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File: 00216-00531 P
CD#: 00216-CORR-00531-00219
Project ID: 10-60004

Dr. Stella Swanson
Chair, Joint Review Panel
Deep Geologic Repository Project

c/o Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, Ontario
K1P 5S9

Dear Dr. Swanson:

**Deep Geologic Repository Project for Low and Intermediate Level Waste – Submission of Response to Information Request EIS-12-512**

The purpose of this letter is to provide the attached response to Information Request (IR) EIS-12-512 from IR Package #12 (Reference 1).

An updated Tracking Table showing how this submission links to various sections in the documents submitted on April 14, 2011 (References 2 and 3), will be provided in a revision of the Tracking Table to be submitted with the final response for IR Package #12, committed for submission by April 4, 2014 in Reference 4.

If you have questions on the above, please contact me at (905) 623-6670, ext. 3326.

Sincerely,

Allan Webster
Director, Nuclear Regulatory Affairs
Nuclear Projects
Ontario Power Generation

Attach.

cc. Dr. J. Archibald – Joint Review Panel c/o CNSC (Ottawa)
Dr. G. Muecke – Joint Review Panel c/o CNSC (Ottawa)
P. Elder – CNSC (Ottawa)
D. Wilson – NWMO (Toronto)

References:

1. JRP letter from Dr. Stella Swanson to Laurie Swami, “Information Request Package #12 from the Joint Review Panel”, November 8, 2013, CD# 00216-CORR-00531-00215.

2. OPG letter from Albert Sweetnam to JRP Chair, “Submission of Information in Support of OPG’s Licence Application for a Deep Geologic Repository for Low and Intermediate Level Waste”, April 14, 2011, CD# 00216-CORR-00531-00090.

3. OPG letter from Albert Sweetnam to JRP Chair, “Submission of an Environmental Impact Statement for a Deep Geologic Repository for Low and Intermediate Level Waste”, April 14, 2011, CD# 00216-CORR-00531-00091.

4. OPG letter from Laurie Swami to Dr. Stella Swanson, “Deep Geologic Repository Project for Low and Intermediate Level Waste – Acknowledgment of Information Request (IR) Package #12”, December 4, 2013, CD# 00216-CORR-00531-00216.

# ATTACHMENT

Attachment to OPG letter, Allan Webster to Dr. Stella Swanson, “Deep Geologic Repository Project for Low and Intermediate Level Waste – Submission of Response to Information Request EIS-12-512”

January 22, 2014

CD#: 00216-CORR-00531-00219

# OPG Response to Information Request EIS-12-512 from Joint Review Panel

## OPG Response to Information Request EIS-12-512 from Joint Review Panel

| IR# | EIS Guidelines Section | Information Request and Response |
|---|---|---|
| EIS 12-512 | • Section 14, Cumulative Effects | ***Information Request:***<br>***DGR Expansion Plans***<br>*Provide the existing Technical Assessment and all associated support documents for the expansion of the proposed DGR to accommodate the disposal of decommissioning waste, LLW and ILW, from the Pickering, Darlington and Bruce nuclear generating stations. The response must include plans for anticipated changes to both the physical layout of the subsurface (shafts, emplacement rooms, etc.) and surface (WRMA, SWMP, etc.) facilities and structures and their operational parameters.*<br>*The anticipated timing of any expansion activities relative to currently proposed DGR phases must be included in this response.*<br>***Context:***<br>*The cumulative effects analysis presented in the EIS lists the emplacement of decommissioning waste from the OPG-owned and operated nuclear generating stations (Pickering, Darlington and Bruce) into the DGR as a reasonably foreseeable activity. The Hosting Agreement with Kincardine includes provision for accepting decommissioning waste into an expanded DGR (EIS, Table 10.4-3, item 31). An approximate doubling of the underground capacity was envisioned from ~200,000 $m^3$ to ~400,000 $m^3$ (IR EIS-04-145).*<br>*Since the finalization of the EIS in 2011, the earlier than anticipated planned decommissioning of the Pickering Nuclear Facility has triggered the expectation from OPG that the L&ILW from that site would be placed into the proposed DGR. During the hearing OPG referenced the existence of an expansion Technical Assessment (Hearing Transcript Volume 23: October 28, 2013, p.121, l. 21) which details initial plans for the expansion and its impact on the proposed DGR.* |
| | | **OPG Response:**<br>The ability of the DGR Project to support the potential for future expansion is identified in the project requirements and was assessed as part of the design process. As such, a formal Technical Assessment report had not been prepared.<br>However, the requested information is provided in Attachment A.<br>This response includes the expansion layout referenced by OPG in the hearings as the expansion GA, or general arrangement drawing (Hearing Transcript Volume 23: October 28, 2013, p.121, l.21). |

# ATTACHMENT A

# EIS-12-512: DGR Expansion Plans

This response to the Information Request presents the assessment of several components of the design, and the potential impact on the environment, of the potential expansion of the Deep Geologic Repository (DGR). The ability to support such a future expansion is identified as part of the project requirements (NWMO 2010) and is a consideration in all aspects of the design. As such, this information has not been formally documented in a stand-alone report. The information provided in this response shows that expansion could be achieved without major changes to the DGR facility infrastructure or safety case. Before the DGR facility is expanded to accept additional waste, further analysis would be completed in detail and the required regulatory approvals would be sought. Further, experience gained through the construction and operation of the proposed DGR would be incorporated into the expansion design and planning.

## 1. BACKGROUND

Ontario Power Generation (OPG) is currently seeking regulatory approval for site preparation and construction of a DGR with a capacity of approximately 200,000 $m^3$ (packaged volume) for low & intermediate level waste (L&ILW) arising from operations and refurbishment activities from OPG owned or operated reactors (see Figure 1) (OPG 2012). The activity that causes the waste to come into existence however is not an important consideration. Rather, it is the characteristics of that waste from a volume, material, and radionuclide perspective that is important. The 200,000 $m^3$ would provide sufficient capacity for disposal of the estimated L&ILW wastes to be generated through the operation and refurbishment of the OPG owned or operated reactors.

