



UNPROTECTED/NON PROTÉGÉ

ORIGINAL/ORIGINAL

CMD: 22-H104

Date signed/Signé le : 16-AUGUST 2022

Reference CMD(s)/CMD de référence : 17-H11

Issue Required Approval(s) for

Délivrer l'approbation requise pour la

**Ontario Power
Generation Inc.'s
Consolidated Financial
Guarantee**

**Garantie financière
consolidée d'Ontario
Power Generation Inc.**

Hearing in writing based solely on
written submissions

Audience par écrit fondée uniquement
sur des mémoires

Scheduled for:
November 2022

Prévue pour :
Novembre 2022

Submitted by:
CNSC Staff

Soumis par :
Le personnel de la CCSN

e-Doc 6811500 (WORD)
e-Doc 6850756 (PDF)

Summary

This CMD pertains to a request for a decision regarding:

- the revised consolidated financial guarantee proposed by Ontario Power Generation (OPG) for its nuclear facilities

The following actions are requested of the Commission:

- accept CNSC staff's recommendation for the proposed revision to OPG's financial guarantee

Résumé

Le présent CMD concerne une demande de décision au sujet de :

- la révision de la garantie financière consolidée proposée par Ontario Power Generation (OPG) pour ses installations nucléaires

La Commission pourrait considérer prendre les mesures suivantes :

- accepter la recommandation du personnel de la CCSN à l'égard de la révision à la garantie financière proposée par OPG

Signed/signé le

16 August 2022

Patrick Burton

Director General (Acting)

Directorate of Nuclear Cycle and Facilities Regulation

Direction de la réglementation du cycle et des installations nucléaires

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EXECUTIVE SUMMARY

Canadian Nuclear Safety Commission (CNSC) staff acknowledge that the traditional territory of the [Wendat, Anishinabek Nation, and the territory covered by the Williams Treaties with the Michi Saagiig and Chippewa Nations](#) were signed within the location of the [Pickering](#) and [Darlington](#) Nuclear Generating Stations.

The [Bruce Nuclear Generating Station](#) location is in the traditional territory of the Anishinabek Nation: the peoples of the 3 fires known as Ojibway, Odawa and Pottawatomie Nations. And further give thanks to the Chippewas of Saugeen, and the Chippewas of Nawash, now known as the Saugeen Ojibway Nation, as the traditional keepers of this land. The Bruce region is also homeland to the Historic Saugeen Métis and to the Métis Nation of Ontario.

The [Nuclear Safety and Control Act](#) (NSCA) and associated regulations require that applicants and licensees make adequate provision of financial guarantees for the safe decommissioning of licensed activities.

In accordance with section 24(5) of the NSCA, CNSC licences include conditions requiring that “The licensee shall maintain a financial guarantee for decommissioning that is acceptable to the Commission.”

[REGDOC-3.3.1, Financial Guarantees for the Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#), provides requirements and guidance for the establishment and maintenance of funding for the decommissioning of nuclear facilities and activities licensed by the CNSC.

[Ontario Power Generation Inc.](#) (OPG) maintains a consolidated financial guarantee for decommissioning of all OPG- and Bruce Power-operated nuclear facilities in Ontario. The financial guarantee is based upon preliminary decommissioning plans and cost estimates for decommissioning prepared by OPG for each facility.

OPG is required to revise the financial guarantee and the associated decommissioning plans at least every 5 years or when requested by the Commission. In accordance with this, OPG has updated the preliminary decommissioning plans, the associated cost estimates and the financial guarantee for the 2023–27 period.

CNSC staff reviewed the preliminary decommissioning plans, the cost estimates for decommissioning and the proposed consolidated financial guarantee for the 2023–27 period. Based on these reviews, CNSC staff found that the revised preliminary decommissioning plans provide a basis for credible cost estimate for the future decommissioning of OPG’s nuclear facilities that reflect the lifecycle stage, the assumed decommissioning strategy and end state of the facilities.

Regulatory documents [REGDOC-2.11.2](#), *Decommissioning*, and [REGDOC-3.3.1](#), *Financial Guarantees for the Decommissioning of Nuclear Facilities and Termination of Licensed Activities*, were published in January 2021. OPG had started preparing the 2023–27 submission of its consolidated financial guarantee before the publication of these regulatory documents and as of today has not formally implemented REGDOC-2.11.2 and REGDOC-3.3.1. CNSC staff, however, have assessed the updated 2023–27 financial guarantee submission against the requirements of REGDOC-3.3.1 and determined that OPG’s submissions meet the regulatory criteria set in the document.

CNSC staff found that the proposed financial guarantee for the 2023–27 review period is adequate for decommissioning of the facilities covered under the OPG consolidated financial guarantee.

CNSC staff recommend that the Commission accept the revised consolidated financial guarantee proposed by OPG.

Referenced documents in this CMD are available to the public upon request, subject to confidentiality considerations.

1 OVERVIEW

1.1 Background

[Ontario Power Generation Inc.](#) (OPG), owner of nuclear facilities in Ontario, is required to have in place a financial guarantee acceptable to the Commission in accordance with licence conditions of these nuclear facilities. To meet the licence conditions, OPG maintains consolidated financial guarantee for decommissioning.

The following OPG licensed facilities are covered under the consolidated financial guarantee - the Darlington and the Pickering A & B Nuclear Generating Stations, the Darlington, Pickering and Western Waste Management Facilities and the Radioactive Waste Operations Site-1 (RWOS-1).

