way they can consider the risks and hazards associated with the distance and mode of transportation and all factors that influence a recommendation for centralized versus localized facilities.

The policy must speak to commitment, of the government (from local to national), of the local society, i.e., communities, the nuclear industry, and of the proponent of the facility – which may be independent of the waste generator. This commitment must speak to informed decision-making and transparency on both sides; a commitment to openly communicate issues, concerns, and actions. Both the communities and the proponent must be protected from undue influence to either accept or reject a proposal.

It should be noted that a policy framework and guidance is easier to define for individual categories of waste than for all types of radioactive waste. The issue of categorization makes the development of facility design and regulation easier, but may limit the ability to adapt solutions (i.e., facilities) to new wastes, e.g., "mixed" wastes. Setting categories is a detail, a simplification best left to the regulator. Waste can go through a number of stages (e.g., segregation, storage, and disposal), which means waste can pass through different categories as it moves from useful to not useful. Managing this detail should be the responsibility of the regulator, and not this policy. The policy should not exclude the possibility of an owner of waste transferring ownership of the waste to another owner/operator who may recycle or repurpose the waste material for sale. The policy should apply to managing waste products of a business, before and after processing.

Linking management methods and waste categories in the policy will limit innovation and technical development of waste facilities, including developing processes for recycling, reusing, and recovering valuable material from waste. The policy should encourage developing waste management solutions. The current and proposed waste management facilities arose because the designers recognized the special characteristics of the waste (form, composition, and location) and the environment surrounding the waste, including waste reconstitution and minimization. The safety of the management system was ensured by allowing the regulator (or a future waste organization) to carefully balance the system (call it the engineering environment) and the harmful characteristics of the waste. The policy should foster innovations and developments and leave limiting the design and engineering of the solutions to the organizations responsible for implementing the policy, e.g., the CNSC and NWMO for fuel waste.

Disposal

Any framework or policy guideline for the disposal of waste should not prescribe the type of facilities needed for either storage or disposal. The policy should be clear that whatever is designed must be safe, and the key point of the policy is to define safe. The guiding principle in the nuclear industry, "as low as reasonably achievable" (ALARA), is a good operating principle, but does not define a requirement that can be assessed when long term predictions are necessary. In an operational facility where monitoring of both the environment and health can be performed, reevaluating ALARA is possible and safety requirements can be adjusted to ensure a healthy environment. The policy can state ALARA, but should direct the regulator to define what is reasonable, while allowing flexibility to change that specification with advancing world-wide knowledge.

The policy should recognize that the longer the required isolation, the greater the uncertainty associated with the problem. This uncertainty arises for both technical predictions of performance, and of socioeconomic conditions. It is not possible to predict social or institutional structure. In fact, the availability of natural analogues for technical systems provides an avenue to justify the performance of physical systems, an avenue not available for future socioeconomic systems.

A policy framework for disposal must insist on passive systems for long-term safety. It should not demand a multi barrier system, but it should demand redundancy and safety measures, which will often generate multi barrier solutions. In some situations, safety can be achieved with very few barriers or impediments to the release of radioactive materials. It is incumbent upon the regulator to perform a rigorous safety analysis that demonstrates the system meets the requirements for long-term retention. The need for short-term monitoring and control is a useful principle, but it must be consistent with disposal – the ultimate need to abandon human control of the facility. Here it is important that the policy distinguish between safety and retention because limited release can be safe to human heath and the environment.

The policy should also establish the principle of care and attention. The regulator could mandate this to demonstrate safety during a "retrievability period" where the waste facility is not necessarily closed. The policy needs to define the objectives for the period of care and monitoring of the radioactive hazard of the radioactive waste and how the objectives are consistent with the principles of safety for human health and the environment. This might require different wording for high level waste because of the indefinite time

of longer lived waste. Care is needed in defining this policy statement because some low hazard waste (e.g., low-level radioactive waste) may contain long-lived hazardous material. For this, the regulator should determine the specific parameters needed to meet the safety requirement. Examples of objectives could be transport time through the barrier system, distance from the environment, fraction above an exemption quantity, etc. – the performance of a natural system.

