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Nuclear Waste Management and Commercial Services

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**OPG Proprietary**

May 26, 2021

File No: [redacted]

**The Honourable Seamus O'Regan, Minister of Natural Resources**
Natural Resources Canada
nrcan.radwastereview-examendechetsradioactifs.rncan@canada.ca

Dear Minister O'Regan:

**Ontario Power Generation (OPG) Response to NRCan Discussion Papers – Radioactive Waste Policy Review**

OPG wishes to thank Natural Resources Canada for the invitation to participate in the federal review of the Radioactive Waste Policy Framework.

This letter includes OPG's responses to the four Discussion Papers, posted by Natural Resources Canada at www.radwastereview.ca on the topics of waste minimization, waste storage facilities, decommissioning, and waste disposal.

OPG is Canada's largest generator of clean, low-carbon electricity from nuclear energy. We safely transport, process and store the by-products, meeting or exceeding all the requirements of our licence conditions. While practising good stewardship of these materials, and embracing the environmental three Rs (reduce, re-use and recycle), we continue to support the development of lasting solutions for permanent disposal – the right thing to do for future generations. We welcome your initiative to modernize the federal policy framework in alignment with international best practices.

As stated in our submissions, nuclear energy provides important societal benefits; as a safe, low-cost and reliable source of electricity; in the production of medical isotopes; and as clean energy emitting zero or low carbon and, therefore, a vital tool to reach Canada's climate goals. All of society will similarly benefit from a policy that supports feasible, sound solutions for the resulting by-products.

We look forward to further participation in this review, following Natural Resources Canada's report on the period of public engagement.

Yours sincerely,

[redacted]

**Encl:** (1) Waste Minimization, (2) Waste Storage Facilities, (3) Decommissioning, (4) Waste Disposal

# Waste Minimization

The following is prepared and provided by Ontario Power Generation (OPG) in response to NRCan's public review of Canada's Radioactive Waste Policy Framework.

1. What are your views on waste minimization? Should Canada continue to use the concept of the waste hierarchy?

   - Yes, OPG maintains that Canada should continue to use the concept of the waste hierarchy. It is a critical feature of a safe, environmentally and socially responsible waste management system.
   - OPG, as a waste owner, applies the waste hierarchy in its nuclear operations and continues to seek opportunities for further application of the various elements.
   - Not all elements of the waste hierarchy can be applied easily or practically to all types of radioactive waste. Therefore, the waste hierarchy should be viewed in this context. Further discussion on this topic is included below as Table 1.
   - Waste Owners must balance many considerations when applying the waste hierarchy. The ALARA concept should be extended to apply to waste minimization where owners seek an optimal solution for the waste while balancing these various considerations.
   - Reclassification is also a key part of the waste hierarchy that should be considered and is further discussed in the answer to question 3 below.
   - The utilization of the Very Low Level Waste (VLLW) category may become useful for Canadian purposes as dismantling activities progress and disposal of large volumes of items such as concrete is required.
   - The utilization of "clearance" or "free release" of materials following rigorous and approved regulatory processes is a key component of minimizing waste. Clearance or free release of clean concrete, for example, will greatly minimize waste volumes during the dismantling and decommissioning of nuclear sites.

- The following table illustrates the applicability of each element of the waste hierarchy to the different radioactive waste types. Low-level radioactive waste (LLRW) is the most amenable to all parts of the waste hierarchy and offers the most opportunities for volume reduction, waste minimization, reuse and recycling.

*Table 1: Application of Waste Hierarchy to Different Waste Types*

| Waste Type | Prevention | Volume Reduction | Re-Use/Recycling |
|---|---|---|---|
| **Low-Level Waste** | **√**<br><br>Many measures are implemented within the nuclear generating stations to prevent articles from entering the low-level waste stream. | **√**<br><br>Many technologies exist and are utilized presently by the industry such as incineration, compaction, metal melting, decontamination. | **√**<br><br>The two most notable examples are the decontamination of metal components for return to the scrap metal market and the metal melting of large components for creation of shielding blocks for reuse in the broader nuclear industry. |
| **Intermediate-Level Waste** | **~**<br><br>There are fewer opportunities for prevention at source for ILW since these wastes are produced from station systems that are integral to the plant such as water filtration systems. | **~**<br><br>Some technologies do exist for reduction of some ILW waste streams. For example, there is a plant in the US that can process and volume reduce resin. This technology is not currently available in Canada.<br><br>Some ILW streams such as pressure tubes and calandria tubes are not candidates for current volume reduction technologies.<br><br>Incineration cannot typically be used for volume reduction of ILW due to the higher dose rates of the materials. | **~**<br><br>OPG has recently partnered with a third party vendor to pilot a process to divert some ILW metal components to metal melt after the internal surfaces are treated. |
| **High-Level Waste, specifically fuel** | X | **~**<br><br>OPG is interested in technologies which could reduce or reuse used nuclear fuel and is encouraging developments in this area. Fuel recycling may reduce volumes of fuel for disposal but will not avoid the need for permanent disposal. | **~**<br><br>Some SMR technologies contemplate the re-use of CANDU fuel. |

Legend: **√** = yes, opportunities exist
~ = some opportunities or limited opportunities exist
X = no opportunities currently exist or are likely to exist

OPG actively utilizes many parts of the waste hierarchy in its current nuclear operations. These are detailed below:

Prevention:

The prevention of low-level waste begins at the source or at the point of waste generation, which for OPG is within the nuclear generating stations themselves. Some of the measures taken at the station to prevent the generation of low level radioactive waste include but are not limited to:

- Removing packaging from tools, equipment and supplies prior to bringing them into the plant (Figure 1)
- Utilization of washable and re-usable Personal Protective Equipment (PPE) garments
- Utilization of waste collection stations which encourage segregation of waste streams (Figure 2)

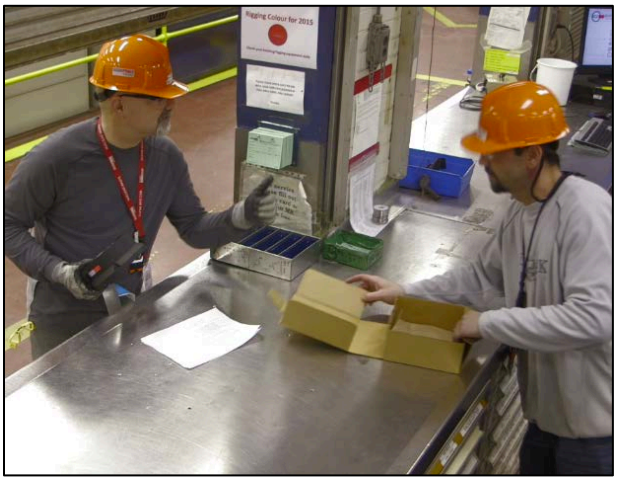

*Figure 1: Diverting materials at the nuclear stations, by removing packaging before items enter rad zones*

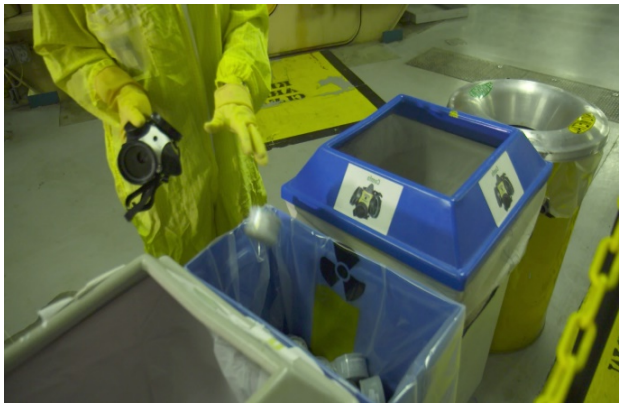

*Figure 2: Waste Segregation collection areas within the nuclear station*

Reduction/Minimization:

- Some low level wastes are then incinerated at the Western Waste Management Facility, resulting in approximately 95% reduction in volume (Figure 3).
- Other low level wastes are compacted resulting in 75% reduction in volume (Figure 4).

*Figure 3: Low-Level Radioactive Waste Incinerator at Western Waste Management Facility*


*Figure 4: Low-Level Radioactive Waste Compactor at Western Waste Management Facility*

- Through decontamination and/or characterization, some low level materials can also be released from regulatory control which further minimizes volumes requiring interim storage and disposal. In particular during dismantling and decommissioning of nuclear facilities, some materials may be more amenable to this such as concrete. REGDOC 2.11.1 section 8.1 speaks to this as follows:

  *"The clearance and exemption of waste from regulatory control after having been appropriately characterized, processed and/or stored for a sufficiently long period of time, together with the reuse and recycling of material, can be effective in reducing the amount of radioactive waste that needs further processing or storage."*

- A recent example of OPG utilizing this approach was during the dismantling of the Spent Solvent Treatment Facility in 2019 (Figure 5). The project required detailed surveys to be completed following the US EPA's MARSSIM methodology and OPG's Radiation Protection Program. Detailed survey results were provided to the CNSC. Some concrete debris was able to be disposed of in conventional waste through the thorough and rigorous application of this methodology.


*Figure 5: Dismantling of the Spent Solvent Treatment Facility and resulting concrete debris*

Re-using/Recycling:

- Some large metal objects such as heat exchangers have been processed through metal melt by a third party vendor (Figure 6).


*Figure 6: A heat exchanger first is segmented, then processed via metal melting. The resulting metal ingot is then re-used within the nuclear industry as a shielding block*

- Low-level waste is further sorted at Western Waste Management Facility. Tools are recovered and decontaminated as required and reused. Scrap metal is decontaminated and, after confirmation of meeting CNSC-approved clearance levels, recycled into the scrap metal market (Figure 7).

*Figure 7: (Left to Right) Waste Sorting, Clean tools for resuse, and scrap metal*

Another consideration

While the category of Very Low Level Waste is recognized by the IAEA and by the CNSC in REGDOC 2.11.1, it has not been widely utilized by OPG. The utilization of such a category may become useful for Canadian purposes as dismantling activities progress and disposal of large volumes of items such as concrete is required.

The IAEA defines this as follows (Reference: IAEA General Safety Guide No. GSG-1 "Classification of Radioactive Waste"):

*"Very low level waste (VLLW): Waste that does not necessarily meet the criteria of EW [exempt waste], but that does not need a high level of containment and isolation and, therefore, is suitable for disposal in near surface landfill type facilities with limited regulatory control. (…) Typical waste in this class includes soil and rubble with low levels of activity concentration. Concentrations of longer lived radionuclides in VLLW are generally very limited."*

Internationally, several countries actively use this classification in their waste management systems. For example, France utilizes the Very Low Level Waste (VLLW) classification in their CIRES facility at l'Aube, managed through ANDRA.