OPG retains ownership and responsibility for the cost of decommissioning for the [Bruce Power](#)'s operated facilities. The Bruce Power licensed facilities covered under this financial guarantee are the Bruce A & B Nuclear Generating Stations, the Central Maintenance Facility (CMF) and the newly constructed Central Storage Facility (CSF) included on the Bruce power reactor licence.

The financial guarantee must remain valid, in effect and sufficient to meet decommissioning needs according to the most up-to-date preliminary decommissioning plans (PDPs). Licence conditions require that OPG maintain decommissioning plans and financial guarantee for decommissioning. OPG is also required to report annually to the CNSC on the status and adequacy of the financial guarantee through the submission of a written report.

To ensure that the financial guarantee remains valid, in effect and sufficient, a requirement is included in the Licence Conditions Handbooks (LCH) that OPG revise the financial guarantee and the associated decommissioning plans at a minimum every five years or when requested by the Commission. In accordance with this, OPG submitted revised preliminary decommissioning plans, cost estimates and a proposed revision to their financial guarantee for the 2023-2027 period.

1.2 Highlights

OPG's consolidated financial guarantee covers the cost for future decommissioning of the facilities listed below and the long-term management of waste and used fuel:

- Nuclear Generation Stations - the Darlington, Pickering A & B and Bruce A & B
- Class I Waste Management Facilities - the Darlington, Pickering and Western Waste Management Facilities (WWMF)
- Waste Nuclear Substance Licence Facility Radioactive Waste Operations Site-1 (RWOS1) and facilities supporting operations the Central Storage Facility (CSF) and the Central Maintenance Facility (CMF).

- Long-term waste management repositories for both used nuclear fuel and low and intermediate level radioactive waste (L&ILW).

The revised cost estimate for the proposed financial guarantee has increased by \$2,083 Million (M) since the last review in 2017 from \$44,034 M to \$46,117 M. To be comparable the cost estimates have been normalized to 2023 constant dollars.

The increase is due to changes in the planning assumptions, including:

- The updated NGSs end of life dates (refer to Table 1).
- The Used Fuel Long-Term Management cost estimate has been updated to reflect the [Nuclear Waste Management Organization](#)'s ("NWMO") 2021 cost estimate for the national used nuclear fuel deep geologic repository ("Used Fuel DGR") with an assumed in-service date of 2043.
- OPG cancellation of the L&ILW deep geologic repository ("L&ILW DGR") project following a vote by the [Saugeen Ojibway Nation](#) community members not to support the project in January 2020. At this time, OPG is awaiting the results of [Natural Resources Canada](#)'s process to modernize Canada's Radioactive Waste Policy and [Canada's Integrated Strategy for Radioactive Waste](#) for L&ILW. For financial planning purposes, the proposed 2023 – 2027 Financial Guarantee is based on a conceptual assumption consisting of transportation and emplacement of LLW into a near surface disposal facility located away from the WWMF and transportation and emplacement of ILW into an expanded Used Fuel DGR.
- L&ILW Operations and Used Fuel Storage (UFS) cost estimates have been updated to reflect revised waste volume projections and address changes in program planning assumptions and actual experience. For the L&ILW Operations program, this includes an enhanced focus on LLW waste minimization (volume reduction) through sorting and processing, leading to fewer waste packages for long-term disposal

The constant dollar value of \$ 46,117 M represents what it would cost to conduct the decommissioning in 2023. The present value of the future cost represents \$20,480 M as of January 1, 2023. The economic assumptions for the development of the financial guarantee are explained further in section 2.2.4 of this CMD.

The forecasted fair market value of OPG's Nuclear Funds, comprising of the Decommissioning Segregated Fund (DSF), the Used Fuel Segregated Fund and the trust fund for the management of used fuel established pursuant to the [Nuclear Fuel Waste Act](#) (NFWA), is projected to be \$25,148 M by January 1, 2023. By 2027, the present value of the future decommissioning liability is estimated to be \$22,303 M while the OPG's Nuclear Funds fair market value is expected to be \$28,250 M.

Therefore, OPG is proposing to satisfy the entire estimated value of costs for decommissioning of its facilities through OPG's Nuclear Funds.

1.3 Overall Conclusions

CNSC staff reviewed the OPG submission and have concluded that:

- the revised preliminary decommissioning plans provide basis for a credible cost estimate for the future decommissioning of the nuclear facilities covered under the OPG’s consolidated financial guarantee.
- the proposed consolidated financial guarantee is adequate for the future decommissioning of the nuclear facilities covered under the OPG’s consolidated financial guarantee.

1.4 Overall Recommendations

CNSC staff recommend the following:

- that the Commission accept the OPG revised Consolidated Financial Guarantee for the period from 2023 to 2027