The DGR project has also assessed the feasibility of an expansion of the DGR from the current planned waste volume capacity of 200,000 $m^3$ to a capacity of 400,000 $m^3$. This additional capacity could account for the potential of future L&ILW waste volumes arising from either new operational and refurbishment activities or decommissioning activities.

This consideration of the expansion of the DGR also supported the requirement in the Environmental Impact Statement Guidelines to perform a cumulative effects assessment of including L&ILW arising from decommissioning. The following considerations respecting expansion of the DGR have been assessed at a conceptual level:

- Repository layout within the existing site constraints (assuming that the surface and underground footprint are not constrained within the lands currently designated as OPG retained lands at the Bruce nuclear site);
- Constructability of the expanded repository;
- Impacts to waste operations;
- Environmental impacts of expanded repository; and
- Safety implications of decommissioning waste inventory.

Section 2 describes the proposed design impacts (to both underground and surface facilities) and operational impacts of expanding the repository. Section 3 describes additional considerations specific to L&ILW arising from decommissioning activities, and Section 4 discusses timing of the potential expansion.

## 2. REPOSITORY EXPANSION

A general layout of the expanded underground repository has been prepared to assess the feasibility of this planning assumption. For this layout, the DGR was conservatively assumed to be expanded to double in size (i.e., 400,000 $m^3$ packaged waste volume). Figure 2 shows the expansion layout and Figure 3 shows the proposed and expanded repository footprint on the Bruce nuclear site. The underground layout and required number of emplacement rooms would be updated when the volume of additional waste is better defined. The expansion assumes that the emplaced waste is isolated by closure walls prior to initiation of expansion (i.e., no waste emplacement during construction activities).

The expanded layout retains the general features of the original layout. It is designed to accommodate Panels 1 and 2 having been filled and isolated by closure plugs. It maintains the following post-closure safety relevant features: no additional shafts, same geologic formation for the repository openings with a shale cap rock, maintaining the same minimum distance from Lake Huron, and the same geomechanically stable room positioning (i.e., parallel with the assumed principle horizontal stress direction).

The following provides additional information on impacts to specific aspects of the design and repository operations resulting from an expanded facility.

## 2.1 IMPACT TO UNDERGROUND FEATURES FOR EXPANSION

***Expansion of Underground Repository***

It is currently assumed that an additional 32 rooms would be excavated in two panels to provide the additional volume. The rooms in the two expansion panels would be similar in size and arrangement to rooms in Panels 1 and 2.

The host Cobourg Formation is present beneath the entire Bruce nuclear site and thus could accommodate this expansion. This would be confirmed by drilling additional deep boreholes (minimum of 3 additional boreholes) outside the footprint of the expanded repository.

***Underground Services Area***

The existing Maintenance Shop, Service Garage, Diesel Fuel Bay, Cap Magazine and Explosives Storage facilities would be re-established to service underground mining equipment and to support mining activities in the same manner as they would have been used during the initial construction.

The underground Refuge Station and Lunchroom would be equipped as required for the construction force. The permanent compressed air system providing emergency air for breathing inside refuge stations during operations would remain in service for repository expansion. The two portable refuge stations used in Panels 1 and 2 during operations would also be available for use during the expansion.

***Lowering of Mining Equipment***

Mining equipment that would be required to construct the rooms and tunnels in the expansion area would be disassembled, as required, to allow equipment to be lowered to the repository level inside the Main Shaft cage. Some mining equipment may also be lowered to the repository level using the Ventilation Shaft hoisting system. Once underground, the equipment would be reassembled either in the Main Shaft station or in the Maintenance Shop.

***Underground Ventilation System***

The underground ventilation system installed for the initial construction would remain for use during DGR operations. However, due to lower airflow requirements in operations, the system will operate at a reduced capacity. Once repository expansion commences, the system would be reprogrammed to operate at the higher capacity required for construction.

The equipment and general approach to mining during repository expansion is assumed to be similar to that used during initial construction of the underground repository. Therefore, airflow requirements are expected to be similar and major ventilation equipment allocations at the time of initial construction would be suitable for use during repository expansion. This would also include auxiliary booster fan and temporary ducting arrangements to provide ventilation to construction areas.

During repository expansion and depending on the timing of the expansion, the first five rooms in Panel 1 would likely be empty and not isolated by closure walls. The ventilation through these rooms could be stopped by closing the louvers at the backend of each room. However, if one or more of these rooms are required for storage or laydown of materials and equipment needed for the expansion, the ventilation could be maintained in these rooms and has been accounted for in the required air volumes.

To establish flow-through ventilation in the expansion panels, a return air tunnel system would need to be constructed that bypasses the now-isolated Panels 1 and 2 (see Figure 2). These panels would be isolated by closure walls at locations shown on Figure 2. As each section of the repository expansion is completed and connected to the permanent return air tunnel system, the aforementioned temporary ventilation would be removed.

***Underground Waste Rock Handling System***

The underground waste rock handling system is located at the Ventilation Shaft. At the end of initial DGR construction, the equipment for the underground waste rock handling system at the loading pocket would be removed. However, major structures at the Ventilation Shaft would remain, including the underground rock structure (waste rock raise) to the loading pocket, concrete-lined 5-m-diameter shaft, headframe and hoist house. The hoist at the ventilation shaft used during construction for skipping waste rock to surface, along with all headframe and shaft equipment for these activities, is removed following construction to avoid the need for extended maintenance.

Prior to the start of underground expansion work, the waste rock handling system would be re-established. Specifically the following equipment would either be re-installed or refurbished at the Ventilation Shaft:

- Double-drum hoisting system in hoist house;
- Surface waste rock handling system in Ventilation Shaft headframe;
- Rock skip in Ventilation Shaft;
- Underground loading pocket system; and
- Rock dump including rock grizzly and hydraulic rock breaker.

## 2.2 IMPACT TO SURFACE FEATURES FOR EXPANSION

***Expansion of Waste Rock Management Area***

The waste rock from the expansion of the underground repository could be accommodated on the DGR site through expansion of the Waste Rock Management Area (WRMA). This expansion of the waste rock pile would increase height by about 20 m to a total height of 35 m and the footprint area would increase by approximately 2 ha from the current proposed area (i.e., increase from 9 ha to 11 ha - see Figure 4).