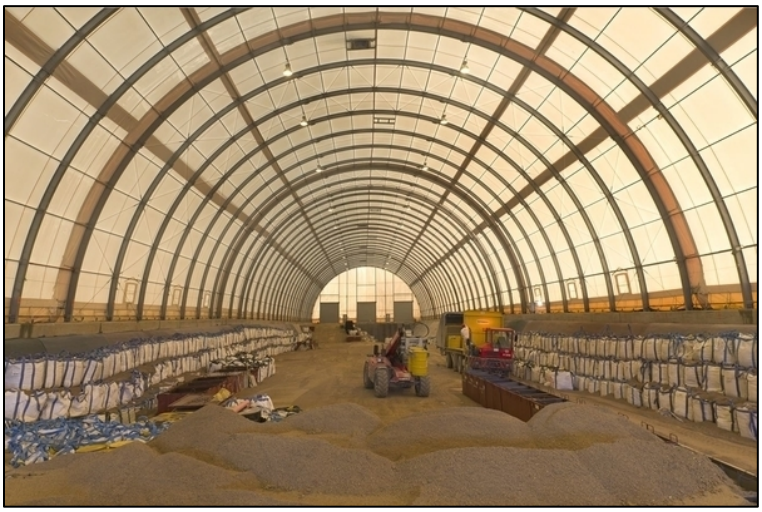

*Figure 8: ANDRA's very low-level waste facility at the CIRES site in Aube, France*

2. What should be the role of government, the regulator and waste owners with respect to minimizing radioactive waste?

OPG acknowledges and accepts the role of government and of the waste owner more generally as related to radioactive waste management, as outlined in CNSC REGDOC-2.11 (referenced in this NRCan discussion paper) as follows:

- the Government of Canada is responsible for developing policy, and regulating and overseeing radioactive waste producers and owners to ensure that they comply with legal requirements and meet their funding and operational responsibilities in accordance with approved long-term waste management plans.

- Waste owners are responsible, in accordance with the "polluter pays" principle, for the funding, organization, management and operation of the facilities required to safely manage their wastes over the short and long terms. The framework recognizes that arrangements may be different for the four broad categories of radioactive waste found in Canada:

    - low-level radioactive waste
    - intermediate-level radioactive waste
    - high-level radioactive waste
    - uranium mine and mill waste

OPG also acknowledges the role of the CNSC as a strong, independent regulator. OPG provides the following additional or supplemental comments specifically as they relate to waste minimization and its role as waste owner:

- Nuclear energy provides important societal benefits; as a low-cost and reliable source of electricity; and as clean energy, emitting zero carbon and, therefore, a vital tool in the fight against climate change. All of society will similarly benefit from a policy framework and strategy that supports feasible and environmentally sound solutions for the resulting by-products.
- The current *Radioactive Waste Policy Framework* acknowledges the need for management of radioactive waste in a comprehensive manner taking into account considerations for safety, comprehensiveness, environmental soundness, integration and cost-effectiveness. Taken in a context of waste minimization, OPG as a waste owner must also balance all of these considerations.
- The nuclear industry utilizes a principle of ALARA ("As Low as Reasonably Achievable") when designing and implementing radiation protection and environmental protection management systems. Since the act of waste minimization has both radiation protection and environmental protection considerations, the ALARA concept should be extended to waste minimization. Even the best efforts at waste minimization will not result in a zero-waste permanent solution. Waste minimization is, and must be, pursued to an extent which is "as low as reasonably achievable" where reasonableness in this case means integrating many aspects including but not limited to:
    - whether the volume reduction or waste minimization technology produces a by-product that is more challenging for permanent disposal than the original.
    - whether the energy requirements to perform the waste minimization far exceed the energy requirements to, for example, transport and dispose.
    - whether a volume-reduction technology may be excellent at achieving volume reduction but results in radiological emissions that would, for example, exceed any regulatory limits.

- IAEA GSR Part 5 "Predisposal Management of Radioactive Waste" speaks to these various considerations:

    "*Radioactive material for which no further use is foreseen, and with characteristics that make it unsuitable for authorized discharge, authorized use or clearance from regulatory control, shall be processed as radioactive waste. The processing of radioactive waste shall be based on appropriate consideration of the characteristics of the waste and of the demands imposed by the different steps in its management (pre-treatment, treatment, conditioning, transport, storage and disposal). […]*

    *Various methods are applied for processing radioactive waste of different types. Consideration has to be given to identifying suitable options and to assessing the appropriateness of their application. Decisions have to be taken*

*within the overall approach to the predisposal management of radioactive waste on the extent to which the waste has to be processed, with account taken of the quantities, activity and physical and/or chemical nature of the radioactive waste to be treated, the technologies available, the storage capacity and the availability of a disposal facility. ]…]*

*Consideration has to be given to the consequences of dealing with any secondary waste (both radioactive and non-radioactive) that is created during processing."*

- As noted above, the waste hierarchy is a key part of a strong waste management program but its individual elements apply differently to different waste streams. Despite all best efforts in applying the waste hierarchy by waste owners, disposal will still be required for all final by-products. Some waste streams currently do not have commercially-viable outlets for recycling or reuse. While technologies could be pursued to find these new uses, the volumes may be too small to result in any significant savings in final disposal volume or to ever amount to a commercially viable product. For example, the ash from OPG's radioactive waste incinerator cannot be re-utilized like coal ash as an additive in commercial concrete or cement due to its low-level radioactivity. Also, the volumes in storage are not significant enough to warrant a large investment in research and development, to only yield marginal benefits.
- A waste owner cannot pursue waste minimization devoid of cost considerations. OPG has obligations to the ratepayers of Ontario to moderate the price of electricity in the Province; therefore any technologies to be pursued must be assessed on their own individual cost/benefit analysis and compared to costs of eventual disposal.