2 MATTERS FOR CONSIDERATION

2.1 Background Information

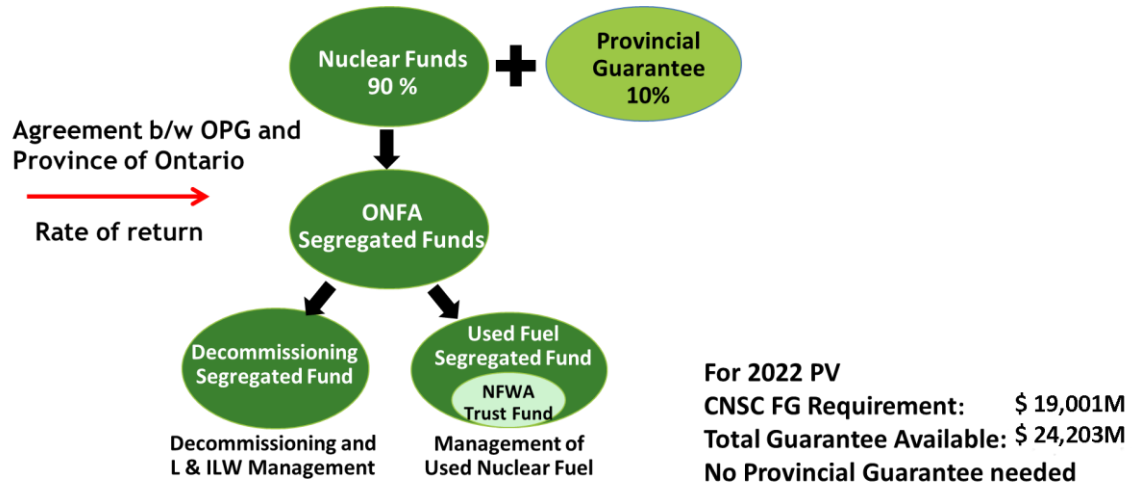
The current consolidated financial guarantee for the decommissioning of the OPG owned facilities was accepted by the Commission in 2017 [1]. For the 2018-2022 review period, OPG had estimated a constant dollar liability of \$39,872 M (\$44,034 M normalized to 2023 constant dollars). The current financial guarantee is satisfied by the funds accumulated in OPG’s Nuclear Funds.

Funding Structure of OPG’s Financial Guarantee

To fund the financial guarantee, OPG maintains Nuclear Funds consisting of:

1. ONFA Funds established pursuant to the Ontario Nuclear Funds Agreement (ONFA) [O. Reg. 53/05: PAYMENTS UNDER SECTION 78.1 OF THE ACT \(ontario.ca\)](#) comprising of the Decommissioning Segregated Fund (DSF) and the Used Fuel Segregated Funds (UFSF).
2. NFWA Trust Funds for the management of used fuel established pursuant to the [Nuclear Fuel Waste Act](#) (NFWA).

The ONFA Funds and the NFWA Trust Funds are collectively called the “Nuclear Funds”. If the value of the Nuclear Funds is not sufficient to cover OPG’s future decommissioning liability, OPG makes up the value through a Provincial Guarantee. The funding structure of the OPG’s consolidated financial guarantee is presented in Figure 1 (created by CNSC staff).

Figure 1: Funding Structure of OPG's Financial Guarantee (CNSC)

Ontario Nuclear Funds Agreement (ONFA)

As noted above, the [ONFA Funds](#) consist of two funds, the Decommissioning Segregated Funds (DSF) and the Used Fuel Segregated Funds (UFSF). These segregated funds cover the decommissioning liability of OPG's facilities and interim management of low and intermediate level radioactive waste and used nuclear fuel. The ONFA segregated funds were established in July 2003. These are single-purpose segregated funds which are held in third-party custodian trustee accounts. OPG has no right to access any of the assets of the segregated funds unless for approved purposes.

Significant controls and oversight are applied to the ONFA funds by both OPG and the Province of Ontario. The funds are overseen by a dedicated committee of the OPG Board of Directors and by the [Board of the Ontario Financing Authority](#) (ofina.on.ca). Investment strategies, valuation and audits of the segregated funds are performed by external third-parties.

CNSC access to the ONFA funds is provided through a legal agreement between the CNSC, OPG and the Province of Ontario (the "CNSC Financial Security and ONFA Access Agreement").

Nuclear Fuel Waste Act (NFWA) Trust

The value of the [Nuclear Fuel Waste Act](#) (NFWA) trust fund is included in the value of the UFSF. The Ontario NFWA Trust was established on November 15, 2002 under the Nuclear Fuel Waste Act (S.C. 2002, c.23) in accordance with the requirements of this Act. Under the NFWA a dedicated [Nuclear Waste Management Organization](#) (NWMO) was established to manage the [Adaptive Management Project](#) (APM) for developing a central deep geological repository in Canada and to addresses the funding.

Under the NFWA, each owner of used fuel, including OPG, is required to establish independently managed trust funds – NFWA Trust Funds to fully finance the implementation of the APM.

OPG makes annual contributions to the NFWA trust based on the percentage of the generated fuel bundles, as required under the NFWA.

Provincial Guarantee

The Provincial Guarantee is a guarantee made out payable to the CNSC by the Province of Ontario that allows for funds (up to a defined amount) to be provided to the CNSC upon demand should OPG not meet its decommissioning obligations. CNSC access to the Provincial Guarantee is provided through a Provincial Guarantee Agreement between the CNSC and the Province of Ontario.

For the 2018-2022 review period, OPG has met the financial guarantee requirement without provision of Provincial Guarantee.

2.2 2023-2027 Financial Guarantee Proposal

2.2.1 Overview

In support of the 2023-2027 financial guarantee proposal, OPG submitted updated PDPs and cost estimates for decommissioning, present value cost estimates and projected fund values.

Based on the current cost estimates and projections, OPG is proposing to meet the entire estimated value of cost for decommissioning of its facilities through OPG's Nuclear Funds without a Provincial Guarantee for the 2023-2027 period. The forecasted fair market value of those funds is projected to be \$25,148M as of January 1, 2023.

By 2027, the present value of the future decommissioning liability is projected to be \$22,303 M while the OPG's Nuclear Funds fair market value is expected to be \$28,250 M.