Associated with the principle of care and attention is the principle of closure. The policy should address the intent of closure to assist the regulator in defining the specific requirements for this activity. This step is not a decommissioning stage, it is a designed operating stage. Unlike most facilities, a disposal facility does not begin operation until it is closed. Unlike most human constructions, a disposal facility does not operate, it proceeds by natural processes. It may be helpful for the policy to state that disposal systems must rely on natural processes, i.e., passive systems, and not on the need for human maintenance and intervention. The policy should describe the general expectations for closure, establish the demonstration of safety based on all the available evidence including that from the care and attention period (which includes groundwater movement, facility water inflow, environmental releases, environmental changes, natural and anthropogenic, and other data found useful for input into an environmental evolution model). The evidence, along with the environmental performance assessment model, should demonstrate the facility behaves as expected and then provides evidence for the regulator to agree that final closure should proceed. The closure method and the criteria to be met should be part of the new license and must show the developments in science and technology have been considered, along with a robust demonstration of performance in an environmental assessment.

Storage

The policy must allow for a variety of storage facilities to be developed; it should not prescribe acceptable facilities. It should establish the health and safety policy that should be met and allow the regulator to develop contemporary regulations and criteria for such facilities. Examples could be, categorical statements of meeting conventional health and safety requirements, mining regulation, as applicable, radiological safety requirements, and environmental release requirements for conventional, biological, chemical, and radiological hazards. A new policy statement should include long-term storage of 100-500 a duration. These were not considered in the previous policy; such long isolation time were considered disposal. However, such facilities are considered today and, in effect, shifts the burden to future generations. In those circumstances where this is considered acceptable, the policy should clearly state that at some time (e.g., 200 a) the facility should have a simple provision to close and seal the facility in the event of a social or natural change in the environment. For example, care and attention of the facility may not be possible if the environment near the storage facility is not conducive to human life, or if civil unrest (or war) makes the continued maintenance and monitoring of the facility unreliable. The provision for closure and sealing needs to be reasonable at the time of construction, but could evolve with time (adaptive) as new technology becomes available. While we must be optimistic that society will evolve with a positive trajectory, it is possible for periods of regression to occur. To assure safety during these periods, our generation must prepare for such events with appropriate contingency measures.

The decommissioning plan for such long-term storage facilities must be reasonably well developed – how will the waste be retrieved, how will the waste be processed for further storage or disposal, etc. The policy should explicitly require that retrievability and decommissioning are part of the storage facility design, but details of both should be left to the regulator. The policy should be careful to not permit in-situ disposal as an endpoint of storage unless a justified plan and design for the conversion is included.

In situ decommissioning should be a term that is excluded from the policy, and the explanation should be that all decommissioning must be done in situ, i.e., on location. Decontamination, reprocessing, recycling may be done on- or off-site. The activity that is intended is in situ disposal, and this should be clearly defined in the policy. A question arises why Cameco, at their Port Hope facility, was required to remediate their uranium leak and were not allowed to simply execute an in situ disposal plan for the

uranium, while geologic surveys routinely dispose lost sources in the borehole. One is a licensed facility, the other is a licensed source/operation. The regulator has reasonable oversight in the activities and the policy should allow the regulator to reject legacy constructions or operations that failed to properly plan for decommissioning. Removing in situ decommissioning from the vocabulary and forcing the clear intent of disposal should help the regulator determine if a method of "abandoning" a radioactive source is appropriate for the source and location. Future "in situ" disposal facilities should need well developed and justified plans and designs for the isolation. The final facility design should demonstrate long-term safety – it must meet the environmental release limits. This does create a problem for legacy sites, such as mining waste and other historical wastes, but to propagate this into the future would be a mistake and a reflection of very poor planning. The Port Hope project has demonstrated that alternatives to in situ disposal are possible if the community is engaged and accepting of the solution. Other communities may not be so accepting, and any proposed solution may pose greater risk to the community than maintaining or strengthening the existing condition. It may also prove problematic for other industries that use nuclear devices in their tools and accidentally lose those tools. For example, radioactive sources for geologic survey of boreholes are lost because of cable breakages and other accidents. The most common remediation for this is to pour concrete into the borehole and close the hole and abandoned, i.e., in situ disposal. Retrieving the source is very expensive and could make the survey too expensive, which would mean a loss of data and potentially lead to bad decisions. This example is not meant to condone the practice, but there is a need to address such problems without removing the economic viability of the operation.