3. <u>Are there other principles, beyond those identified by the IAEA, that you feel are important to consider when designing and implementing a waste minimization program?</u>

- The principle of reclassification should be considered. CSA N292.0 and N292.3 speak briefly to reclassification (ref: CSA N292.0-A.3.2) as follows:

*"Decay storage can have the goal of allowing for sufficient decay so that the waste no longer requires a licence (…)" – reference CSA N292.0-A3.2*

*"Decontamination removes both fixed and loose surface contamination by either physical, chemical, or electrochemical means. Its use can result in the reclassification and possible clearance of radioactive wastes and the minimization of radioactive waste volumes." – reference CSA N292.3, section 9.2.5.1*

- Some of OPG's oldest wastes have been in storage for over 40 years. Completing updated waste characterization studies on these wastes, for example, may be able to demonstrate that reclassification is possible after these decades of decay storage. Further studies will be required by OPG to confirm if any of its Intermediate-Level Waste packages in storage for several decades have possibly decayed to Low-Level Waste acceptance levels. Any reclassification of such wastes would follow normal regulatory processes, aligned with CNSC requirements regarding Public Information and Disclosure.

# Waste Storage Facilities

The following is prepared and provided by Ontario Power Generation (OPG) in response to NRCan's public review of Canada's Radioactive Waste Policy Framework.

1. What are your views on how radioactive waste is currently stored in Canada?

- The policy should recognize that these wastes were created in the pursuit of purposes which were beneficial to Canadian society, from electrical power generation to medical isotope production and are integral to clean-energy (zero- or low-carbon) strategies that will meet Canada's climate-change targets.
- The current storage of radioactive waste within OPG's waste facilities is safe, secure and environmentally sound.
- OPG's storage facilities meet or exceed all federal and provincial regulations.
- All storage structures and containers have a finite design life. Robust aging management programs are in place and will likely permit the service life to be extended beyond the original design lives with appropriate engineering analysis and regulatory approval.
- However, current storage structures and containers cannot be utilized, or service lives extended, in perpetuity; therefore, permanent disposal solutions will still be required.
- OPG has been safely transporting, handling, processing and storing radioactive waste for over 50 years. This includes the safe interim storage of the following types of waste:
  - Low-level radioactive waste (LLRW) consisting of items such as paper, plastic, concrete, metals.
  - Intermediate-level radioactive waste (ILRW) consisting of items such as resins, filters and reactor core components.
  - High-level radioactive waste (HLRW) consisting of used nuclear fuel.
- The breakdown by volume and location of each of these three waste types is included in the "Inventory of Radioactive Waste in Canada" report found on NRCan's website. This inventory report is updated every three years in alignment with the International Atomic Energy Agency (IAEA) Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.
- At OPG, these three waste types are safely stored within three sites licensed by the Canadian Nuclear Safety Commission:
  - Western Waste Management Facility
  - Pickering Waste Management Facility
  - Darlington Waste Management Facility
- Examples of storage of various waste types at OPG are shown in the Figures below.

*Figure 9: Storage of Steam Generators at Western Waste Management Facility*

*Figure 10: Storage of Low Level Waste containers at Western Waste Management Facility*


*Figure 11: Storage of Used Fuel Dry Storage Containers at OPG*

*Figure 12: Storage of Intermediate Level Waste at Western Waste Management Facility*

2. <u>What should be the role of government, the regulator and waste owners with respect to radioactive waste storage?</u>

- OPG acknowledges and accepts the role of government, and of the waste owner more generally, as related to radioactive waste management, as outlined in CNSC REGDOC-2.11 and more specifically related to waste storage as outlined in IAEA Safety Standards Safety Guide No. WS-G-6.1, Storage of Radioactive Waste.
- OPG also acknowledges the role of the CNSC as a strong, independent regulator.
- As the licensee for the three waste management facilities noted above, OPG has the accountability to ensure safe, secure and environmentally sound storage that complies with all CNSC regulations as well as provincial regulations such as those from the Ontario Ministry of the Environment, Conservation and Parks (MECP).
- In alignment with the "Responsibilities of Operators" outlined in IAEA WS-G-6.1, OPG offers these additional comments as it relates to its waste storage facilities:
  a) OPG waste facilities have a robust management system, including programs and procedures necessary to ensure safety of personnel, the public and of the environment.
  b) OPG waste facilities are licensed by the Canadian Nuclear Safety Commission and the operation of the facilities is in accordance with the license conditions and all other applicable regulations.
  c) OPG has developed thorough waste acceptance criteria for all waste types which are applied to all waste generators. OPG verifies compliance with the waste acceptance criteria prior to accepting waste for storage.
  d) OPG maintains detailed records on waste inventories through a comprehensive system tracking waste from its source, through the transportation and into storage facilities.
  e) OPG develops and maintains safety hazard assessments for the storage facilities which then informs facility specific operational limits and conditions.
  f) Through the Ontario Nuclear Funds Agreement (ONFA) with the Province of Ontario, OPG has put in place the required mechanisms to ensure that sufficient financial resources are available to undertake the operations of storage facilities through their entire life cycle through to decommissioning.