***Stormwater Management Pond***

The Stormwater Management Pond (SWMP), as designed and accepted for initial construction, would be sufficient to handle the run-off and underground water discharge that would occur during the construction of the expanded repository. The quality and quantity of surface water run-off from the DGR site during expansion would not change significantly relative to run-off expected during initial construction. Similarly, it is likely that the quality and quantity of process water used and pumped to surface during repository expansion would be similar to initial construction. Should there be a need to increase the holding capacity of the SWMP, there is sufficient space adjacent to the proposed SWMP to the south-west to extend the pond. Any water treatment processes that may be deemed necessary during the initial construction phase would be installed and commissioned prior to the start of the repository expansion work.

***Surface Facilities and Services***

At the time of repository expansion, the Waste Package Receiving Building would be decontaminated, as necessary, and used as a staging area for underground mining activities. Similarly, the Ventilation Shaft and hoist house would be turned over and used for expansion activities (see above). Areas for Contractor trailers for temporary office space, change rooms, and equipment trailers would be located in areas marked in green on Figure 4.

The following describes the anticipated impact of repository expansion construction work on various services:

- Electrical – no impact. The size of the electrical distribution system is based on the initial construction needs. There is no predicted change to these needs during the expansion of the underground facility as they are very similar to those of the initial construction needs.
- Service water – minor impact. The service or process water demand during expansion is expected to be the same as the demand during initial construction. The service water supply

system installed at surface during initial construction would still be in-place at the time of expansion. However, large-diameter service water piping would be reinstalled in the Main Shaft and Ventilation Shaft to bring water to the repository level for mining activities. At the end of the initial construction, large-diameter service water piping would be removed and replaced with smaller-diameter piping that is sized for operational needs.

- Compressed air – no impact. Compressors would be brought to the site to meet the compressed air requirements for the construction equipment. Temporary air lines for the distribution of the compressed air would be installed, as required. The permanent compressed air system that services the refuge station would remain operational.
- Underground dewatering – minor impact. Pumps used for operations dewatering would be removed and a similar dewatering system as used during initial construction would be installed. Temporary sumps would be installed, as required, in the repository expansion area to bring the construction water to the main sump. At the end of repository expansion, pumps used for operations dewatering would be reinstalled.

***Commissioning of Expanded DGR Facility***

Prior to turn-over to operations staff, all systems would be commissioned by following same or similar procedures used following completion of initial construction.

***Environmental Emissions during Construction***

Emissions to the surface environment resulting from the construction of the expanded repository would be similar to those that will occur during initial construction. Dust and noise emissions would arise due to handling, transfer and placement of waste rock in the Waste Rock Management Area. Surface water run-off from the waste rock pile would be directed to the Stormwater Management Pond. Monitoring and mitigation options that are planned for initial construction would also be implemented during repository expansion.

## 2.3 IMPACT TO DGR OPERATIONS FOR EXPANSION

***Temporary Stoppage of DGR Waste Package Receipt and Emplacement***

At the time of underground expansion, waste-filled rooms in Panels 1 and 2 would be fully isolated by concrete closure walls in the access tunnels. This ensures that there is no contaminated airflow for the construction period as the shafts would be turned-over for construction use. Contamination checks would be performed and, if necessary, areas would be decontaminated prior to allowing construction workers to work and travel through previously zoned areas.

Before the start of expansion construction activities, the emplacement of operational L&ILW in the underground repository would cease. At the time of expansion, most of the L&ILW stored above ground at Western Waste Management Facility (WWMF) would have been transferred into the DGR. During the expansion, operational L&ILW would continue to be delivered to WWMF from operating nuclear generating stations and, after processing, would be stored as usual in a Low-Level Storage Building(s) (LLSB) or in-ground structures. Once DGR expansion has been completed and the DGR facility is again operational, these wastes would then be retrieved from temporary storage and transferred to the DGR.

***Operational Changes***

The expanded DGR facility would be operated using the same procedures as will be used during operation of DGR with Panels 1 and 2 only. It is expected that waste packages would be similar in design to the waste packages that would be placed in Panels 1 and 2. Therefore the same or similar equipment would be used to handle and stack the waste packages.

***Environmental Emissions***

Air emissions due to operation of the expanded DGR facility would be similar to emissions during DGR operations with Panels 1 and 2 only. Air emissions are expected to be similar because: a) most of the rooms in Panels 1 and 2 would be isolated by closure walls and thus the majority of underground ventilation air would be passing through rooms in the two expansion panels; b) the characteristics of the wastes are expected to be sufficiently similar to currently proposed wastes such that radionuclide releases from packages to ventilation air would be similar; and c) the sequence of waste emplacement operations would be similar to the sequence used during initial operations; i.e. small number of active emplacement rooms, minimal ventilation through waste-filled rooms and periodic isolation of a series of waste-filled rooms with closure walls.

The quantity and quality of water that would be discharged from the Stormwater Management Pond during operation of the expanded DGR facility is expected to be same as quantity and quality of water discharged during initial operations.

## 3. CONSIDERATIONS FOR WASTE ARISING FROM DECOMMISSIONING

OPG is planning to place L&ILW arising from decommissioning in the DGR. However, as decommissioning is not expected to occur for several decades, the detailed waste volumes and characteristics are not currently available since the full characterization cannot occur until reactor shutdown and will also depend on decommissioning methods available at that time. Therefore, OPG is not presently seeking a licence to accommodate additional L&ILW from decommissioning activities. A decision on whether to formally seek a licence, and the supporting analyses, would only occur decades in the future as discussed below.

***L&ILW Waste Volume***

Initial assessments from decommissioning cost estimates indicate that the volume of L&ILW generated by decommissioning of the stations will correspond to a volume of approximately 135,000 $m^3$ packaged volume (OPG 2011a, Section 3.1). It is presently estimated that the wastes will be approximately 10-20% ILW by package volume (comparable to the 20% ILW volume in L&ILW from operations and refurbishment), although the exact ratio will vary depending on the waste treatment and volume reduction options available at the time of decommissioning.