CNSC can access the ONFA funds upon demand. CNSC access to the ONFA funds is provided through legal agreements between the CNSC, OPG and the Province of Ontario.

2.2.2 Decommissioning Plans

Planning for decommissioning is an ongoing process, taking place throughout each stage of the licensed facility lifecycle. The PDPs are updated and submitted to CNSC staff for review and acceptance at a minimum every five years or when required by the Commission. The PDPs provide the basis for periodic revision of the cost estimate for decommissioning and establishing the financial guarantee. At the current time, the PDPs are submitted for planning purposes only. The CNSC requires that the PDP be based on the best available conservative information and predictions.

The PDP is refined over time as the execution of decommission phases approaches and the uncertainty decreases. OPG is required to develop Detailed Decommissioning Plans (DDPs) and obtain Commission approval prior to executing decommissioning activities.

In support of the financial guarantee submissions, OPG updated the PDPs for the facilities covered under its consolidated financial guarantee. A list of the facilities for which OPG submitted a PDP is provided in Table 1.

Table 1: Licensed Facilities Covered under the OPG Inc.'s Consolidated Financial Guarantee

<u>Site / Facility</u>	<u>Type of Licence</u>	<u>Licence Number [5]</u>
Darlington Nuclear Generating Station	Power Reactor	PROL 13.03/2025
Pickering A and B Nuclear Generating Station	Power Reactor	PROL 48.01/2028
Bruce A and B Nuclear Generating Station	Power Reactor	PROL 18.02/2028
Western Waste Management Facility	Waste Management Facility	WFOL-W4-314.00/2027
Pickering Waste Management Facility	Waste Management Facility	WFOL-W4-350.00/2028
Darlington Waste Management Facility	Waste Management Facility	WFOL-W4-355.01/2023
Radioactive Waste Operations Site-1 (RWOS-1)	Waste Nuclear Substance	WNSL-W1-320.05/2029
Central Maintenance Facility (CMF)	Under Power Reactor	PROL 18.02/2028
Central Storage Facility (CSF)	Under Power Reactor	PROL 18.02/2028

Decommissioning Timelines for Nuclear Generation Stations

OPG selected a deferred dismantling strategy for decommissioning of the NGSs. The station is put into a permanent and stable shutdown state, which includes removal of fuel and drainage of the moderator and heat transport systems prior to transition to the Storage with Surveillance phase of decommissioning. This provides for a storage period of 30 years in order to allow for radioactive and thermal decay of the used fuel and activated components prior to the onset of active decommissioning. The proposed end-state of the NGSs sites after completion of decommissioning is that they will be free of industrial and radiological hazards and meet the criteria for release from regulatory control.

In order to determine the decommissioning liabilities for nuclear generating stations, shutdown dates need to be projected. For the 2023-2027 financial guarantee submission, the NGSs end of life assumptions for Pickering and Darlington have been updated. There are no changes to the end of life assumptions for the Bruce stations. The operation of Pickering to the end of 2025 is subject to the CNSC's regulatory approval.

The updated NGSs end of life dates are presented in Table 2.

Table 2: Nuclear Generating Station End of Life Dates Projection

Station/Unit	Projected Unit End of Life Dates	
	2018–2022 FG	2023–2027 FG
Pickering A – Unit 1	2022	2024
Pickering A – Unit 2	2005	2005
Pickering A – Unit 3	2005	2005
Pickering A – Unit 4	2022	2024
Pickering B – Unit 5	2024	2025
Pickering B – Unit 6	2024	2025
Pickering B – Unit 7	2024	2025
Pickering B – Unit 8	2024	2025
Darlington – Unit 1	2053	2055
Darlington – Unit 2	2049	2050
Darlington – Unit 3	2052	2053
Darlington – Unit 4	2055	2056
Bruce A – Unit 1	2043	2043
Bruce A – Unit 2	2043	2043
Bruce A – Unit 3	2061	2061
Bruce A – Unit 4	2062	2062
Bruce B – Unit 5	2062	2062
Bruce B – Unit 6	2058	2058
Bruce B – Unit 7	2063	2063
Bruce B – Unit 8	2063	2063

* Dates are subject to change based on ongoing end of life assessment.

Decommissioning Timelines for Waste Facilities

The decommissioning of the WMFs will be aligned with the decommissioning of the co-located NGSs. OPG assumption is that all used fuel, retube waste and L&ILW will be removed from these facilities and transferred to the respective Used Fuel or L&ILW long-term management facilities when they become available. At completion of decommissioning, the WMFs sites will be free of industrial and radiological hazards and meet the criteria for release from regulatory control.

CNSC staff assessed the PDP for each facility listed in Table 1.

2.2.3 2023-2027 Decommissioning Cost Estimates

Since the 2018-2012 financial guarantee cost estimates were established, a number of changes have occurred in OPG planning assumptions. These changes are reflected in the 2023-2027 financial guarantee cost estimates include:

- The updated NGSs end of life dates (refer to Table 2).
- The Used Fuel Long-Term Management cost estimate updated to reflect the NWMO 2021 cost estimate for the Used Fuel DGR. The Used Fuel DGR assumed in-service date remains 2043.
- OPG cancellation of the L&ILW deep geologic repository (“L&ILW DGR”) project following a vote by the Saugeen Ojibway Nation community members not to support the project in January 2020. At this time, OPG is awaiting the finalization of Canada’s Radioactive Waste Policy and Canada’s Integrated Strategy for Radioactive Waste for L&ILW. For financial planning purposes, the proposed 2023 – 2027 Financial Guarantee is based on a conceptual assumption consisting of transportation and emplacement of LLW into a near surface disposal facility located away from the WWMF and transportation and emplacement of ILW into an expanded Used Fuel DGR.
- L&ILW Operations and UFS cost estimates updated to reflect revised waste volume projections and address changes in program planning assumptions and actual experience. For the L&ILW Operations program, this includes an enhanced focus on LLW waste minimization (volume reduction) through sorting and processing, leading to fewer waste packages for long-term disposal.
- All station and waste management facility decommissioning cost estimates updated in 2020/2021 to reflect current OPG planning and program assumptions, changes in industry practice, and station specific changes which have occurred since the previous decommissioning cost estimates were issued.