- There is a further consideration for government, the regulator and waste owners with respect to radioactive waste storage, which will become more relevant in the next decades. Specifically, some storage facilities in Canada will reach the end of their original design lives within the next decade, including some of OPG's low level waste storage structures. OPG and other waste owners have extensive aging management programs which include inspection of structures and containers and remediation of those structures and containers as required. Prudent inspection and maintenance programs accompanied by rigorous engineering analysis will likely enable waste owners to present safety cases to the regulator for extension of those design lives.
- However, this is not something that will be able to be done indefinitely. At some future point, permanent disposal will be required. The longer that disposal solutions are pushed out into the future, the more wastes that will be created and accumulated, despite efforts at waste minimization. This is due to the need to remediate and overpack these wastes as time goes on.
- Nuclear energy provides important societal benefits; as a low-cost and reliable source of electricity; and as clean energy, emitting zero carbon and, therefore, a vital tool in the fight against climate change. All of society will similarly benefit from a policy framework and strategy that supports feasible and environmentally sound solutions for the resulting by-products.

# Decommissioning

The following is prepared and provided by Ontario Power Generation (OPG) in response to NRCan's public review of Canada's Radioactive Waste Policy Framework.

1. What do you feel are important policy considerations that should influence the choice of decommissioning strategies by nuclear operators and should be considered as part of Canada's radioactive waste policy?

   - The IAEA recognizes the various approaches to decommissioning and the selection of a strategy is very contingent on each plant's unique characteristics.
   - The availability of disposal facilities is critical in enabling decommissioning activities and should ideally be available before the beginning of decommissioning, particularly for the largest volumes of wastes produced which are typically Low Level Waste.
   - OPG has several types of nuclear facilities that will require decommissioning in the future, ranging from large multi-unit generating stations such as Pickering to waste management facilities to smaller specific-use buildings or licensed sites. Each of these may warrant a different approach.
   - External stakeholders have a keen interest in the expected end uses of the site and therefore this could influence the approach taken.
   - The understanding of immediate or prompt decommissioning as being dismantlement "without any planned delays" as stated in the Discussion Paper could be interpreted as decommissioning beginning the day after station shutdown. This is simply not realistic; even the most prompt of decommissioning plans will require planning, preparation and execution of several years and may not begin immediately after shutdown.
   - There is much international experience on decommissioning of power plants and the available technologies. Canadian operators will have some unique, first-of-a-kind technical considerations related to CANDU technology.
   - OPG established the Centre for Canadian Nuclear Sustainability (CCNS) to advance nuclear innovation, collaboration and research in decommissioning and other areas of interest.
   - The utilization of the Very Low Level Waste (VLLW) category may become useful for Canadian operators as dismantling activities progress and disposal of large volumes of items such as concrete is required.
   - The utilization of "clearance" or "free release" of materials following rigorous and approved regulatory processes, as noted in REGDOC 2.11.2 section 8.1, is a key component of minimizing waste during decommissioning. Clearance or free release of clean concrete, for example, will greatly minimize waste volumes during the dismantling and decommissioning of nuclear sites.
   - Through decontamination and/or characterization, some low level materials can also be released from regulatory control which further minimizes volumes requiring interim storage and disposal. In particular during dismantling and decommissioning of nuclear facilities, some materials may be more amenable to this such as concrete.

The following are some key policy considerations that should influence the choice of decommissioning strategies and these are further elaborated in this response:

- Availability of permanent disposal within Canada
- Ability to utilize a combination of decommissioning strategies depending on the facility – for example, a combination of prompt and deferred decommissioning may be appropriate for larger more complex facilities
- Location of the facility with respect to nearby population density and potential end use of the facility

IAEA Safety Reports Series No. 50, *Decommissioning Strategies for Facilities Using Radioactive Material*, speaks to the various considerations as follows:

*"The selection of the appropriate strategy to be used to decommission a facility can vary depending on a number of factors. No two facilities are exactly the same and their locations and conditions can result in different strategies being considered acceptable. The factors that are considered cover a wide range of topics from purely technical issues to social and economic issues."*

In this same IAEA document, the IAEA recognizes three strategies as being appropriate for decommissioning: Immediate Dismantling, Deferred Dismantling and Entombment. While the nomenclature is slightly different, these three strategies are in alignment with the Canadian strategies listed in NRCan's discussion paper. Specifically, immediate (prompt) decommissioning, deferred decommissioning and in-situ decommissioning respectively.