Although the present estimate of decommissioning waste volume is 135,000 $m^3$ (as packaged) compared with the current reference volume of 200,000 $m^3$, a doubled repository size was considered for conceptual design purposes. The specific repository volume would be adjusted for the amount and nature of wastes arising from decommissioning.

***L&ILW Characteristics***

The waste types arising from decommissioning activities are fundamentally the same as those arising from operations and refurbishment activities, but the amounts of the various wastes will be different.

Low Level Waste (LLW) arising from decommissioning will include the same lightly contaminated tools, cleaning materials and other supplies as with operations. It will also include large amounts of materials from the dismantlement of the facility systems, structures and buildings, such as mechanical, electrical and instrumentation materials as well as concrete and structural steel. These materials are also present in LLW arising from operations, but at lower volumes.

The Intermediate Level Waste (ILW) waste arising from decommissioning will include components from dismantling of reactor systems and immediate structures, similar to irradiated core components and retube wastes currently received. The ILW is not expected to include significant amounts of ion exchange resins, as these would have been removed at station shutdown. The ILW from decommissioning contains a similar high proportion of metal as with ILW from refurbishment. Additionally, it will have higher activity steel from the core internals.

A full characterization of decommissioning waste will depend upon the stations operating history, life of the reactors and length of radiological decay prior to decommissioning. The total radionuclide inventory for all the Pickering stations is presently estimated to be about 53,000 TBq at 30 years following shutdown. The inventory for all reactor units is estimated to be 390,000 TBq at 30 years following shutdown. The inventory of decommissioning waste with time is shown in Figure 5.

Similar to the wastes from operations and refurbishment, almost all the radioactivity resides in the ILW component from decommissioning. The radioactivity inventory is larger due mostly to the presence of Ni-63, which is a component of activated stainless steel associated with the reactor core. The total amounts of Ni-59, Ni-63, Fe-55, Co-60, Cl-36 and Ca-41 are expected to be higher in wastes from decommissioning than in operational and refurbishment wastes. Ni-59 (101,000 year half-life), Ni-63 (100 year half -life), Fe-55 (2.7 year half-life) and Co-60 (5.3 year half-life) are primarily activation products in metal. Cl-36 (301,000 year half-life) and Ca-41 (102,000 year half-life) are primarily activation products in concrete.

***Implications of Expansion on DGR Safety***

The aspects which most affect safety related to waste arising from decommissioning are:

- Higher radionuclide inventory, and
- Larger amount of concrete and metal.

The characteristics of waste arising from decommissioning and the potential implications of including wastes arising from decommissioning in an expanded DGR on both operational safety and long-term safety are discussed below.

***Operational Safety Implications***

Waste arising from decommissioning is assumed to be emplaced at the start of the post-expansion operational phase (mid 2040's) with Pickering waste arising from decommissioning first (see Figure 2). Initially, the wastes arising from decommissioning could be emplaced in the remaining rooms of Panel 1 along with wastes from ongoing operations and refurbishment. As per the current design, the other rooms in Panels 1 and 2 would have been isolated with closure walls with no radionuclide release to the environment.

For L&ILW arising from operations and refurbishment, the most important radionuclides for operational safety are H-3 and C-14 for inhalation exposure and Co-60 and Cs-137 for external irradiation (OPG 2011b, Chapter 7). Due to the nature of the waste, the total H-3 inventory in the decommissioning wastes in ventilated rooms is expected to be less than the H-3 inventory in ventilated rooms in the reference design with operational and refurbishment wastes. Similarly, the total C-14 inventory in the decommissioning wastes in ventilated rooms is also expected to be less than the C-14 inventory in the current assessment. Therefore, the impact of wastes arising from decommissioning would result in similar or less inhalation dose than in waste arising from operations and refurbishment.

The Co-60 inventory in wastes arising from decommissioning, primarily associated with activation products in steel from the core internals, is expected to be higher than in the waste arising from operations and refurbishment. This would require a detailed waste characterization following station shutdown and detailed assessment of dose rates. Mitigating measures such as shielding or greater stand-off distance would be considered as part of the ALARA assessment during detailed design of the expansion case, and drawing on the experience gained during the operation of the DGR with wastes arising from operations and refurbishment. These measures would ensure that doses remain within OPG dose targets.

***Long-Term Safety Implication***

For L&ILW from operations and refurbishment, the most important radionuclides in terms of the higher dose scenarios for long-term safety are C-14 and Nb-94. Since the wastes arising from decommissioning are expected to have roughly similar amounts of these radionuclides to that in the current licence application for wastes arising from operations and refurbishment, the impact of adding waste arising from decommissioning to the DGR would result in a calculated postclosure peak dose that is approximately double the dose calculated for waste arising from operational and refurbishment only. The increase in other radionuclides, notably Ni-59 and Ni-63, has limited effect since these are sufficiently small dose contributors for L&ILW from operations and refurbishment that their dose contribution remains relatively small even considering their larger inventory in L&ILW from decommissioning. For the Normal Evolution Scenario, the dose remains many orders of magnitude below the dose criterion of 0.3 mSv per year. For the Disruptive Scenarios, the impact remains within the risk criterion of $10^{-5}$ per year.

This is based on a very preliminary assessment. A request for permission to expand the DGR would be supported by detailed waste characterization following station shutdown and confirmed through a full safety assessment of an expanded DGR to accommodate L&ILW from decommissioning.

The gas generation potential in L&ILW from decommissioning could be larger than that from L&ILW from operations and refurbishment due to higher metal content. This would have to be taken into account in the repository design and safety assessment supporting the safety case for the inclusion of low and intermediate level waste from decommissioning. Since much of the metals and organics reside in the LLW from decommissioning, they may be reduced through future volume reduction, and/or decontamination and recycling technologies. Increased space may also be required to accommodate gas generation from L&ILW from decommissioning.

## 4. TIMING

The DGR is anticipated to start operation in the 2020's. It would operate for about 40 years, with the first waste panel filled in approximately 10-15 years and then isolated by closure walls. The next half-panel would be filled and closed off in another 10-15 years based on receipt of L&ILW from operations and refurbishment.