Nuclear Generation Stations

Nuclear generating station cost estimates were produced for all of OPG's nuclear generation stations by TLG Services LLC (TLG), a U.S. based consultant that has extensive experience in assessing decommissioning costs. TLG has been OPG's primary consultant in developing these cost estimates and is the same consultant that was used for the development of the current financial guarantee.

The methodology used to develop the estimate, consistent with OPG's decommissioning strategy, followed the guidelines developed by TLG for producing commercial nuclear power plant decommissioning cost estimate and the DOE "Decommissioning Handbook" [Decommissioning handbook: procedures and practices for decommissioning \(Technical Report\) | OSTI.GOV](#). The cost estimation methodology used by TLG is aligned with the most up-to-date international practices for decommissioning cost estimation as published in [NEA](#) and [IAEA](#) reports [2, 3, 4] consistent with the requirements and guidance provided in Regulatory document [3.3.1](#).

The estimating process is reflecting the deferred decommissioning strategy selected by OPG for the NGSs. It is based on a unit cost factor integrated with OPG's site specific information which includes local labour rates and costs. The unit factors account for each activity critical duration, material/equipment, and labour cost.

A contingency is then applied as a specific provision for unforeseen elements of cost within the defined scope of the estimate. Individual activity contingencies depend on the degree of difficulty judged appropriate from actual decommissioning experience and are addressed through a percentage contingency applied on a line-item basis. The cost estimation for decommissioning has been prepared using a Work Breakdown Structure (WBS) which is a systematic approach ensuring the reliability of the resulting costs.

In addition to the routine uncertainties addressed by contingency, a risk contingency of 7% was added to account for potential uncertainties associated with out of scope factors.

The estimated cost for decommissioning of the NGSs is summarized in Table 3. The total estimated cost for decommissioning of all NGSs, escalated to 2023 dollars and increased by the OPG decommissioning oversight costs is estimated to be \$18,066 M.

Waste Management Facilities

The cost estimates for the Pickering, Darlington and Western WMFs were updated to reflect the current facilities configuration and adjusted for the inventory of Dry Storage Facilities (DSFs) and L&ILW storage/processing facilities included in the planning assumptions.

OPG's strategy for decommissioning its WMFs includes decommissioning of the facilities at such time as all used nuclear fuel in dry storage and L&ILW in interim storage has been transferred to disposal facilities. The sites will then be restored and made available for other OPG uses. The same unit factor methodology and WBS presentations is used for the cost estimation of WMFs decommissioning.

The scope of this estimate is to provide for the decommissioning of all WMFs as listed in table 1.

The estimated cost for decommissioning of the WMFs is summarized in Table 3.

The total estimated cost for decommissioning of all WMFs and escalated to 2023 dollars is estimated to be \$225 M.

WNSL and Other Supporting Facilities – RWOS-1, CMF and CSF

OPG has included in their financial guarantee costs associated with decommissioning of the WNSL RWOS-1 and other supporting maintenance and operations facilities as CMF and CSF located at Bruce site.

OPG's strategy regarding the decommissioning of the RWOS1, the CMF and the CSF is to decommission the facilities at such time that all stored waste has been removed. The RWOS1, CMF and CSF sites will then be restored and made available for other OPG uses.

The estimated cost for decommissioning of RWOS1, CMF and CSF is summarized in table 3. The total estimated cost for decommissioning of all three facilities and escalated to 2023 dollars is estimated to be \$63 M.

Used Fuel Management

The cost estimate for the used fuel management was developed based on the OPG planning framework covering the interim storage and the long-term management of used fuel.

OPG's strategy for interim management of used fuel is to initially store the used fuel in water pools in the stations' irradiated fuel bays (wet storage) and subsequently in Dry Storage Containers (DSC) at the nuclear generating station sites until such time that the proposed Adaptive Phased Management (APM) long-term management facility is available. The NGSs which shut down before the APM long-term management facility is available, will continue to transfer fuel from irradiated fuel bays into DSCs at the WMFs.

The scope of the cost estimate for the used fuel interim storage includes:

- processing, storage and decommissioning of DSC during and after station life
- construction and operation of Dry Storage Facilities (DSF)
- management of wet bays after station shutdown

In 2021, the Use Fuel Storage (UFS) cost estimate was updated and adjustments were made to reflect updated station operating life assumptions, current operational experience and planned post station shutdown activities.

For the long-term management of used fuel, in 2021, the [NWMO](#) updated the APM cost estimate using a single point estimate based on a total national lifecycle inventory of 5.5 million used fuel bundles. Updates to the cost estimate include the NWMO's continued development and demonstration of the engineered barrier system design and components, and the narrowing of potential siting areas down to two sites. The assumption of in-service date 2043 for the Used Fuel DGR remains unchanged.