For the purposes of this NRCAN Discussion Paper, OPG has reviewed the considerations outlined within IAEA Safety Reports Series No. 50 and has provided its own commentary on some of those considerations, specific to the Canadian context as outlined in Table 1 below.

| ***IAEA Safety Reports Series No. 50 Section # and quote*** | ***OPG corresponding commentary and possible policy considerations*** |
|---|---|
| 3.1 *"It is necessary to initiate planning with an initial or preliminary decommissioning plan (…)*" | OPG has prepared Preliminary Decommissioning Plans (PDPs) for each of its nuclear facilities in accordance with the Canadian Nuclear Safety Commission (CNSC) Regulatory Guide G-219 and Canadian Standards<br>Association (CSA) Standard N294. The purpose of the PDPs is to define the areas to be decommissioned and the sequence of the principal decommissioning work. |
| 3.1 "*The decommissioning strategy of a facility takes into account the characteristics of the site where the facility is located."* | It is important to note that expectations of external stakeholders regarding the decommissioning strategies could vary depending on the location of the site. For sites that are located in more populous or urban areas, external stakeholders may expect more prompt decommissioning. Therefore, it is not only the technical characteristics of the site location that are relevant and must be considered but also the social characteristics. |
| 3.*1 " The choice of a decommissioning strategy is strongly influenced by major* | To address each of these points in an OPG (and Ontario) context:<br>a) Adequate funding is assured for the decommissioning of Ontario owned and leased reactor facilities and waste management facilities. This is done through the Ontario Nuclear Funds Agreement (ONFA) and confirmed to the |

| | |
|---|---|
| *issues such as availability of adequate funding, availability of radioactive waste storage or disposal facilities, cost of waste disposal, expected use of the site after decommissioning, available technology and experience in using it, spent fuel management options, continued operation and strategies for decommissioning of other facilities at the site, the need to protect the health and safety of the public and interested party opinion."* | regulator through the CNSC's Financial Guarantee process. Ontario currently has sufficient funds set aside for the long-term liability management and future decommissioning of these facilities.<br>b) The current funding for decommissioning of OPG's nuclear facilities assumes a deferred decommissioning approach and an approved schedule. Changes to this approach and timeline could impact the adequacy of funding.<br>c) While interim waste storage facilities are available, the lack of current availability of disposal facilities limits the ability to execute immediate or prompt decommissioning of all facilities. Further elaboration on this point is included in the commentary for section 3.7 in this table below.<br>d) More commentary is included on the "expected use of the site" concept in the answer to question 2 below.<br>e) There is much international experience on decommissioning of power plants and the available technologies. Canadian operators will have some unique, first-of-a-kind technical considerations related to CANDU technology. OPG established the Centre for Canadian Nuclear Sustainability (CCNS) to advance nuclear innovation, collaboration and research in decommissioning and other areas of interest.<br>f) OPG has significant capability and operating experience in dry fuel storage of spent fuel. OPG can therefore structure its decommissioning plans in a way that focuses on prompt de-fuelling of the reactor in the first initial years after shutdown. |
| *3.2 "The type of facility, its past functions and the extent of cleanup needed (e.g. soil/sediment, groundwater) will have a major impact on the strategy selected."* | OPG has several types of nuclear facilities which will require decommissioning in the future, ranging from large multi-unit generating stations to waste management facilities to smaller specific-use buildings or licensed sites. Each of these may warrant a different approach.<br><br>Smaller buildings or facilities on nuclear sites may be good candidates for immediate dismantling because they no longer serve a purpose once the nuclear station is shut down, and/or they are fairly simple and straightforward to dismantle |
| *3.7 "If no disposal route exists for a particular waste category, the only option may be to store the waste on-site in regulated storage facilities. Lack of a disposal facility is in itself insufficient reason for not performing immediate dismantling. The waste can be placed into an interim storage facility that will also require* | The availability of disposal facilities is critical in enabling decommissioning activities and should ideally be available before the beginning of decommissioning, particularly for the largest volumes of wastes produced which are typically Low Level Waste.<br><br>International experience on decommissioning strongly favours only handling the materials from dismantling and the radioactive waste once. The lack of disposal facilities then goes against this principle resulting in wastes having to be handled more than once by transferring them to interim storage to then eventually be transported again for permanent disposal. |

| | |
|---|---|
| *decommissioning eventually, once a final disposal scheme for the waste is decided upon."* | While interim storage can be utilized for smaller volumes of dismantling waste, larger volumes would require corresponding storage structures which themselves require decommissioning when emptied to permanent disposal. Transportation is also minimized if dismantling and decommissioning wastes can be sent directly to permanent disposal.<br><br>The nature of disposal facilities and even their location will define the way in which dismantling and decommissioning activities are planned, designed and executed. This impacts how materials are removed from the plant, how they are segregated and treated on the site.<br><br>Of particular note, the waste management facilities remain in operation for many years after the shutdown of reactor sites. Their decommissioning approach is wholly dependent on the availability of permanent disposal and cannot proceed without disposal availability. |

As also articulated in OPG's Response to the NRCAN Discussion paper on Waste Minimization:

Through decontamination and/or characterization, some low level materials can also be released from regulatory control which further minimizes volumes requiring interim storage and disposal. In particular during dismantling and decommissioning of nuclear facilities, some materials may be more amenable to this such as concrete.

REGDOC 2.11.1 section 8.1 speaks to this as follows:

*"The clearance and exemption of waste from regulatory control after having been appropriately characterized, processed and/or stored for a sufficiently long period of time, together with the reuse and recycling of material, can be effective in reducing the amount of radioactive waste that needs further processing or storage."*

A recent example of OPG utilizing this approach was during the dismantling of the Spent Solvent Treatment Facility in 2019 (Figure 1). The project required detailed surveys to be completed following the US EPA's MARSSIM methodology and OPG's Radiation Protection Program. Detailed survey results were provided to the CNSC. Some concrete debris was able to be disposed of in conventional waste through the thorough and rigorous application of this methodology.