The first station to be decommissioned will be Pickering A. This is scheduled to shutdown in the 2020's. The earliest time at which decommissioning will start is the 2040's. The schedule for shipment of wastes from decommissioning to the DGR (assuming a license has been obtained) would be selected to allow isolation of a panel before repository expansion would begin. It is possible that some L&ILW from decommissioning would be placed in Panel 1 to allow either the full panel or the half-panel to be filled and closed.

At that time in the 2040's or 2050's, the further emplacement of wastes into the DGR would be suspended. The construction and commissioning of the expanded DGR would proceed over a 4-5 year period. Following completion of the expansion, the repository would then resume operation.

## 5. CONCLUSIONS

This response to the Information Request presents preliminary design and environmental considerations for the potential expansion of the Deep Geologic Repository (DGR). The information shows that expansion of the DGR to accommodate L&ILW arising from decommissioning activities could be achieved without major changes to DGR facility infrastructure or safety case.

The potential need to expand the DGR to accommodate waste arising from decommissioning does not arise until approximately the 2040's. Before the DGR facility is expanded to accept additional waste, further analyses would be completed in detail. This would include waste characterization, safety assessment and environmental assessment. It would also require a full regulatory approval of the expansion.

## References

NWMO. 2010. OPG's Deep Geologic Repository for Low and Intermediate Level Waste - Project Requirements. Nuclear Waste Management Organization document DGR-PDR-00120-0001 R002. Toronto Canada. (CEAA Registry Doc# 300)

OPG. 2011a. OPG's Deep Geologic Repository for Low and Intermediate Level Waste - Environmental Impact Statement, Volume 1: Main Report. Ontario Power Generation report 00216-REP-07701-00001 R000. Toronto, Canada. (CEAA Registry Doc# 298)

OPG. 2011b. OPG's Deep Geologic Repository for Low and Intermediate Level Waste - Preliminary Safety Report. Ontario Power Generation report 00216-SR-01320-00001 R000. Toronto, Canada. (CEAA Registry Doc# 300)

OPG. 2012. OPG Letter, A. Sweetnam to S. Swanson, "Updated Information in Support of OPG's Licence Application for a Deep Geologic Repository for Low and Intermediate Level Waste", CD# 00216-CORR-00531-00101, February 10, 2012. (CEAA Registry Doc# 336)