Managing the waste from SMRs is a real issue worthy of testing in a policy framework before enacting the policy. I believe that a good plan for decommissioning, dismantling, and removing nuclear facilities should be a cornerstone of a waste management licensing policy. The granting of a license should only occur if the decommissioning plan addresses the ability to remove and dismantle. Testing the current licensing process against the new policy should identify weaknesses presented in the Radioactive Waste Management Policy review. Many of the suggestions lie in regulation and not policy, but if the revised policy principles directs the regulator to generally address the concerns, the policy has succeeded. We should avoid prescribing activities (specifically decommissioning of SMRs), but the regulator should be satisfied that such activities are developed, i.e., technically feasible with the technology available today. This would deter entombment and leave this practice to cases of unforeseen, catastrophic emergencies. Similarly, requiring a prompt decommissioning should not be in a policy, but it should be clear that decommissioning must take place as soon as practicable. Demanding prompt decommissioning may be a useful regulatory tool, but should not be a policy because of the variety of situations where such a practice may be contrary to long-term safety. A delayed decommissioning allows for radioactive decay that eases the burden on disposal facilities, minimizes or eliminates transportation of radioactive materials, and maintains some social economic benefit to the surrounding communities.

Loose ends

With regard to disposal, the concept of waste minimization will often be a commercial/economic consideration. As such, the policy could recommend waste minimization, but the driver would be with the proponent. On the other hand, a requirement to minimize environmental damage, including minimizing the footprint of the facility, would be something valuable for the policy.

The inclusion or exclusion of mining waste is a different, and interesting, proposal because this could apply to radioactive waste generated from non-nuclear mining operations. This agency might be aligned with general waste since the main difference between a uranium mine and a copper/nickel mine is the volume of radioactive waste generated.

Appendix 1: Policy statements from superseded CNSC documents

Policy Statements from CNSC P-290

a. The generation of radioactive waste is minimized to the extent practicable by the implementation of design measures, operating procedures and decommissioning practices;

b. The measures needed to prevent unreasonable risk to present and to future generations from the hazards of radioactive waste are developed, funded and implemented as soon as reasonably practicable;

c. The management of radioactive waste is commensurate with its radiological, chemical, and biological hazard to the health and safety of persons and the environment and to national security;

d. The predicted impacts on the health and safety of persons and the environment from the management of radioactive waste are no greater than the impacts that are permissible in Canada at the time of the regulatory decision;

e. The assessment of future impacts of radioactive waste on the health and safety of people and the environment encompasses the period of time when the maximum impact is predicted to occur;

f. The trans-border effects on the health and safety of persons and the environment that could result from the management of radioactive waste in Canada are not greater than the effects experienced in Canada;

And the policy of the CNSC to consult and cooperate with provincial, national, and international agencies to:

g. Promote harmonized regulation and consistent national and international standards for the management of radioactive waste; and

h. Achieve conformity with the measures of control and international obligations to which Canada has agreed concerning radioactive waste

The policy statement from CNSC G-320:

The design of a nuclear facility should be optimized to exceed all applicable requirements. In particular, a radioactive waste management facility should more than meet the regulatory limits, remaining below those limits by a margin that provides assurance of safety for the long term. This expectation is necessitated by the uncertainty of long term predictions, the uncertainty of future human actions, and the possibility that the waste management system being assessed may not be the only source of contaminants to which receptors will be exposed.