*Figure 13: Dismantling of Spent Solvent Treatment Facility and resulting concrete debris*

2. In what ways should Canada's policy address the setting of end-state objectives for decommissioning?

- The very nature of nuclear plants and their already existent transmission and grid connectivity makes them an ideal candidate for reuse as power generation sites (whether nuclear or not) and/or industrial uses.

- Nuclear plants are significant contributors to economic activity and job creation both locally and provincially. Therefore, there often remains a desire for the site to continue with some type of industrial purpose which then sustains these economic drivers.

- As stated by the Federal Minister of Natural Resources, on NRCAN's website,

*"Nuclear energy plays an important role in providing safe, reliable and affordable non-emitting power. It will also be critical to Canada's efforts to achieve net-zero emissions by 2050. Simply put, without nuclear energy in our electricity mix, we risk failure in meeting our climate change targets"*

Therefore the re-use of existing nuclear sites for future nuclear generation purposes aligns with Canada's goals.

- Nuclear energy provides important societal benefits; as a low-cost and reliable source of electricity; and as clean energy, emitting zero carbon and, therefore, a vital tool in the fight against climate change. All of society will similarly benefit from a policy framework and strategy that supports feasible and environmentally sound solutions for the resulting by-products.
- As stated in CNSC REGDOC 2.11.1,

*"Completion of decommissioning involves verifying that decommissioning activities have been completed and that the end state has been achieved. Decommissioning ends with the release of the facility, location or site from CNSC regulatory control, even if the CNSC subsequently authorizes the site for any other licensed activity in the future, or if unrestricted release cannot be achieved, institutional controls are required to be in place"*

- As an operator, OPG must follow CNSC regulations in decommissioning its facilities. Depending on the decommissioning approach taken, the nature of the site and the operator's ability to meet clearance levels for the site, the regulator will then either approve release of the site from regulatory control or will require that institutional controls are in place. This will be one key factor in then establishing the next uses of the site.
- Also, as stated in the IAEA Safety Series No. 50,

"*The potential demand for reuse of the site either for specific restricted or unrestricted purposes is a consideration for the decommissioning strategy decision makers. Reuse of the site is {…} generally not optimized in the case of deferred dismantling, except in the case where reuse means the siting of new nuclear facilities on the existing site. […] All decommissioning strategies will need to take into account interested party engagement and, potentially, extended public information and feedback programmes."*

- Canada's Radioactive Waste Policy needs to recognize the vital role that nuclear generating sites can play in Canada's climate goals and enable reuses of the site that are aligned with these goals.

# 1. Waste Disposal

The following is prepared and provided by Ontario Power Generation (OPG) in response to NRCan's public review of Canada's Radioactive Waste Policy Framework.

1. What do you feel are important policy considerations that should influence the choice of disposal approaches by waste owners and should be considered as part of Canada's radioactive waste policy?

Foreword:
In our responses to NRCAN's other discussion papers, OPG has reiterated its commitment and support of the waste hierarchy and waste minimization. Also, we have stated that the current storage of radioactive waste within our waste facilities is safe, secure and environmentally sound.

While waste minimization is a key component of a strong waste management system, there will remain by-products and materials that still require permanent disposal. Also of note is that storage structures and containers have a finite design life and cannot be utilized in perpetuity; therefore, permanent disposal solutions will still be required.

Internationally, *"the preferred strategy for the management of all radioactive waste is to contain it (i.e. to confine the radionuclides to within the waste matrix, the packaging and the disposal facility) and to isolate it from the accessible biosphere." – reference IAEA Specific Safety Requirements No. SSR-5 "Disposal of Radioactive Waste", section 1.6*

Storage at the surface has a higher risk, in the longer term (such as thousands of years) for exposure to the biosphere, due to risks in aging packages and buildings, uncertainties about future climate or extreme weather conditions, and uncertainties about long-distant future societal conditions for continued regulation and maintenance by humans.

The IAEA guidance on disposal also recognizes that the type of disposal facility can vary depending on the type of waste being disposed of and its corresponding radioactive half-life, as depicted in Figure 1 below. (*Reference IAEA Nuclear Energy Series No. NW-T-1.27 "Design Principles and Approaches for Radioactive Waste Repositories")*