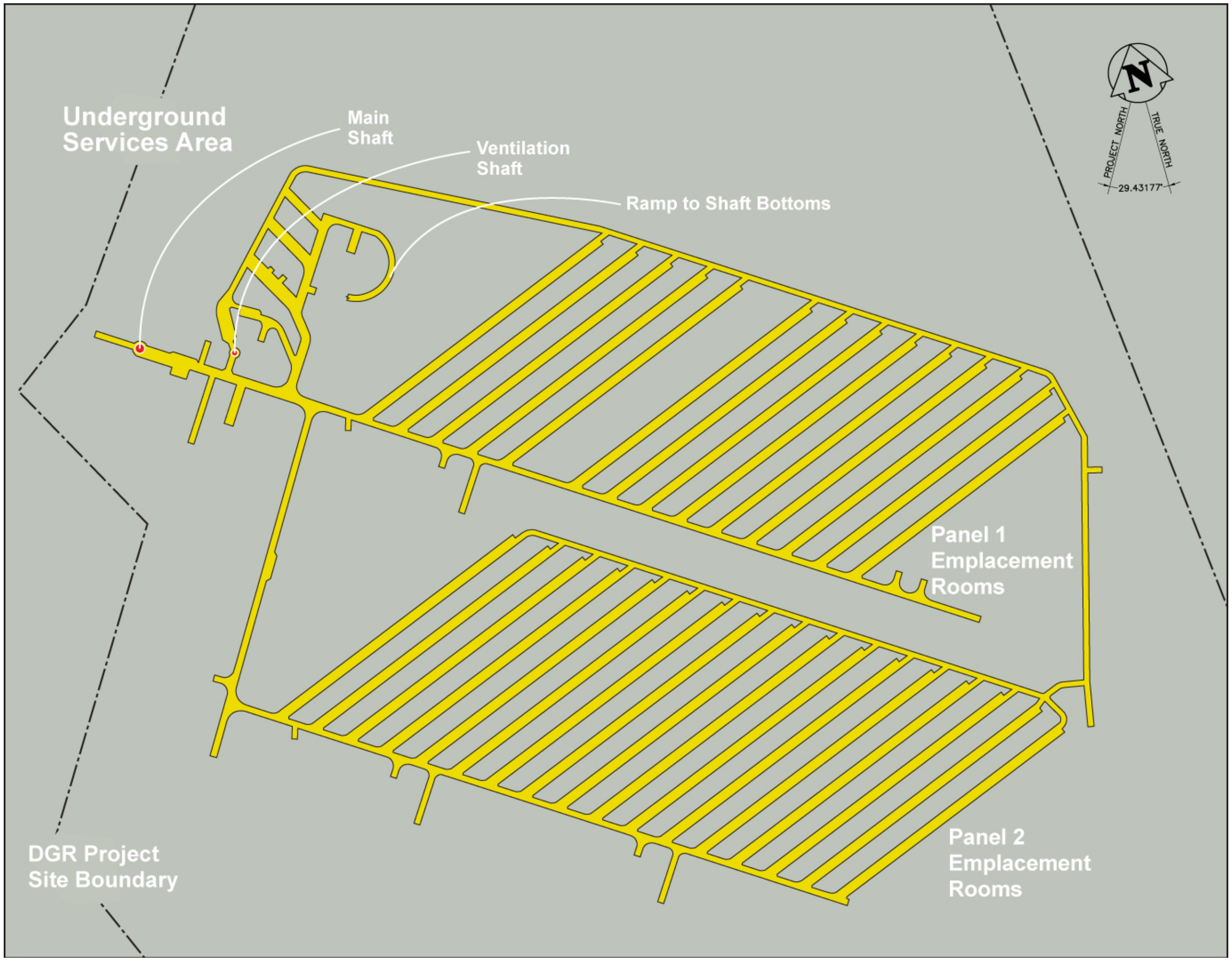



**Figure 1: OPG's Deep Geologic Repository for L&ILW – OPG's Proposed Layout for Operational and Refurbishment Waste**

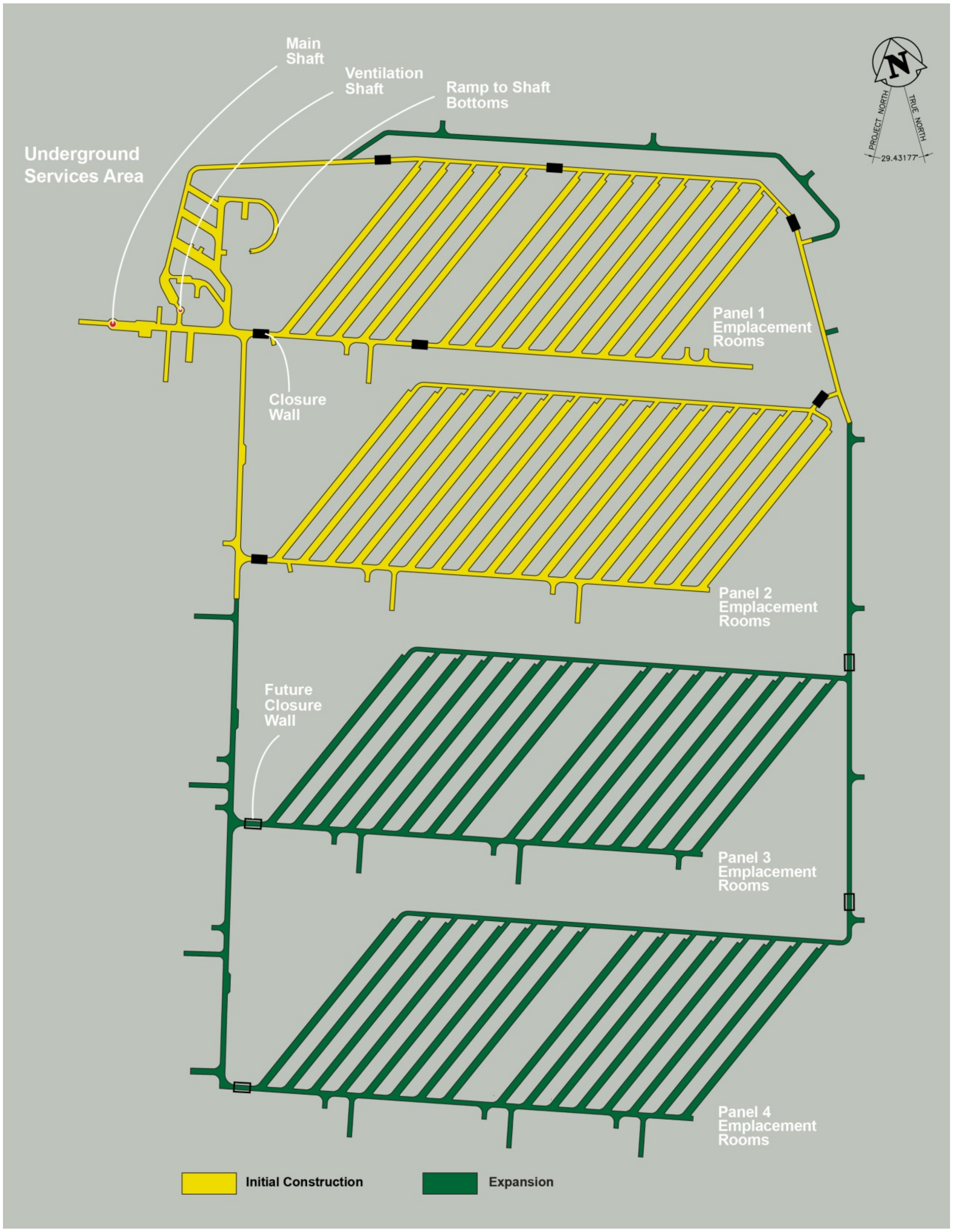



**Figure 2: OPG's Deep Geologic Repository for L&ILW – Conceptual