By the end of 2027, OPG estimates that it will have an inventory of 3,281,784 used fuel bundles. The estimated cost for long-term management of this used fuel is \$21,852 M (2023 dollars), while the interim storage cost is \$2,449 M. This results in a total cost estimate for used fuel management of \$24,301 M (2023 dollars).

Low and Intermediate Level Radioactive Waste Management

Low and intermediate level radioactive waste (L&ILW) produced at OPG's nuclear generation stations is centrally stored at the WWMF until a long-term waste management facility is in-service. The cost estimate for L&ILW management includes cost estimates for interim storage of L&ILW and cost estimates for long-term management L&ILW.

For the interim storage of L&ILW, the 2021 cost estimate is based on updated waste forecast with enhanced focus on waste reduction through sorting and processing. It includes all costs for transporting, processing and storing of operational L&ILW arising from the stations locally and centrally at the WWMF until assumed long-term disposal facilities are available.

For the Long-Term Management of L&ILW, the proposed 2023-2027 CNSC Financial Guarantee cost estimate is based on the emplacement of operational LLW in an assumed near surface disposal facility and emplacement of operational ILW in an assumed expanded Used Fuel DGR. The LLW near surface disposal facility is assumed to be in-service in the 2040s and the expanded Used Fuel DGR is assumed to be in-service in 2043. ILW packages are assumed to be shipped directly from the nuclear stations to the disposal site once operational.

The cost to dispose of decommissioning L&ILW in these facilities includes Fixed and Variable cost components. The Fixed cost components include the cost to construct the facilities for decommissioning waste and also the cost to decommission them. The Variable cost components include the cost to transport the waste to the waste facilities and the cost to emplace the waste in them.

The estimated cost for long-term management of L&ILW is \$2,278 M (2023 dollars), while the L&ILW interim storage cost is \$1,184 M. This results in a total cost estimate for L&ILW management of \$3,462 M (2023 dollars).

It should be noted that the L&ILW long-term disposal facilities are assumed for cost estimating purposes only, and no project or site selection process has commenced. OPG’s future planning assumptions for the L&ILW Long-Term Management Program will be informed by the outcomes of the Natural Resources Canada’s process to modernize Canada’s Radioactive Waste Policy Framework and Integrated Waste Management Strategy.

Cost Estimate Structure

In order to estimate the future decommissioning liability for its financial guarantee, OPG summarizes the costs associated with decommissioning its facilities. To these, OPG adds the costs associated with the management of low and intermediate level radioactive waste and the management of used nuclear fuel including the packaging and transportation. Schematic diagram of OPG cost estimation structure is presented on figure 2 (created by CNSC staff).

Figure 2: Cost Estimate Structure (CNSC)



Development of the Final Estimate

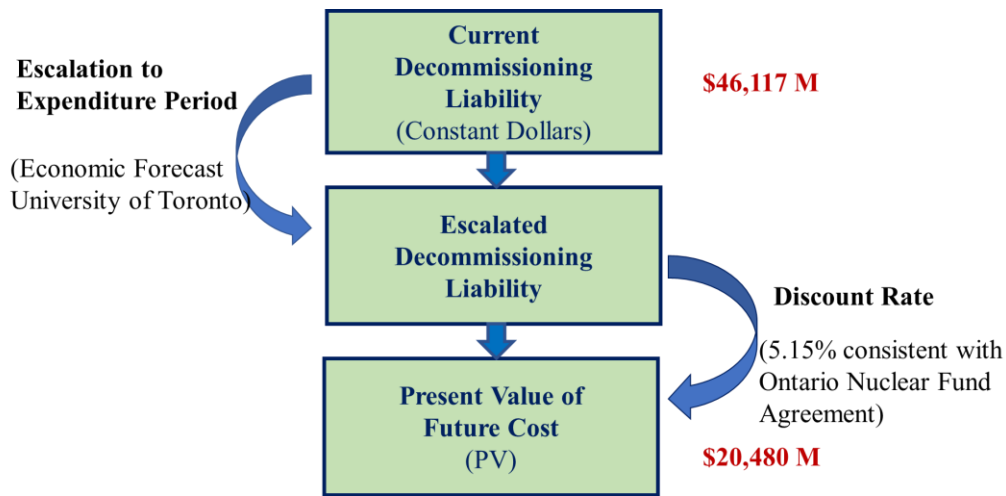
OPG summarizes the updated cost estimates for all waste management and decommissioning programs described above in constant dollars, which assumes that expenditures occur at the time of the estimate preparation. OPG submitted a Documentary Information Summary (DIS) which summarizes the liability for all nuclear waste management and facilities decommissioning for the period 2023 -2027.

Economic Assumptions

For the development of the final financial guarantee, OPG applies a common method used in finance for calculating the present value (PV) of a project cost. Cost estimates are first prepared in constant dollars, which assume that expenditures occur at the time of the estimate preparation. The estimates are then escalated to the scheduled expenditure period using economic forecasts prepared by external experts contracted by OPG and then a discount rate is then applied to determine the present value of future costs. OPG applies escalation rates from the University of Toronto's Institute of Policy Analysis Economic Forecasting Series. The Ontario forecast is used as the source of the escalation rates given that the majority of the work programs are expected to be executed in Ontario. The discount rate applied is consistent with the Ontario Nuclear Funds Agreement (ONFA). The development of the final financial guarantee for the period 2023-2027 is shown on Figure 3.