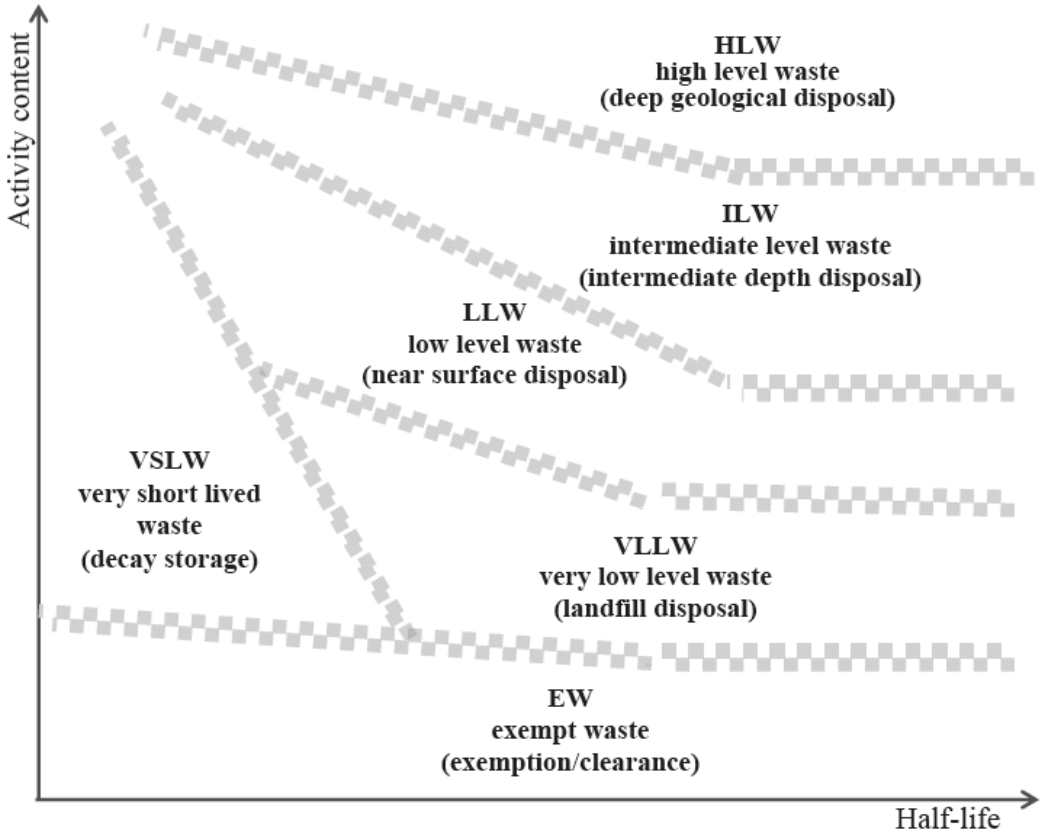


*FIG. 1. The IAEA waste classification scheme [10].*

Given the above foreword, OPG proposes the following policy considerations related to disposal approaches:

- The policy should recognize that these wastes were created in the pursuit of purposes which were beneficial to Canadian society, from electrical power generation to medical isotope production and are integral to clean-energy (zero- or low-carbon) strategies that will meet Canada's climate-change targets.

- While there is nothing in the current Rad Waste Policy framework that would prohibit or preclude waste owners collaborating on a permanent disposal project, there would be significant social license considerations to do so. Particularly, any combined disposal facility amongst waste owners could result in waste crossing inter-provincial boundaries. Hence the policy would benefit from language that would encourage waste owners to collaborate and that would provide some policy lever that would aid a project proponent to be successful in siting such a combined disposal facility

- Collaboration by waste owners does not necessarily mean that all waste types would be or could be disposed of in one repository. The types and volumes of waste, their current storage locations and the required transportation distances to a potential repository all influence the selection of options for disposal. The recognition that various solutions may be required within a country or state is articulated

in IAEA SSR-5 "Disposal of Radioactive Waste" section 1.1.4 as follows: *"Within any State or region, a number of disposal facilities of different designs may be required in order to accommodate radioactive waste of various types."*

- The policy could benefit from articulation of this potential need for various disposal options and this is recognized in IAEA SSR-5 "Requirement 1: Government Responsibilities" as follows:

*(…)The government is required to establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities shall be clearly allocated for disposal facilities(…)This shall include: confirmation at a national level of the need for disposal facilities of different types;"*

- The policy needs to also acknowledge the long time frames for disposal facility projects and utilize a principle of adaptability during those time frames. It will be future generations that will make the decisions about, for example, closure of these facilities and post-closure monitoring. Again, the IAEA guidance speaks to this:

*"Programmes to develop and implement geological disposal possess characteristics that distinguish them from many other large projects, such as railroad construction or natural resource exploration. Geological disposal programmes will usually take place over longer time periods, perhaps half a century or even more to plan and to implement. The facilities constructed need to perform reliably over thousands of years. It follows that issues of intergenerational equity will be important in order to consider the needs for future generations." - reference IAEA-TECDOC-1566 "Factors Affecting Public and Political Acceptance for the Implementation of Geological Disposal"*

2. <u>What should be the roles and responsibilities of government, the regulator and waste owners with regards to radioactive waste disposal facilities, including:</u>
    - <u>Funding</u>
    - <u>Closure of a disposal facility and its institutional control, and</u>
    - <u>Indigenous and Public Engagement and involvement in site selection and post-closure?</u>

- OPG acknowledges and accepts the role of government, and of the waste owner more generally, as related to radioactive waste management, as outlined in CNSC REGDOC-2.11. OPG also acknowledges the important role of the CNSC as a strong, independent regulator.

- Above all else, the responsibility of the waste owner as it relates to disposal is safety.

"*The operator has to be responsible for developing a disposal facility that is practicable and safe and for demonstrating its safety, consistent with the requirements of the regulatory body."* - reference IAEA SSR-5 section 3.12

- Related to funding, the waste owner's role is already well understood and is confirmed through the CNSC Financial Guarantee governance.

- While operators will remain responsible for the facility design, construction and operational costs of permanent disposal facilities, including the related costs of public engagement and Indigenous

engagement, as is currently required, all parties should be open to additional financial support for willing hosts that recognizes their role in providing lasting solutions.

- Related to Indigenous engagement, in accordance with OPG's Indigenous Relations Policy, OPG remains committed to working with Indigenous communities, proximate to its present and future operations, to foster positive and mutually beneficial relationships that will create social and economic benefits through partnership and collaboration.
- Siting of disposal facilities should be done in a way in which Indigenous communities, municipalities and local residents can be a part of the project and its benefits. This is done through job creation, education and training and development of local new businesses.