Expansion Layout**

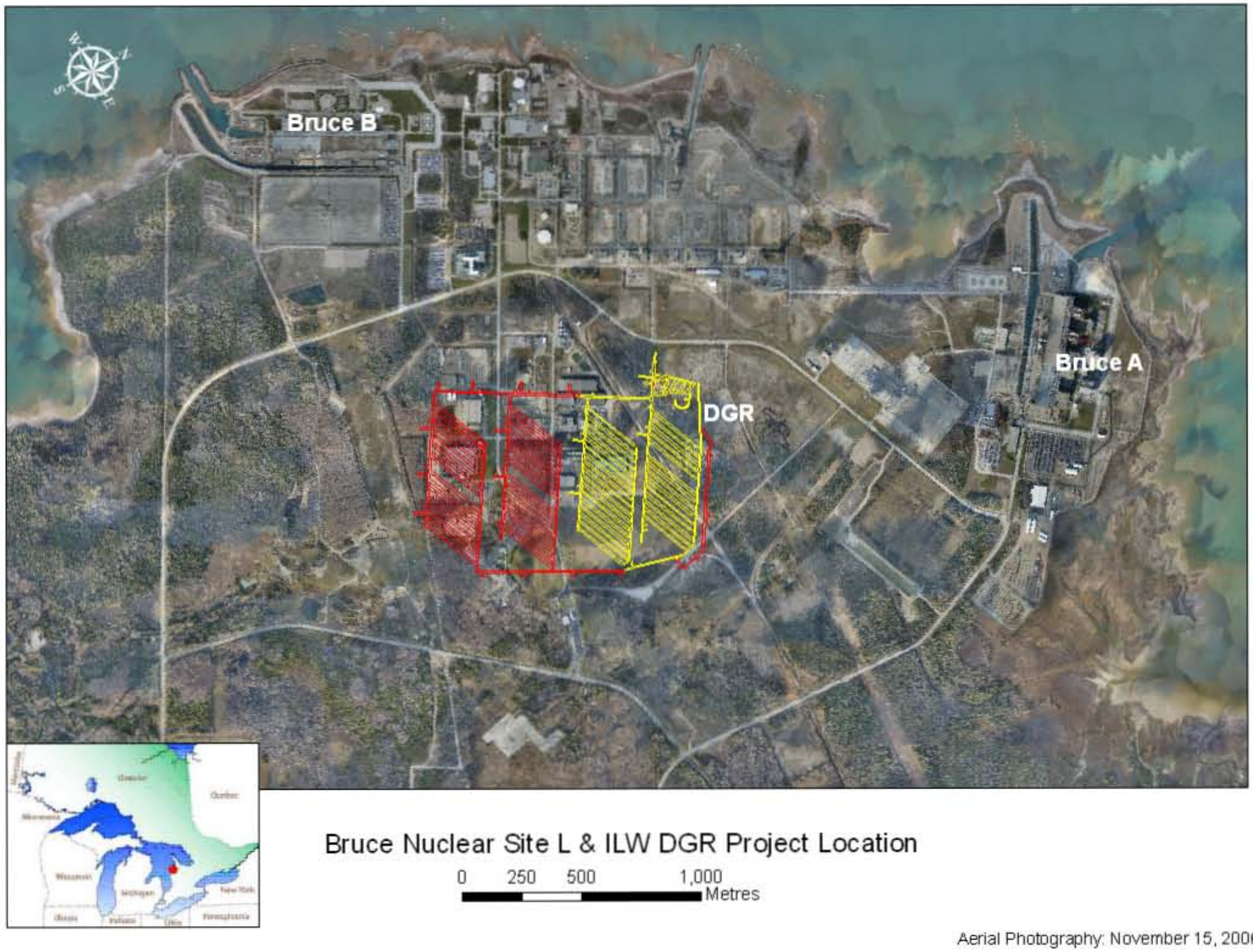



**Figure 3: OPG's Deep Geologic Repository for L&ILW – Relative Positioning of the Expansion Layout on the Bruce Nuclear Site**

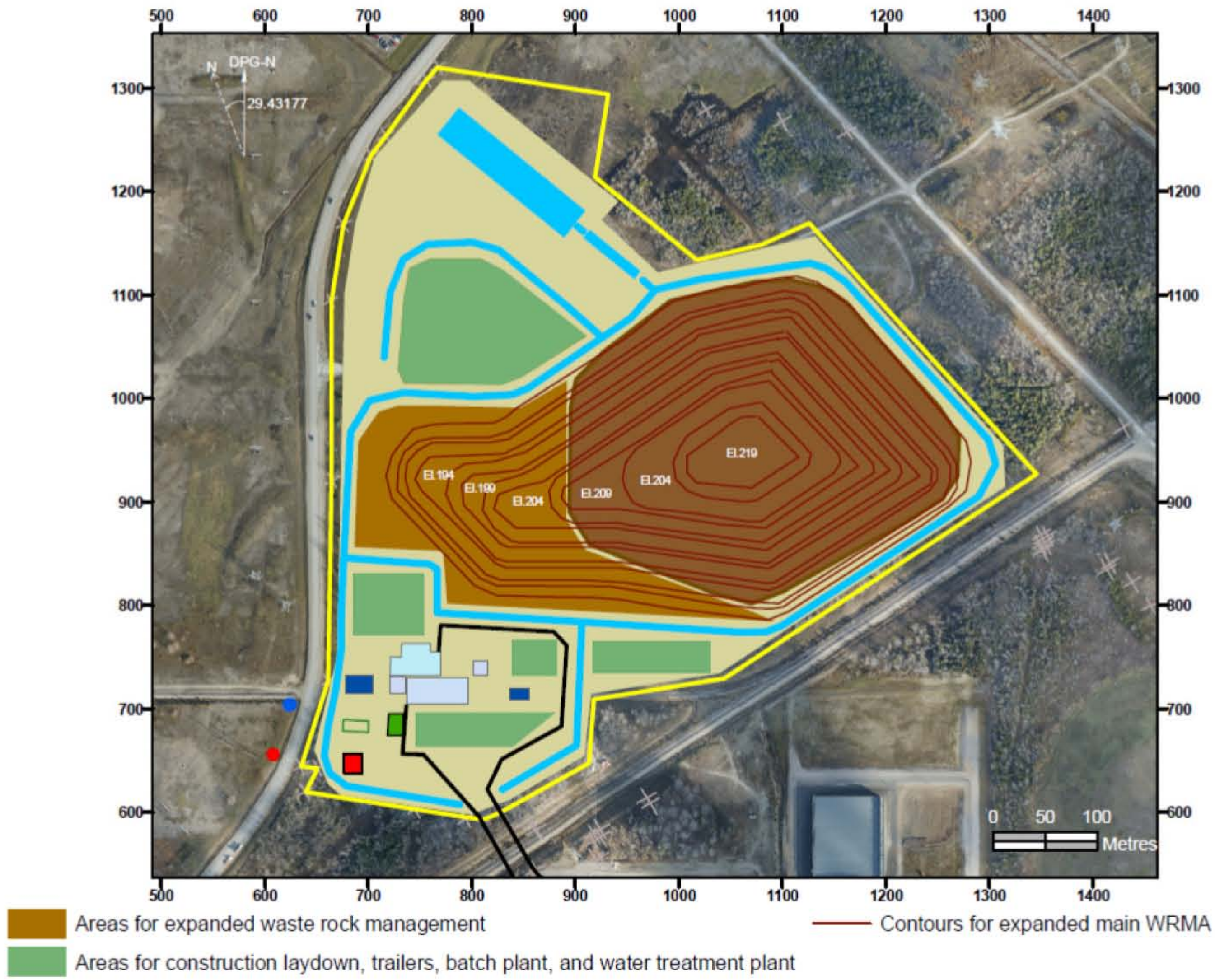
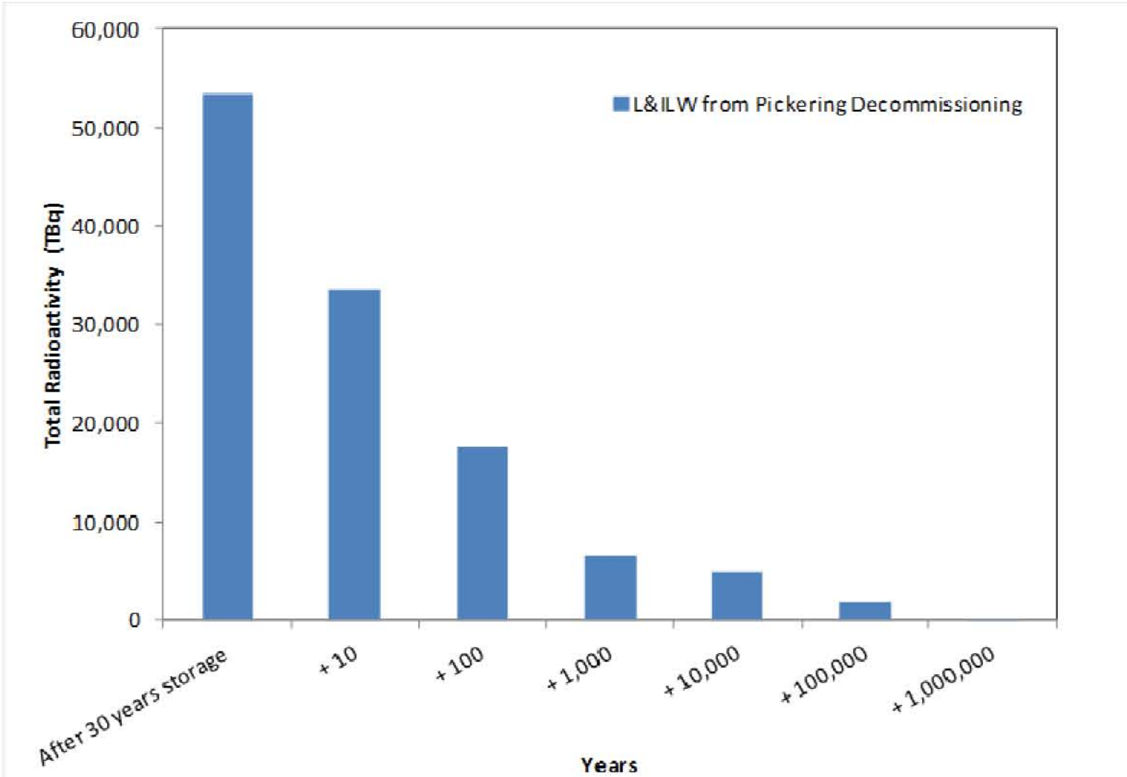