In order to develop the final estimate, OPG has used the updated economic forecasts from the University of Toronto Institute of Policy Analysis Economic Forecasting Series. While the long-term escalation rate for labour cost and other costs remains unchanged at 3.4% and 2.0%, respectively, and the long-term escalation rate for material and equipment increased from 2.0% in the 2017 to 2.1% in 2022.

After escalation, the total discount rate of 5.15%, consistent with the ONFA, is applied to determine the present value (PV) of cost. There is no change to the applied discount rate from the previous period. The development of the final cost estimate is shown on the following diagram (created by CNSC staff).

Figure 3: Development of the Final Estimate (CNSC)

A summary of the cost estimates breakdown in 2023 constant and present value dollars as of January 1, 2023 for OPG's proposed 2023-2027 financial guarantee is presented in table 3 below.

Table 3: Summary of Cost Estimates

Activity	2023 Constant \$M	January 1, 2023, PV \$M
<i>Decommissioning Nuclear Generating Stations</i>		
Pickering A	3,401	1,960
Pickering B	3,410	1,934
Bruce A	3,594	1,109
Bruce B	3,542	986
Darlington	4,119	1,312
Subtotal Nuclear Generating Stations	18,066	7,300
<i>Decommissioning of WMF and WNSL Facilities</i>		
Pickering Waste Management Facility	39	17
Western Waste Management Facility	158	56
Darlington Waste Management Facility	28	7
RWOS-1, CMF and CSF	63	25
Subtotal Decommissioning Other Facilities	288	105
<i>Waste Management</i>		
Used Nuclear Fuel - Interim Storage	2,449	1,851

Activity	2023 Constant \$M	January 1, 2023, PV \$M
Used Nuclear Fuel - Long-term Management	21,852	9,222
Subtotal Used Fuel Management	24,301	11,073
Low and Intermediate Level Radioactive Waste - Interim Storage	1,184	898
Low and Intermediate Level Radioactive Waste - Long-term Management	2,278	1,104
Subtotal Low and Intermediate Waste Management	3,462	2,002
Total Financial Guarantee Cost Estimate	46,117	20,480

The Province of Ontario Approval of Cost Estimates

The OPG has submitted the above cost estimates to the Province of Ontario on December 17, 2021 as part of the ONFA reference plan which should be approved by the Province before submitted to CNSC. Based on the Province of Ontario review, the Ontario Minister of Finances approved the reference plan effective January 1, 2022.

2.2.4 2023-2027 Financial Guarantee

The proposed 2023-2027 financial guarantee associated with decommissioning and nuclear waste management in support of licences for nuclear generating stations, waste management and other nuclear facilities owned by OPG, including Bruce NGS, as listed in table 1 of this CMD, is summarized in Table 4 below.

Table 4 presents the projected annual minimum financial guarantee required amount and the projected value of the Nuclear Funds as of January 1 of each year for the 2023-2027 period.

Table 4: 2023-2027 Financial Guarantee Projections

Year (January 1 st)	Financial Guarantee Required Amount \$ M	Nuclear Funds Value* \$ M
2023	20,480	25,148
2024	21,149	26,102
2025	21,764	27,011
2026	22,140	27,768
2027	22,303	28,250

* includes fund growth assumptions

The instrument to satisfy the 2023-2027 financial guarantee is the Nuclear Funds. As presented in table 4, the total amount of the 2023-2027 financial guarantee is expected to be satisfied by the forecasted fair market value of the Nuclear Funds and OPG does not anticipate the need for a Provincial Guarantee for this review period.

CNSC can access the ONFA funds upon demand. CNSC access to the ONFA funds is provided through legal agreements between the CNSC, OPG and the Province of Ontario.

2.2.5 2023-2027 Financial Guarantee Agreements

The Ontario Nuclear Funds Agreement

OPG has provided a draft for the Fifth Amending Agreement to the CNSC Financial Security and ONFA Access Agreement. The purpose of the amendment is to replace the existing “Schedule A” and “Schedule B” of the original agreement with the proposed “Schedule A” and “Schedule B” attached to the amending agreement.

“Schedule A” updates the licence numbers, while “Schedule B” updates the amount of the decommissioning cost estimates and financial guarantee provision on a yearly basis from January 1, 2023 through to December 31, 2027.

Should the Commission accept the financial guarantee proposed by OPG for the future decommissioning of its nuclear facilities located in Ontario, the Fifth Amending Agreement to the CNSC Financial Security and ONFA Access Agreement will be signed by the parties responsible for its execution, the OPG’s President and Chief Executive Office (CEO), the Ontario Minister of Finances and the CNSC President and CEO.

The Provincial Guarantee

The existing Provincial Guarantee Agreement expired on December 31, 2017.

OPG has estimated that based on the market performance of the OPG Nuclear Funds, the total financial guarantee proposed for the 2023-2027 review period could be met without provision of Provincial Guarantee. Therefore, OPG proposes not to renew the Provincial Guarantee Agreement for the 2023-2027 period.

Based on the CNSC staff assessment of the proposed financial guarantee and the annual review of the ONFA funds year-end financial statements, CNSC staff concur with the OPG’s estimate, summarized in table 4, that at this point a Provincial Guarantee is not required for the 2023-2027 period.

2.2.6 CNSC Oversight of Financial Guarantee

Annual Reporting

OPG reports to CNSC annually on the status of the financial guarantee through a submission of financial guarantee annual report and ONFA year-end statements.

Based on the CNSC staff review of the annual reports during the 2018-2022 period, the net asset balance in the OPG segregated funds was sufficient to cover the financial guarantee projection for each year.