**Figure 4: OPG's Deep Geologic Repository for L&ILW – Expansion Surface Layout**



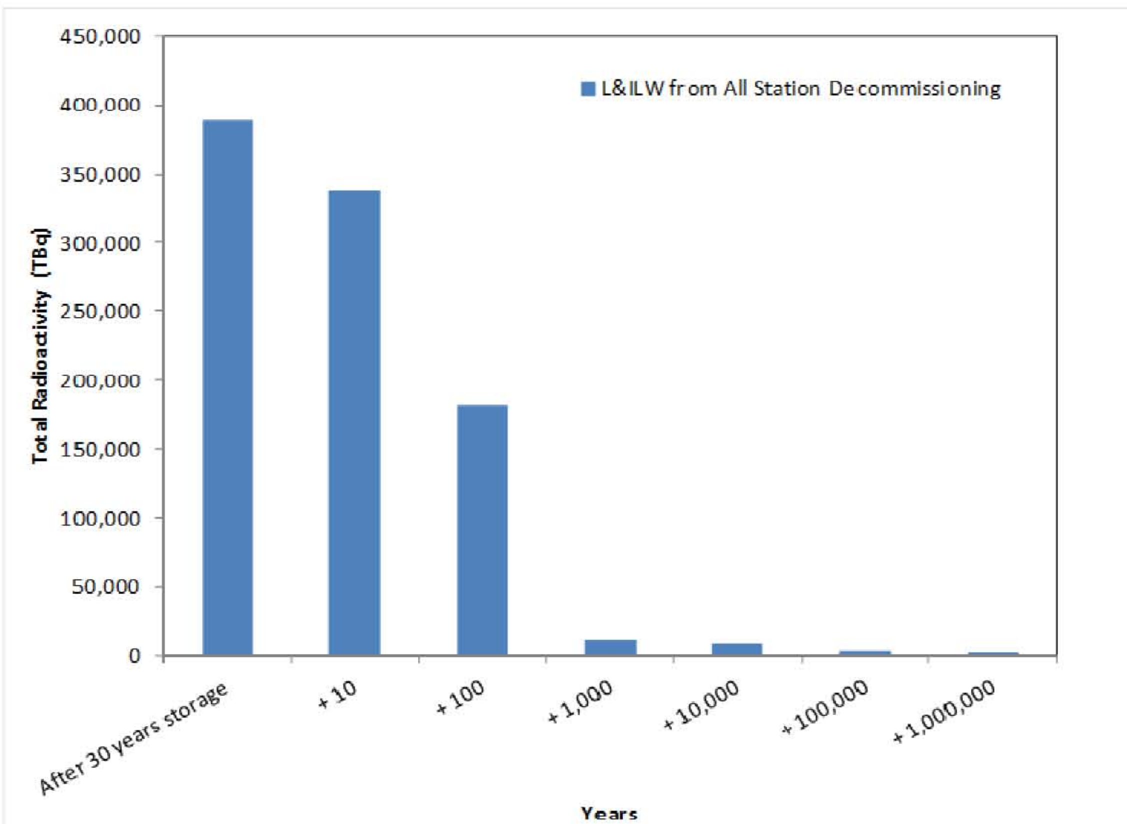




**Figure 5: Total Projected Radionuclide Inventory of L&ILW from Decommissioning (top: Pickering stations; bottom: all the stations)**