12(2) Request for Information under the [*General Nuclear Safety and Control Regulations*](#)

In April 2020, in response to the financial market fluctuations during Covid-19 pandemic and the uncertainty associated with the performance of the OPG consolidated financial guarantee for decommissioning, CNSC issued to OPG a 12(2) Request for Information under the *General Nuclear Safety and Control Regulations*. CNSC staff requested OPG to report quarterly on the status of their financial guarantee.

In April 2021, based on financial markets stabilization and the OPG responses demonstrating the validity of the consolidated financial guarantee through the requested quarterly reporting, CNSC closed the 12(2) Request for Information.

3 OVERALL CONCLUSIONS AND RECOMMENDATIONS

3.1 Overall Conclusions

CNSC staff have concluded that:

- the revised preliminary decommissioning plans provide basis for a credible cost estimate for the future decommissioning of the nuclear facilities covered under the OPG's consolidated financial guarantee.
- the proposed consolidated financial guarantee is adequate for the future decommissioning of the nuclear facilities covered under the OPG's consolidated financial guarantee.

3.2 Overall Recommendations

CNSC staff recommend the following:

- that the Commission accept the OPG revised Consolidated Financial Guarantee for the period from 2023 to 2027

REFERENCES

- [1] CNSC Record of Decision, Financial Guarantee for the Future Decommissioning of Ontario Power Generation Inc.'s Facilities in Ontario, [Record of Decision - OPG - Financial Guarantee](#) (nuclearsafety.gc.ca) October 11, 2017, e-doc: 5400969.
- [2] Nuclear Energy Agency (NEA), Organization for Economic Co-Operation and Development (OECD), *[International Structure for Decommissioning Costing \(ISDC\) of Nuclear Installations](#)*, France, 2012.
- [3] Nuclear Energy Agency (NEA) Organization for Economic Co-Operation and Development (OECD), *[The Practice of Cost Estimation for Decommissioning of Nuclear Facilities](#)*, France 2015.
- [4] IAEA, Nuclear Energy Series Technical Report NoNW-T-2.12, *Data Analysis and Collection for Costing of Research Reactor Decommissioning*, Vienna, 2021.

GLOSSARY

For definitions of terms used in this document, see [REGDOC-3.6, Glossary of CNSC Terminology](#), which includes terms and definitions used in the *Nuclear Safety and Control Act* and the Regulations made under it, and in CNSC regulatory documents and other publications.

Additional terms and acronyms used in this CMD are listed below.

Glossary Term	Glossary Definition
APM	Adaptive Phased Management
CEO	Chief Executive Officer
CMD	Commission Member Document
CMF	Central Maintenance Facility
CNSC	Canadian Nuclear Safety Commission
CSA	CSA Group (formerly Canadian Standards Association)
DGR	Deep Geological Repository
DSC	Dry Storage Container
DSF	Decommissioning Segregated Fund
DOE	Department of Energy
FG	Financial Guarantee
L&ILW	Low and Intermediate Level Radioactive Waste
LCH	Licence Condition Handbook
M	Million
NFWA	<i>Nuclear Fuel Waste Act</i>
NGS	Nuclear Generating Station
NSCA	<i>Nuclear Safety and Control Act</i>
NWMO	Nuclear Waste Management Organization
ONFA	Ontario Nuclear Funds Agreement
OPG	Ontario Power Generation
PROL	Power Reactor Operating Licence
PV	Present Value

Glossary Term	Glossary Definition
PDP	Preliminary Decommissioning Plans
RWOS-1	Radioactive Waste Operations Site-1
TLG	TLG Services
UFSF	Used Fuel Segregated Fund
UFS	Used Fuel Storage
WFOL	Waste Facility Operating Licence
WMF	Waste Management Facility
WNSL	Waste Nuclear Substance Licence
WWMF	Western Waste Management Facility

A. BASIS FOR THE RECOMMENDATIONS(S)

A.1 Regulatory Basis

The regulatory basis for the recommendations presented in this CMD is as follows:

[Nuclear Safety and Control Act](#)

Paragraph 24(5) of the *Nuclear Safety Control Act* provides that a licence may contain any term or condition that the Commission considers necessary for the purposes of the Act, including a condition that the applicant provide a financial guarantee in a form that is acceptable to the Commission.

Paragraph 24(6) of the *Nuclear Safety Control Act* provides that the Commission may authorize the application of the proceeds of any financial guarantee.

Paragraph 24(7) of the *Nuclear Safety Control Act* provides for the means by which a refund may be granted for any funds that have not been spent.

[General Nuclear Safety and Control Regulations](#)

The *General Nuclear Safety and Control Regulations* requires under paragraph 3(1)(l) that a licence application contains a description of any proposed financial guarantee relating to the activity to be licensed.

[Class I Nuclear Facilities Regulations](#)

Paragraph 3(k) of the *Class I Nuclear Facilities Regulations* required that an application for a licence in respect of a Class I nuclear facility, other than a licence to abandon, shall contain the proposed plan for the decommissioning of the nuclear facility or of the site.

A.2 Technical Basis

The technical basis for the recommendations presented in this CMD are compared against the following:

- CNSC regulatory document [2.11.2 Decommissioning](#)
- CNSC regulatory document [3.3.1 Financial Guarantees for the Decommissioning of Nuclear Facilities and Termination of Licensed Activities](#)
- CSA standard N294-19, *Decommissioning of Facilities Containing Nuclear Substances*